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The G-8 Summit held at Sea Island, Georgia, on June 8-11, 2004, exemplified the increasing global integration of the United States economy.[1] Every year, capital flows both out from (hereafter FDI) and into the United States (hereafter FDIUS) to facilitate global trade liberalization.[2] The literature on foreign direct investment to developing countries is abundant (Finance India, 1996; Bosworth & Collins, 1999) but disproportionately low on FDIUS (Hymer, 1976; Lowe, 2004). This latter form contributes to annual U.S. gross domestic product (GDP). In 2003, one of eleven trillion dollars totaling the GDP was due to exports.[3] In the same year, part of total imports composed 45 percent of intermediate and unfinished goods used in the U.S. for final products. Subsidiaries of foreign companies in this country supported 21.6 million jobs in 2003, including Pirelli Tire and Siemens in Georgia and Toyota in Alabama and West Virginia (Hall, 2004).

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In recent years, however, FDIUS had shown wide fluctuations in per-month five-year averages from $10.58 billion (1986-1990) to $8.61 billion (1991-1995), from $46.89 billion (1996-2000) to $23.08 billion between 2001 and 2002. For detailed information, see Table 1. The purpose of this article is to examine the question of what proportion of the said fluctuations was caused by Federal Reserve interest rate policy actions or currency exchange rate variations by using a Taylor-type FDIUS optimal rule equation through a dynamic linear model (Taylor, 1993; Ball, 1999). The period covers 1975:01 through 2002:12 per-month. Results from this study will enhance current insight into the relationships between FDIUS and the interest, exchange, and inflation rates. This study will also estimate changes in FDI caused by one percentage point change in interest rates or one index point change in exchange rates. Such information is useful for people daily engaging in monetary policy initiatives and exchange rate issues.

The Model

The research adopted a modified Ball's formulation (1999) of a simple linear dynamic system with three equations for a large open-economy. This model is called Taylor–type because it adheres to the Taylor simple dynamic model tradition without a stochastic component (Taylor, 1993). This system includes

$$x_t = \beta r_{t-1} + \delta e_{t-1} + \lambda x_{t-1} + \varepsilon \quad (1)$$

$$\pi_t = \pi_{t-1} + \alpha x_{t-1} - \gamma(e_{t-1} - e_{t-2}) + \eta \quad (2)$$

$$e_t = \theta r_t + v \quad (3)$$

where x componentizes one of the two measurements of FDIUS: growth rate of FDIUS or FDIUS in proportion to GDP. Interest rate is expressed

Table 1
Fluctuations of FDI and New Investments in the United States

Year	FDIUS		Year	New Investment	
	Monthly ($billions)	Change (%)		Annual ($billions)	Change (%)
1975-1980	1.36	-6.8	1994	45.63	196.0
1981-1985	3.81	3.4	1996	79.93	75.2
1986-1990	10.58	3.4	1998	215.26	169.0
1991-1995	8.61	112.9	2000	335.63	55.9
1996-2000	46.89	6.6	2001	147.11	-56.2
2001-2002	23.08	- 13.4	2002	52.56	-64.3

(Source: Anderson. 2003)

by r (either nominal or real), inflation rate by π, foreign exchange rate by e, and $\alpha, \beta, \delta, \gamma, \theta$ as parameters. The residuals, ε, η, ν are white noise shocks with zero means and respective variances. Note that the first equation distinguishes the relationship between FDIUS, interest rate, and exchange rate, assuming $\beta > 0$ and $\delta > 0$, which implies a trend that a higher federal funds rate drives up other domestic interest rates and draws fast increase in FDI to this country. A higher value of the U.S. dollar prompts a higher exchange rate and increases imports, later transferring wealth to foreigners and making FDIUS more attractive. In this linear dynamic system, the exchange and federal funds rates are policy variables, while FDIUS and inflation rate are state or target variables. A steady-state equilibrium of the simulated system is achieved when benchmark parameter values converge and produce parameter estimates.

The second equation is inflation targeting, while the third sets the relationship between exchange and interest rates. Equation 2 may also be viewed as an open economy Phillip's curve with some rational expectations. The Taylor-type efficient rule equation is derived from all three equations. Contemporaneous inflation rate is affected by the lagged state variable, e.g., FDIUS growth rate, lagged inflation, and the gap in lagged exchange rate.

