INTERNATIONAL JOURNAL OF FINANCE AND ECONOMICS
Int. J. Fin. Econ. **6**: 201–216 (2001)
DOI: 10.1002/ijfe.159

MODELLING FUNDAMENTALS FOR FORECASTING CAPITAL FLOWS TO EMERGING MARKETS

ASHOKA MODY[a], MARK P. TAYLOR[b,*] and JUNG YEON KIM[c]
[a] *The World Bank, USA*
[b] *University of Warwick, Coventry, UK and Centre for Economic Policy Research, London, UK*
[c] *The International Monetary Fund, USA*

ABSTRACT

In this paper, we provide capital flow forecasts to 32 developing countries using a vector error correction framework based on underlying domestic (pull) fundamentals and international (push) factors. In general, pull factors have a heavier weight in determining these capital flows. However, short-term dynamics of capital flows can be significantly influenced by external developments. Simulations under various economic scenarios show that while financial variables (such as the US interest rate and high-yield spread) are important, real US activity may be even more potent in influencing capital flow movements. Copyright © 2001 John Wiley & Sons, Ltd.

KEY WORDS: capital flows; economic fundamentals; vector autoregression

JEL CODE: F21; F34

1. INTRODUCTION

The extreme turbulence in world financial markets in recent years has placed the role and the magnitude of foreign capital flows to developing countries under intense scrutiny once again. As markets recovered during 1999 largely due to continued growth in the US economy and the deepening of credit markets in the euro area, emerging markets rebounded from a series of crises that began in Asia in 1997. Global asset prices saw strong increases in 1999. The fundamentals in many emerging markets improved and their domestic and external financing situation continued to recover. However, beginning in early 2000, participants in mature and emerging markets began to manifest their loss of confidence. Signs of inflationary pressures in major currency areas emerged and the correction of equity markets, especially in the technology sector took place. It appeared that investors became increasingly more risk averse, which led to increased volatility and a decline even in mature equity and bond markets. This in turn adversely affected emerging markets during 2000 (International Monetary Fund, 2000).

Increased market volatility has re-emphasized the importance of forecasting capital flows to developing countries, and in particular, gauging the degree of potential reversibility of capital flows, since a surge in capital flows to a developing country may require important compensating policies by the domestic authorities in order to offset any adverse effects in the recipient economy (World Bank, 1997, chapter 4). While a number of studies examine the history and nature of capital flows to developing countries, attempts to model capital flows econometrically appear to be limited.[1] Hence, the focus of this paper is on three types of capital flows (bond flows, equity flows and syndicated loan flows) to 32 developing countries, their time-series characteristics and their underlying fundamental determinants, as a means of developing a basis for econometric forecasting of capital flows to emerging markets.

In Section 2 we explore the issue of forecasting capital flows taking a fundamentals-based approach, taking into consideration the country-specific or 'pull' factors that reflect domestic investment

* Correspondence to: Department of Economics, University of Warwick, Coventry, CV4 7HL, UK. E-mail: mark.taylor@warwick.ac.uk

opportunities and risks, as well as global or 'push' factors that mirror economic activity in developed countries which tend to affect the supply of investment funds towards emerging markets. In particular, we show how a tractable empirical forecasting framework may be developed from a logically consistent underlying theoretical framework. In Section 3 we briefly discuss the data used (a full listing is given in Appendix A), while in Section 4 we provide a summary and discussion of our forecasting exercises for the three categories of flows and 32 countries considered. In Section 5 we discuss how the forecasts would be affected by certain movements in the global variables, such as a hike in US interest rates or a marked downturn in US economic activity. In Section 6 we offer some concluding remarks and suggestions for further research.

2. MODELLING AND FORECASTING CAPITAL FLOWS TO DEVELOPING COUNTRIES: A FUNDAMENTALS APPROACH

Capital flows to developing countries can be driven either by internal, country-specific factors, or external, global factors. Country-specific or 'pull' factors are those reflecting domestic investment opportunities and risks, which influence a pull on overseas funds, while global or 'push' factors reflect a push on investment funds toward emerging markets. Push factors are conceived to capture the level of economic activity and alternative investment opportunities in developed countries.

Fernandez-Arias and Montiel (1996) have developed a useful analytical framework that incorporates the effect of domestic and global factors on capital flows. They separate potential domestic causes into those operating at the project level and those that operate at the country level. Assuming capital flows may occur as transactions in different types of assets, indexed by s ($s = 1, \ldots, N$), the domestic return on an asset of type s is decomposed into two components: a project expected return (G_s) and an adjustment factor depending upon the creditworthiness of the country (C_s). The project return is assumed to be a function of a vector of net flows (F) going to specific project types, while the creditworthiness factor is assumed to be a function of the vector of the end-of-period stocks of liabilities of all types, S: $S = S_{-1} + F$, where S_{-1} denotes the initial stocks of liabilities. Given that external creditors will diversify their portfolios, the opportunity cost of assets of type s, V_s, is a function of S. Fernandez-Arias and Montiel (1996) then establish an arbitrage condition – from which F may be solved for – of the form

$$G_s(g, F)C_s(c, S_{-1} + F) = V_s(v, S_{-1} + F) \tag{1}$$

where g, c and v represent shift factors associated, respectively, with the domestic economic environment and domestic creditworthiness (pull factors) and the financial conditions of the creditor country (push factors). G_s, C_s and V_s are assumed to be increasing functions of g, c, and v, respectively. The equilibrium or 'desired' value of the vector of net flows F, F^* say, determined implicitly by equation (1) may be expressed as

$$F^* = F^*(g, c, v, S_{-1}) \tag{2}$$

where F^* is increasing in g and c but decreasing in v and S_{-1}. Holding S_{-1} constant, totally differentiating Equation (2) and approximating total derivatives by first differences yields

$$\Delta F^* = F_1^* \Delta g + F_2^* \Delta c + F_3^* \Delta v \tag{3}$$

where subscripts denote partial derivatives. Equation (3) describes the pattern of changes in desired capital flows, determined by changes in the pull factors g and c and the push factors v by the initial value of S. Increases in g and c and decreases in v may induce prolonged growth in capital flows to developing countries. Differences in short-run and long-run capital movements might arise in accordance with the types of changes in g, c and v: permanent changes in g, c and v may cause long-run, permanent changes in the pattern of net flows, whereas transitory changes in these factors may generate transitory, short-term changes in net flows, which may be reversed over time. For example, the gradual, permanent removal of capital controls and liberalization of restrictions of FDI may reduce the adjustment costs that foreign

investors face in diversifying their portfolios and thus give rise to a gradual stock adjustment (flow) over time. This gradual adjustment also implies a complex dynamic pattern of net flows moving toward their long-run equilibrium value and is consistent with an estimation of capital flows.

Dynamic adjustment can be formally introduced into the Fernandez–Arias–Montiel framework by assuming a simple cost-of-adjustment model (Taylor and Sarno, 1997). In this model, factors such as market imperfections, informational asymmetries (Stiglitz and Weiss, 1981), and entry and exit costs to emerging financial markets (Daveri, 1995) are captured under the assumption that creditors face costs in adjusting their portfolios that are increasing in the size of the adjustment. The desired vector of capital flows is given by Equation (2).

Assume that agents want to minimize the difference between desired and actual flows, subject to adjustment costs. A simple way of modelling this is to assume a simple quadratic loss function for investors:

$$L = (F - F^*)' M_1 (F - F^*) + (F - F_{-1})' M_2 (F - F_{-1}) \tag{4}$$

where M_1 and M_2 are positive definite weighting matrices. From the first-order conditions for minimizing L, we can derive a simple equation for changes in F:

$$\Delta F = (M_1 + M_2)^{-1} M_1 (F^* - F_{-1}) \tag{5}$$

which, rearranging and using Equation (3), can be equivalently expressed in the error-correction form

$$\Delta F = A_0 (F^* - F)_{-1} + A_1 \Delta g + A_2 \Delta c + A_3 \Delta v \tag{6}$$

where $A_0 = (M_1 + M_2)^{-1} M_1$ and $A_i = (M_1 + M_2)^{-1} M_1 F_i^*$, $(i = 1, 2, 3)$.

According to Equation (6) changes in current capital flows are determined partly by the difference between desired and actual capital flows in the previous period and partly by the changes in the factors determining the desired level of capital flows.

An empirical model may be derived from this theoretical framework as follows. Consider a panel of N countries, indexed by i $(i = 1, \ldots, N)$, with portfolio flows at time t denoted f_{it}, assumed to be an integrated process of order one $I(1)$ (Engle and Granger, 1987). Also, define a vector of country-specific factors as x_{it} and a vector of global factors as w_t and assume that both vectors contain at least one $I(1)$ variable and no higher-order integrated variables. Then we consider cointegrating relationships of the kind

$$f_{it} = \beta_i' x_{it} + \gamma_i' w_t + e_{it}, \; i = 1, \ldots, N \tag{7}$$

where f_{it} may be either equity flows, bond flows, or loan flows.