By substituting Equation 3 into 1, then moving one period forward for Equations 1 and 2, it is found that the future paths of x and p rely on the following expression (Ball, 1999), see appendix for detail.

$$e = m[\lambda x + (\beta/\theta)v] + n[\pi + \alpha x + \gamma e_{t-1}] \quad (4)$$

Two coefficients m and n are to be determined. By replacing Equation 3 into Equation 4, the Taylor-type efficient rule equations are

$$wr + (1 - w)e = ax + b(\pi - \gamma e_{t-1}) \quad (5)$$

obtained as

where w, a, b are constants depending on parameter estimates in Equations 1 through 3 and selected values of m and n. The weights, w and (1 - w), represent relative significance of interest and exchange rates with FDIUS; therefore, w has values between zero and one inclusive. In estimation, w will have many efficient values resulting in many efficient rule equations. From such equations, only one will be deemed as the optimal efficient rule equation. The selection criterion is based upon the following objective function: the equation must minimize the modified sum of variances of the target variables (Taylor, 1993).

$$\text{Objective function} = \min\{Var(x) + \mu Var(\pi)\} \quad (6)$$

where m is the modification factor. Interpretation of results will be based upon the selected optimal efficient rule equation for policy simulations.

Data

The FDIUS time series is based upon the Department of Commerce release on international transactions published in the Federal Reserve Bulletin as the net change in FDIUS. Two transformations on the level value of FDIUS series were made, one in proportion to GDP (Krugman & Obstfeld, 2003), the other in growth rate. The former is a conventional measure, but the latter is a new attempt to explore the relationship between FDIUS, interest rate, and exchange rate. This novel attempt has two significant points: (1) FDIUS in proportion to GDP is a very small number; and (2) a new measure constructed in the format used by Friedman on rate of change in money stock (Friedman, 1959) may provide additional information on relationships under investigation. One example of the latter is one set of the policy variables providing better fit to data than the other set.

A positive FDIUS level indicates capital inflows to the U.S.; e.g., foreign investors sent money to the U.S. by obtaining lasting interest in a business enterprise and, therefore, owned or controlled at least ten percent of a business in this country (Anderson, 2003; Lowe, 2004). Likewise, a positive FDIUS growth rate means the total amount of investment in plants and businesses in the U.S. is bigger than the previous month's. For consecutive months, a larger growth rate over consecutive periods indicates a faster accumulation in FDIUS; smaller values imply slower buildup in FDIUS. A negative FDIUS growth rate means that capital inflow has been reduced. The growth rate of FDIUS is considered to be an adjusted value from its zero mean (e.g., no growth at all). After the optimal rule equation is estimated, the growth rate of FDIUS time series is used to find the level value of FDIUS associated with the Federal Reserve's interest rate changes for each month in 2001 and, thus, is used to estimate the loss in FDIUS from September to December due to the 9/11 terrorist attacks. It is recognized that monthly information may not be more robust than quarterly information; however, in this study all time series are taken from 1975:01 to 2002:12 since the Federal Reserve interest rate actions do not fall on a quarterly or yearly basis. They may proceed by months or even shorter periods as observed in 2001. Therefore, a better way to capture the impact of federal funds rate change is to use monthly information.

The Federal Funds Rate

The Federal Reserve System adopts federal funds (FF) rate as a transmission mechanism to deliver monetary policy effects to the economy. The interest rate variable is considered in two respects: nominal federal funds rate and real federal funds rate. The latter is obtained by subtracting the inflation rate from nominal federal funds rate; the former has been widely used in economic analysis (Bernanke & Blinder, 1992; Wong, 2000; Elder, 2004). Other forms of federal funds rates have been attempted for different purposes. For instance, federal funds differential relative to foreign interest rates has been used as an alternative U.S. monetary policy variable (Lewis, 1995). Here, the real federal funds rate is adopted as an alternative to the nominal rate, because, in economic modeling, only the real interest rate is considered in the real goods and services market equilibrium. The Federal Reserve System releases the nominal federal funds rate on a monthly basis.

The consumer price index (CPI) has been the most frequently used the variable for measuring inflation in the economy (Bernanke & Mihov, 1998; Lubik & Schorfheide, 2004). The CPI time series is taken from the Federal Reserve Bank at St. Louis's FRED II database. The monthly inflation rate variable is taken as a percentage increase in the domestic consumer price index for urban workers and is used to convert the federal funds rate

from nominal- to real-value. Inflation and interest rates are closely related as seen in the Fisher effect in the bond market. The interest rate is also tied closely to the exchange rate. These three rates should be studied together to fully understand the impact on inflation and exchange rates due to a shock in interest rate.

The close relationship between the exchange rate and international capital flow has been established by numerous theoretical and empirical studies (Safarian 1985; Freund, 2000; Brooks, et al., 2004; Tomohara, 2004). The exchange rate time series used in this paper consists of two separate periods: the first period includes the value of the dollar based upon an index of the bilateral G-10 currency basket from 1975 to 1989; the second is culled from the broad index value of the multilateral trade weighted currency index of the major trading partners of the United States from 1990 to 2002.[4] This information is available from the Federal Reserve System. For each time series included in this study, the sample mean, sample variance, standard error of the mean, skewness, and results of the Jarque-Bera (JB) normality test are presented in Table 2.

Each sample mean, save that of the FDIUS growth rate series, is statistically significant. Sample means of FDIUS in proportion to GDP and in growth rate are very close in size, but the latter has a larger standard error. All sample skewness and JB normality test statistics are significant at the zero probability level. The JB test results imply that the residuals of these series are not normally distributed by large samples.

The first step in the estimation procedure is conducting a data stationarity check on unit root to determine whether these time series are stable over the long run (Campbell & Perron, 1991).[5] Three different methods were used for this purpose, including the augmented Dickey-Fuller test, the Phillips-Perron rho statistic, and the Bayesian odds test. The results are presented in Table 3.

Results

These results indicate that all time series reject the unit root null hypothesis under the augmented Dickey Fuller test

Table 2
Summary of Statistics of Variables

Item	FDI Growth Rate	FDI Over GDP	Real Federal Funds rate	Nominal Federal Funds rate	Exchange Rate (Index)	Inflation Rate
Sample Mean	0.202	0.204	6.71	7.09	100.81	0.367
Sample Variance	13.14	0.05	10.64	11.64	229.86	0.13
S.E. of mean	0.198	0.012	0.178	0.186	0.827	0.019
Skewness	17.125	2.698	1.219	1.249	1.571	0.612
Jarque-Bera	133×10^4	1588.0	141.0	132.0	218.0	437.0

Note: Observations:334~336. Skewness, and the Jarque-Bera normality test are all statistically significant. Transformation of CPI into inflation rate is $100 \times \Delta CPI_t / CPI_{t-1}$.

Table 3
The Unit Root Tests

Variable	ADF Lags	Value	Phillips-Perron Lags	Value	Bayesian Odds Ratio	Test Range
FDIUS growth rate	1	-338.27	4	-329.03	333.63	5.8 ~ 0.2
FDIUS over GDP	1	-61.13	4	-21.31	11.05	9.1 ~ 3.1
Real FF rate	1	-10.57	4	-8.00	3.57	8.7 ~ 2.7
Nominal FF rate	1	-13.23	4	-7.28	2.03	9.1 ~ 3.1
Exchange rate	1	-8.38	4	-6.78	2.91	9.2 ~ 3.2
Inflation rate	1	-104.81	4	-219.44	130.42	6.0 ~ 0.1

Note: For both the Augmented Dickey-Fuller test and Phillips-Perron test, the variable under investigation is a random walk with drift around a stochastic trend with critical value of -3.98 when n=336. Since all test values are smaller than the critical value, the null hypotheses of unit roots are rejected, all series are stationary. All the Bayesian odds test ratios except the real federal funds rate are either greater than the critical range or smaller than the Schwarz limit, so they are also stationary.

as well as the Phillips-Perron rho statistic test. Only one time series, real federal funds rate, falls within the critical range and may indicate unit root. This time series passed the other two unit root tests; therefore, it is included in this study.