If cointegration is established in an equation of this form, that is, the error term e_{it} is approximately stationary or $I(0)$, then the $I(1)$ variables in x_{it} and w_{it} may be thought of as capturing the long-run or permanent component of f_{it}, whereas e_{it} captures short-run or temporary movements of capital flows. Since e_{it} may alternatively be interpreted as the deviation from the long-run equilibrium $(e_{it} = f_{it} - \beta_i' x_{it} - \gamma_i' w_{it})$, it may be used in an analysis of the short-run dynamics of capital flows through estimation of the vector equilibrium correction model (VECM)

$$\Delta f_{it} = \psi_i - \rho_i (\beta' x - \gamma' w)_{it} + \sum_{j=1}^{p} \theta_{ij} \Delta f_{it-j} + \sum_{j=1}^{p} \lambda_{ij}' \Delta x_{it-j} + \sum_{j=j}^{p} \delta_{ij}' \Delta w_{it-j} + \omega_{it}, \quad i = 1, \ldots, N \tag{8}$$

where i is a country index, ψ_i is a constant term, j $(j = 0, \ldots, p)$ denotes the number of lags and ω_{it} is approximately white noise. Equation (6) is a panel data generalization of the error-correction representation of cointegrated variables established by Engle and Granger (1987) and follow directly from the Granger Representation Theorem (Granger, 1983; Engle and Granger, 1987).

Equation (8) provides the full dynamic interaction of the determinants of capital flows, given the past history of x_{it} and w_{it}, and may be interpreted as the empirical counterpart to the theoretical framework encapsulated in Equation (6).

In order to forecast from this empirical framework, it is also necessary to provide forecasts of the country-specific and global (pull and push) factors. For the pull factors, we simply augmented the vector equilibrium correction system in a straightforward fashion:

$$\Delta x_{it} = \alpha_i - \zeta_i(\beta_i' x - \gamma_i' w)_{it} + \sum_{j=1}^{p} \kappa_{ij} \Delta f_{it-j} + \sum_{j=1}^{p} \mu_{ij}' \Delta x_{it-j} + \sum_{j=1}^{p} \pi_j' \Delta w_{t-j} + \xi_{it}, \quad i = 1, \ldots, N \tag{9}$$

Since, however, it seemed unlikely that emerging countries' domestic factors would have any significant feedback effect of the global variables, forecasts on the global or push factors were derived separately by segmenting this part of the model—i.e. insulating them from feedback from the emerging markets variables. In practice, this means that vector autoregressions were used to forecast the global variables. This is tantamount to augmenting the VECM system with the following set of vector autoregressive (VAR) equations:

$$w_t = \varkappa + \sum_{j=1}^{p+1} \sigma_j' w_{t-j} + \varsigma_t \tag{10}$$

Our VAR forecast of the global variables thus provides a 'baseline forecast' for the global factors. These projections suggest, *inter alia*, that (i) the level of the EMBI will decline gradually to around 600 until end 2003; (ii) that the US high-yield spread will remain stable at about 890 from end 2000 until end 2003; (iii) US industrial production will grow at annual rate of 3–4% over the forecast period after a slowdown in early 2001; (iv) the US short-term interest rate will moderate at around 4%; and (v) the spread between US long-term and short-term interest rates will narrow to less than 300 basis points by end 2003.

As an alternative to forecasting the global factors, they can be set at pre-determined paths in order to simulate the likely effect on the forecast paths of the capital flow series under various scenarios. This alternative approach was also pursued.

3. DATA

The data set used here comprise of monthly records of three types of capital flows (bond, equity and syndicated loan flows) to 32 developing countries in Latin America, Asia, Eastern Europe (including the former Soviet Union), the Middle East and Africa. Specifically, bond flows include international bond issues by all (private, public and secondary) borrowers in the given country, excluding cancelled issues. These include eurobonds, global bonds and foreign bonds. Equity flows include international equity issues in the international capital markets by all borrowers in the given country. Publicly announced syndicated loans to all borrowers (public and private) are included in loan flows. The data are from January 1990 to December 2000 at monthly frequency. The data on this research were obtained from the data bank of the World Bank, Development Economics Prospects Group (DECPG). A full listing of original sources is given in Appendix A.

The 32 countries under study include Argentina, Brazil, Columbia, Ecuador, Honduras, Jamaica, Mexico, Peru and Venezuela for Latin America; China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Papua New Guinea, Thailand and Turkey for Asia; Bulgaria, Hungary, Lithuania, Russia and Ukraine for the Eastern Europe; Algeria, Egypt, Jordan, Lebanon and Morocco for the Middle East; and Cameroon, Nigeria and South Africa for Africa.