The second step in the estimation procedure is generating parameter estimates for the Taylor-type efficient rule equations given in Equation 5, which pertains to international trade and monetary policy. Equation 4 is an intermediate step and, therefore, is not estimated directly. The dynamic linear model is applied to two sets of time series for comparison, each set having two policy variables and two state variables. One set includes FDIUS in growth rate, real federal funds, inflation, and exchange rates; the other set consists of FDIUS in proportion to GDP and nominal federal funds, inflation, and exchange rates. The two time series sets are estimated independently based upon identical benchmark values. In dynamic linear system estimation, the calibration of initial values (the benchmark values of parameter estimates in Equation 5) must be conducted first, and these values are listed in Table 4.

The benchmark value for $ = 0.1 states that for one percentage point (100 basis points) increase in the federal funds rate (nominal or real), the impact on the FDIUS variable is .1 percent. For 2 = 0.4, it suggests that when the Federal Reserve System increases federal funds by 100 basis points, the exchange rate increases correspondingly by .4 index point (Taylor, 1993; Ball, 1999). The range of each benchmark value is also reported in Table 4, which reflects the valid values for each parameter leading to dynamic system convergence in simulations. When initial values are outside these ranges, the system becomes explosive. The estimated efficient rule simulations (equations) are results from approximately 200 simulations and are reported in Table 5.

The first half of Table 5 presents five selected efficient rule simulations with the target variable set to FDIUS growth rate. Each rule simulation has an estimated w such that five rule simulations could be arranged in decreasing order for the value of w. The range of estimated w varies from 0.571 for high to 0.104 for low reflecting respective impact on the FDIUS growth rate due to interest rate change. The meaning of the numbers in the last column is explained below. The second half of Table 5 reports five efficient rule simulations based upon FDIUS in proportion to GDP; they are also arranged

Table 4
Benchmark Values for Dynamic Estimation

Parameter	Benchmark	Range	Source
α	0.80	-0.7 ~ 1.0	Variation of Taylor's (1993)
β	0.10	-2.0 ~ 2.0	This paper
γ	0.50	-1.3 ~ 1.0	Variation of Taylor's (1993)
δ	0.75	-1.0 ~ 1.0	This paper
λ	1.00	-1.4 ~ 3.0	Variation of Taylor's (1993)
θ	0.40	0.2 ~ 2.0	Variation of Ball's (1999)

Note: *The ranges are obtained from linear dynamic estimations when convergence is derived.

Table 5
Selected Efficient Rule Equations Parameter Estimates

Simulation	w	a	b	m	n	Var(x) + μVar(B)
X_1 = Growth rate of FDIUS, r = real Federal funds rate						
#1	0.571	3.036	0.264	2.248	-0.104	246.31
2	0.461	6.432	-0.159	3.004	0.1035	31665.50
3	0.284	2.343	0.224	5.054	-0.399	7.04
4	*0.281	1.871	0.273	5.140	-0.500	4.70*
5	0.104	0.438	0.077	4.193	-0.313	72.12
X_2= FDIUS over GDP, r = nominal Federal funds rate						
#6	0.571	-5.204	0.627	3.64	-0.4	101.95
7	0.128	-2.435	0.144	4.470	-0.4	168.79
8	0.098	-1.858	0.113	4.350	-0.5	61.03
9	*0.070	-1.335	0.081	4.345	-0.5	28.35*
10	0.060	-1.171	0.071	4.337	-0.5	31.83

Note: The rule equation is: wr + (1-w)e = ax +b(p-g e_{t-1}) Where r is respective federal funds rate, e is the foreign exchange rate, x is the respective measure of foreign direct investment in the U.S., p is inflation rate. The value of μ for x_1 is 10^{-1}, for x_2 is 1. The lowest value is designated by *.

according to decreasing w value.

The third step in the estimation procedure is determining the optimal efficient rule simulation from reported Simulations 1 to 5 in previous table for FDIUS growth rate and 6 to 10 for FDIUS in proportion to GDP, respectively. The objective function specified in Equation 6 is used to find the minimum weighted sum of variances of the target variables, FDIUS, x, and inflation rate, π. By applying the standard dynamic econometric method to Equation 6, one obtains the variances of x, and π, based upon estimated parameters (Hendry, 1995). The μ here is set at 0.1 for the growth rate of FDIUS and at 1 for FDIUS in proportion to GDP. Since not all simulations were explosive, out of those useable ones twenty simulations with w values from 0.9 to 0.09 were examined by the

weighted sum of variances. At times, the fine-tuning of vicinity of w values with low sum of weighted variances were further checked by means of parameter restrictions to obtain the appropriate value of w for the optimal efficient rule simulation.

In the first half of Table 5, the fourth simulation exhibits the lowest value of weighted sum of variances, 4.70; the estimated w is 0.281. Thus, the optimal efficient rule equation is specified as

$$0.281r + 0.719e = 1.871x + 0.273(\pi - 0.399e_{t-1}) \qquad (7)$$

Equation 7 may be interpreted thusly: 28 percent of the variation in the growth rate of FDIUS is attributable to a one percentage point change in the real federal funds rate. The remaining 72 percent of the variation is caused by a one index point change in the index value of exchange rate. Thus, an increase in the real federal funds rate initiated by the Federal Reserve System would noticeably affect the FDIUS growth rate. Likewise, a decrease in the real federal funds rate would cause a noticeable negative growth rate of FDIUS. This result has not been reported elsewhere because the emphasis of current literature remains focused on the rate of return of foreign direct investment (Landefeld, et al., 2002; Doukas & Lang, 2003).

In the second half of Table 5, the ninth simulation of w value at 0.07 has emerged as the optimal efficient rule equation on the basis of the minimum sum of variances 28.35. The tenth simulation with a lower value of w at 0.06 and a higher sum of variances suggests that a low w value would not necessarily qualify itself to be the optimal efficient rule equation. It indicates that only 7 percent of the variations in FDIUS in proportion to GDP could be explained by a one percentage point change in the nominal federal funds rate. Note that the negative value of the coefficient "a" corresponds to an inverse relationship between nominal federal funds rate and FDIUS in proportion to GDP. This reversal of sign from positive reported in Simulation 4 to negative in Simulation 9 is not consistent with conventional wisdom. By comparing the two w values in Simulation 9 and in Simulation 4, it is evident that the nominal federal funds rate contributes less to the variations of FDIUS in proportion to GDP than the real federal funds rate does to that of FDIUS growth rate. Using the real federal funds rate, the transmission mechanism of monetary policy influences more readily the FDIUS. Hence, discussion of this paper focuses on Simulation 4.

A discussion of the relationship between the federal funds rate and the exchange rate is in order. Two effects on capital movement occur as the nominal federal funds rate changes: One is the cost of borrowing effect; the other is the foreign exchange effect (Madura, 2003).[6] For the former, when the federal funds rate rises due to monetary policy action from the central bank, other interest rates increase correspondingly. Thus, the cost of borrowing from domestic sources increases; then domestic firms tend to seek capital infusion from private sources outside the country at lower interest rates, and foreign capital inflow increases. Higher user cost of money dampens domestic stock market activities; therefore, there will be less foreign capital attracted to the domestic stock market.

The second effect on capital inflows proceeds by the following steps: When the Federal Reserve raises the federal funds rate, the purpose is to remove inflationary pressure from the economy. By monetary policy action, the money supply tends to slow down, and the price of money tends to increase. Foreigners' demand for U.S. dollars decreases, and the price of the U.S. dollar in foreign exchange markets decreases. Therefore, a fixed quantity of foreign currency is now able to be exchanged for more U.S. dollars—an incentive to foreign investors to invest in the U.S. (e.g., in manufacturing plants). Thus, the growth rate of FDIUS tends to increase. Both effects are caused by a higher federal funds rate and are likely to

enlarge the FDIUS growth rate.

In Equation 7, the coefficient of the growth rate of FDIUS, 1.871, can be interpreted as follows: A positive value suggests that an increase in the federal funds rate leads to an increase in variation of the growth rate of FDIUS, e.g., a one percentage point increase in federal funds rate by the Federal Reserve will cause a 0.53 percentage point (i.e., 1.871 multiplied by 0.281) increase in change of growth rate of FDIUS. A one index point increase in the foreign exchange rate corresponds to a 1.345 percentage point (1.871 multiplied by 0.719) increase in change of the growth rate of FDIUS. In other words, when the economy begins showing signs of inflationary pressure, the Federal Reserve tends to tighten the reins on inflation by either reducing the money supply and/or increasing the short term interest rate. If the money supply is reduced, then the exchange rate tends to increase. In the meantime, national income tends to rise during an economic boom; consumption and investment also tend to expand, leading to more imports and a larger capital inflow.