There are two sets of explanatory variables: country-specific factors and global factors. For country-specific factors we use the consumer price index, the level of domestic credit, the short-term debt to reserves ratio, the level of industrial production, the domestic short-term interest rate, credit ratings, the reserves to import ratio and the domestic stock market index. Global or 'push' factors taken into account in the model included global factors such as the strength of US output growth, US short-term and long-term interest rates, the Emerging Markets Bond Index (EMBI), the US swap rate and the US high-yield spread (as proxies for a measure of risk aversion).

4. FORECASTING RESULTS

Gross private capital flows to emerging markets increased substantially by about 37.6% from 1999 to 2000. This increased level is equivalent to about 76.5% of the inflows of 1997. The largest increase was observed in equity flows, which rose in 2000 by about 75% compared with the previous year. Bond and loan flows also took an upturn, with increases of about 13 and 49%, respectively, by end 2000. The model projects total flows to increase by about 6.9, 9.9 and 4% in 2001, 2002 and 2003, respectively, over the previous year (Table 1).

Global factors driving this forecast increase appear to include a slight slow down in the performance of the US economy combined with declines in US interest rates coupled with the moderation in the Emerging Market Bond Index since its recovery in late 2000. The sensitivity of these results to sudden shifts in global factors is discussed in the next section, which shows that the sharper than expected slowdown of the US economy this year is likely to reduce capital flows below the 'baseline' forecast made here in December 2000 on the assumption of a more favourable US growth outlook.

Although global 'push' factors can have strong effects on private capital flows to developing countries, the econometric analysis shows that domestic pull factors dominate push factors in explaining a high degree of the forecast variance.[2]

On the domestic side, forecast increases in capital flows from the model were usually associated with forecasts of increasing credit ratings and stock prices, and stable or declining short-term debt-reserve ratios. Such countries were also typically forecast to experience stable or moderately rising consumer prices. A strong forecast upsurge in the CPI is associated with declining capital inflow forecasts. The level of domestic credit and domestic industrial production show mixed signals, although the majority of countries with increasing inflow forecasts also have increasing domestic credit and industrial production forecasts. The economic intuition seems clear: higher inflows result in an accumulation of reserves and a rise in stock prices, a restoration of market confidence and an upward revision of the credit rating which induces further capital inflows into the country.

Among the three types of capital flows, equity flows to developing countries showed the largest increase. A possible reason why the model forecasts such strong performance in equity flows is that, compared with bond and loan flows, equity flows in the past have generally been extremely low and probably below the equilibrium level. Thus, the forecast surge in this category of flows may represent a degree of catch-up. Even with the increase of 75% in equity flows for 2000, equity flows would still only account for around 15–20% of overall capital flows to emerging markets.

The rapid growth in aggregate private capital flows to emerging markets is expected to slow down in 2001 according to the forecast, due largely to a forecast sluggish performance of the EMBI, together with improvements in the reserves to short-term debt ratio and the availability of domestic credit in a number of emerging markets. In Asia, after a hike of 63% in 2000, total inflows are expected to decline by about 3% in 2001 due to drops in bond and loan flows to the region. The growth in inflow is expected to pick up again in 2002–2003. A continued buoyant inflow of funds is anticipated for China.

Latin America has also recorded a substantial rise in capital flows during 2000. The recovery is especially evident in the amount of equity flows that began to stir in 1999. In 2000, total equity inflow to Latin American emerging countries reached US$6.8 bn, from US$761 mn in 1999, due to huge inflows to Brazil and Mexico during the second half of 2000. Total private capital inflows to the region increased by 19% in 2000, and are forecast to maintain strong growth in 2001 with an increase of 23%. However, the growth rate is expected to decline, with an increase of 9% in 2002 followed by a decrease of 5% for 2003. Brazil anticipates stable growth in inflows while inflows to Mexico are expected to moderate throughout 2002–2003. Inflows to Argentina are forecast to recover, although a number of countries in Latin America are likely to have limited access to capital markets in the next few years.

Changes in flows to Eastern Europe are dominated by Russia, and the total flow to the rest of the countries in Eastern Europe is expected to decrease by about 21% in 2001 after a hike of 29% in 2000. The growth in loan inflows was exceptionally high in 2000, but these are forecast to decline in 2002 and 2003. The ratio of equity inflows to total private inflows is especially low in this region compared to the rest of the world.