In Equation 7, the impact of the real federal funds rate on the inflation rate is approximately 0.08 (0.281 multiplied by 0.273), that is, .08 percent. The inflation rate is dampened by the lagged exchange rate; the adjusting factor is 0.11 (0.273 multiplied by 0.399), and the inflation rate is reduced by .11 percent. Thus, a minor impact is detected on the inflation rate (Neumann & von Hagen, 2002).

Prior to the terrorist attacks on September 11, 2001, FDIUS amounted to 51 billion dollars in the second quarter of 2001, but quickly fell to -2.6 billion dollars after one year. The attacks caused a great loss not only in human life but also in real estate, and, thus, property values in New York and Washington, DC, fell. The collective confidence of U.S. investors was shaken as well (Virgo, 2001). In early 2001, the United States fell into an 11-month recession. In the same year, the Fed, having firmly relied on the interest rate as an effective monetary policy tool to gauge the market since 1982, dropped the federal funds rate eleven consecutive times from 6.5 to 1.75 percent (Goodfriend, 2002). While the interest rate was declining, the FDIUS also slid from $71 billion in January to $38 billion in July and, finally, to $14 billion in September. Once the initial shock of 9/11 had passed, the FDIUS recovered to $21.9 billion by December 2001.

Table 6 presents the impact of interest rate drop on FDIUS based upon Equation 7. Column 2 of Table 6 shows the FDIUS growth rate; Column 3 records the lowering of nominal federal funds rate; and Column 4 estimates the portion of change in growth rate due to federal funds rate change. This is done by first estimating change in FDIUS growth rate due to one percentage point change in nominal federal funds rate using Equation 7 (0.01 multiplied by Column 2 multiplied by the value of w multiplied by 1.871, or –6.65 multiplied by 10^{-4}). For the 25 basis points change, further adjustment must be made by one quarter. Column 6 is the product of Column 5 and FDIUS of a previous period. The estimation of total loss in FDIUS during the entirety of 2001 was $140.7 million; $38 million of this amount was attributable to the 9/11 attacks and occurred between September and December 2001. Once the economy had recovered from the brief recession, using expansionary monetary policy became unnecessary, and so the Federal Reserve lowered federal funds only once in November 2002. Further loss in FDIUS was found in the first half of 2002, reaching a nadir in June. Information reported in Table 6 provides numerical estimates in support of Virgo's (2001) claim on 9/11 losses in foreign direct investment in the United States.

Table 6
The Impact of the Interest Rate Change on Foreign Direct Investment in U.S. in 2001

Month	(1) FDI (Billions $)	(2) Growth rate of FDIUS	(3) Change in Ff rate (%)	(4) Portion of change In growth rate due to Ff rate change, in e-4.	(5) Portion of FDI Accountable by Ff rate change (Billions $)
12	84.707				
1	71.000	-0.162	-1.00	-6.650	-0.05630
2	57.300	-0.193	0.00	0.000	0.00000
3	43.590	-0.239	-0.50	-1.210	-0.00690
4	46.060	0.057	-0.50	-7.790	-0.03390
5	48.600	0.054	-0.50	-0.8150	-0.00380
6	51.100	0.052	-0.25	-0.0368	-0.00018
7	38.800	-0.241	0.00	0.0000	0.00000
8	26.510	-0.317	-0.25	-1.0010	-0.00388
9	14.210	-0.464	-0.50	- 3.8600	-0.01023
10	14.77	0.180	- 0.50	-16.930	-0.02405
11	19.33	0.153	- 0.50	- 0.7124	-0.00105
12	21.90	0.133	- 0.25	- 0.2650	-0.00051
Total			- 4.75		-0.14070

Note: FF rate is nominal federal funds rate. Column 4 is change in FDIUS growth rate multiplied by the product of 1.871 and 0.281, obtained from equation 7 of this study, then prorated by one percentage point of FF rate. If FF rate falls by one half of one percentage point, the number in Column 4 will be divided by 2. Column 5 is estimated by multiplying Columns 4 and 1.

Conclusion

This article addresses a momentous question regarding capital inflow in the United States: When the Federal Open Market Committee alters federal funds rates, how is the FDIUS affected? On the importance of short-term interest rate versus exchange rate in directing FDIUS movement, the split is 28 percent for the real federal funds rate and 72 percent for the exchange rate, respectively. While recognizing the exchange rate exerts more influence on FDIUS growth rate, the results of this study strongly suggest ample room is available for the monetary authority to maneuver in directing FDIUS through interest rate policy actions. According to the dynamic linear model presented in this article, the FDIUS growth rate responds directly to changes in federal funds rate. A one percentage change in the federal funds rate may be accountable for a .5 percentage point variation in the FDIUS growth rate. It also suggests that when foreign exchange rate makes one index point change, a robust impact is felt on FDIUS growth rate as well as FDIUS. One application of this rule is that along with interest rate cuts in 2001, the 9/11 terrorist attacks snatched $38 million away from FDIUS even though the full effect of what happened in 2001 should be explained by other factors as well. One extension of this research is to investigate the monetary authority's influence on capital inflows into U.S. equities and bank loans (Hejazi and Safarian, 2001). Results from such studies will provide additional insight into the direction and magnitude of global capital movement through dynamic analysis.

Endnotes

1. G8 Summit Chair's Summary, Sea Island, GA, June 10, 2004.

2. The name, foreign direct investment (FDI) or direct foreign investment used here, refers to purchases of land, buildings, real estate, factories, or joint ventures with a foreign company in a foreign country. In the case of capital inflow to the United States (FDIUS), it is money coming into the U.S. for the aforementioned purposes. See p. 390, *International Financial Management*, by Jeff Madura, 7th edition, 2003. An alternative definition of FDIUS is cited by Anderson, 2003.

3. From Bureau of Economic Analysis, U.S. Department of Commerce, see www.bea.gov/bea/newsrelarchive/2004/gdp204a.xls.

4. The G-10, ten-currency basket includes US, UK, Canada, Japan, Germany, Switzerland, Sweden, the Netherlands, France, Italy and Belgium; see "Federal Reserve Bulletin," October 1998.

5. Estimations were based upon RATS software version 5 released in 2000, Estima Inc. Evanston, IL. For the estimation technique see Hendry's *Dynamic Econometrics*, p. 113. The variances of the shocks are assumed to be one.

6. For more information on the exchange rate exposure, see Jeff Madura, p.323.

References

Anderson, T. W. (2003). Foreign direct investment in the United States: New investment in 2002. *Survey of Current Business*, 83: 55-62.

Ball, L. (1999). Policy rules for open economies. In J. Taylor (ed), *Monetary policy rules,* (pp. 127-144), Chicago: Univer-sity of Chicago Press.

Bernanke, B. S. & Blinder, A. S. (1992). The federal funds rate and the channels of Monetary transmission. *American Economics Review*, 82: 901-921.

Bernanke, B. S. & Mihov. I. (1998). Measuring monetary policy. *Quarterly Journal of Economics*, 113: 869-902.

Bosworth, B. P. & Collins, S. M. (1999). Capital flows to developing economies: Implications for saving and investment. *Brookings Papers on Economic Activity*: 143-169).

Brooks, R. et al. (2004). Exchange rates and capital flows. *European Financial Management*, 10: 511-533.

Campbell, J. Y. & Perron, P. (1991). Pitfalls and opportunities: What macroeconomists should know about unit roots. *NBER Macroeconomics Annual*, 6: 141-201.

Doukas, J. & Lang, L. H. P. (2003). Foreign direct investment, diversification and firm performance. *Journal of International Business Studies*, 34: 153-72.

Elder, J. (2004). Some empirical evidence on the real effects of nominal volatility. *Journal of Economics and Finance*, (28): 1-13.

Finance India. (1996). Bibliography on foreign investment. *Finance India*, 10 (2): 423-439.

Freund, C. (2000). Current account adjustment in industrialized countries. *Board of Governors of the Federal Reserve System*, International Finance Discussion Paper No.692.

Friedman, M. (1959). *A program for monetary stability*. New York: Fordham University Press.

Goodfriend, M. (2002). The phases of U.S. monetary policy 1987 to 2001. *Economic Quarterly, Federal Reserve Bank of Richmond*, 88(4): 1-18.

Hall, K. (2004). Economics and public issues conference keynote address. *Southern Business Review*, 30(1): 1-4.

Hejazi, W. & Safarian, A. E. (2001). The complementarity between U.S. foreign direct investment stock and trade. *Atlantic Economic Journal*, 29(4): 420-437.

Hendry, D. (1995). *Dynamic econometrics.* New York: Oxford University Press.

Hymer, S. H. (1976). *The international operation of national firms: A study of direct foreign investment.* Cambridge, MA: MIT Press.

Krugman, P. R. & Obstfeld, M. (2003). *International economics: theory and policy*, 6th ed. Boston: Addison Wesley.

Landefeld, J. S., Lawson, A. M., & Weinberg, D. B. (2002). Rates of return on direct investment. *Survey of Current Business*, 82: 79-86.

Lewis, K. (1995). Are foreign exchange intervention and monetary policy related, and does it really matter? *Journal of Business*, 68: 185-214.

Lowe, J. (2004). Foreign direct investment in the United States: Detail for historical-cost position and related capital and income flows 2003. *Survey of Current Business*, 84: 61-99.

Lubik, T. A. & Schorfheide, F. (2004). Testing for indeterminacy: An application to U.S. monetary policy. *American Economic Review*, 94: 190-217.

Madura, J. (2003). *International financial management*, 7th Ed. Mason, Ohio, South-Western Publishing Company

Neumann, M. J. M. & von Hagen, J. (2002). Does inflation targeting matter? *Review, Federal Reserve Bank of St. Louis*, 84(4): 127-148.

Safarian, A. E. (1985). *Foreign direct investment: A survey of Canadian research*, Montreal: Institute for Research on Public Policy.

Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, 39:195-214.

Tomohara, A. (2004). Globalization for development? Inward FDI and the size of the market. *Southern Business Review*. 30(1): 5-16.

Virgo, J. M. (2001). Economic impact of the terrorist attacks of September 11, 2001. *Atlantic Economic Journal*, 29(4): 353-357.

Wong, K. F. (2000). Variability in the effects of monetary policy on economic activity. *Journal of Money, Credit, and Banking*. 32: 179-198.

Appendix

1. To obtain Eq. (5), we can rewrite Eq. (3) by lagging one period as $e_{t-1} = \theta r_{t-1} + v$ then replace the value of r into Eq. (1). By moving Eqs. (1) and (2) forward one period, combine two equations, and eliminating r, that is Eq. (4). Rearranging terms in Eq. (4) and call $w = -m\beta\theta/(\theta + m\beta - m\beta\theta) = -m\beta\theta/(.)$, $a = z\theta/(.)$, $b = n\theta/(.)$, $z = \lambda m + \alpha n$, $(.) = (\theta + m\beta - m\beta\theta)$, we obtain

$$wr + (1 - w)e = ax + b(\pi - \gamma e_{t-1}) \tag{5}$$

2. To solve for Eq. (6), an autoregressive-moving average, ARMA (2,1), representation is used

$$X_t = \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + E \tag{8}$$

where $X' = [x \pi e]'$

$$\Theta_1 = \begin{bmatrix} \lambda & 0 & (\beta/\theta+\delta) \\ \alpha & 1 & -\gamma \\ (\lambda z+\alpha n) & n & z(\beta/\theta+\delta) \end{bmatrix} \Theta_2 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & \gamma \\ 0 & 0 & n\gamma \end{bmatrix},$$

$$E = \begin{bmatrix} \varepsilon-(\beta/\theta)\upsilon_{t-1} \\ \eta \\ n\eta+z\varepsilon-z(\beta/\theta)\upsilon_{t-1}-m(\beta/\theta)\upsilon \end{bmatrix}$$

z is defined above.

In solving (6) by linear dynamic method, we can stack up the matrices X_t and X_{t-1} as

$$\begin{bmatrix} X_t \\ X_{t-1} \end{bmatrix} = \begin{bmatrix} \Theta_1 & \Theta_2 \\ I & 0 \end{bmatrix} \begin{bmatrix} X_{t-1} \\ X_{t-2} \end{bmatrix} + \begin{bmatrix} E \\ 0 \end{bmatrix}$$

therefore, for estimation purposes, a new matrix is designated as A:

$$A = [a_{ij}] = \begin{bmatrix} \Theta_1 & \Theta_2 \\ I & 0 \end{bmatrix}$$ then $a_{31} = \lambda z + \alpha m$ and $a_{32} = n$

As estimates for λ, z, α are obtained, then given value of n, one can find a value for m.