Table 1. Capital flows to emerging markets: (a) 1997–2000; (b) forecasts for 2001; (c) forecasts for 2002; (d) forecasts for 2003

(a)		1997	1998	1999	2000				Total
					I	II	III	IV	
Latin America	Bond	54 344.15	36 511.73	35 070.10	16 382.50	5990.57	10 503.07	2089.60	34 965.74
	Equity	4331.39	138.66	761.26	1311.21	2183.17	3276.71	0.00	6771.09
	Loan	49 288.91	42 365.38	29 192.25	8337.96	11 238.82	7252.32	8935.78	35 764.88
	Sum	107 964.45	79 015.78	65 023.61	26 031.68	19 412.56	21 032.10	11 025.38	77 501.71
	Annual forecast								77 501.71
	Growth (annum)								19%
Asia	Bond	40 878.77	13 079.43	20 206.63	11 962.89	4981.06	9015.93	5219.90	31 179.77
	Equity	13 234.99	5397.49	14 448.24	6034.83	6678.82	2296.97	10 823.13	25 833.75
	Loan	69 847.16	31 455.74	27 552.15	7156.33	7472.56	17 898.52	11 917.43	44 444.83
	Sum	123 960.92	49 932.67	62 207.01	25 154.04	19 132.44	29 211.42	27 960.45	101 458.36
	Annual forecast								101 458.36
	Growth (annum)								63%
Eastern Europe*	Bond	8054.29	15 357.55	3286.57	450.71	–	181.29	360.00	992.00
	Equity	1755.07	383.25	529.16	19.07	473.19	64.92	–	557.18
	Loan	15 404.05	4724.61	2146.63	283.46	2619.21	2540.79	672.70	6116.17
	Sum	25 213.41	20 465.41	5962.35	753.25	3092.40	2787.00	1032.70	7665.35
	Annual forecast								7665.35
	Growth (annum)								29%
Middle East	Bond	1372.87	1525.00	1672.98	–	434.94	700.00	617.41	1752.35
	Equity	426.38	367.63	291.28	–	56.42	319.37	–	375.78
	Loan	2585.83	2083.06	4732.97	200.00	445.97	285.00	1011.99	1942.96
	Sum	4385.07	3975.69	6697.23	200.00	937.32	1304.37	1629.40	4071.10
	Annual forecast								4071.10
	Growth (annum)								−39%
Africa*	Bond	1078.95	998.89	1885.49	1235.77	250.00	–	–	1485.77
	Equity	1107.77	685.44	4187.58	269.50	180.44	1438.26	46.92	1935.12
	Loan	3496.27	1342.09	2521.58	5065.00	3500.00	550.00	1141.08	10 256.08
	Sum	5682.98	3026.42	8594.65	6570.27	3930.44	1988.26	1188.00	13 676.97
	Annual forecast								13 676.97
	Growth (annum)								59%
	TOTAL	267 206.8	156 415.97	148 484.86	58 709.23	46 505.16	56 323.15	42 835.94	204 373.5
	Annual forecast								204 373.5
	Changes in annual flow		−41%	−5%					37.64%

Table 1. (Continued)

(b)		2001				Total
		I	II	III	IV	
Latin America	Bond	10 628.3799	10780.3381	11 735.608	11 484.7636	44 629.09
	Equity	1102.26	1019.53	1363.55	1348.96	4834.30
	Loan	11 007.13	11 183.12	11 942.24	12 054.23	46 186.72
	Sum	22 737.77	22 982.99	25 041.40	24 887.95	95 650.11
	Annual forecast					95 650.11
	Growth (annum)					23%
Asia	Bond	5952.69	7030.59	8100.71	8166.16	29 250.14
	Equity	7201.21	7578.54	3874.57	8865.64	27 519.95
	Loan	10 506.22	10 352.12	10 635.19	10 600.59	42 094.12
	Sum	23 660.11	24 961.25	22 610.47	27 632.39	98 864.22
	Annual forecast					98 864.22
	Growth (annum)					−3%
Eastern Europe*	Bond	3031.40	161.91	138.89	186.16	3518.37
	Equity	14.50	21.24	23.17	25.52	84.44
	Loan	442.95	693.05	642.43	698.30	2476.74
	Sum	3488.86	876.20	804.49	909.99	6079.54
	Annual forecast					6079.54
	Growth (annum)					−21%
Middle East	Bond	508.05	545.64	527.67	539.08	2120.44
	Equity	213.15	172.39	159.83	155.28	700.65
	Loan	369.37	521.84	544.54	593.28	2029.02
	Sum	1090.57	1239.87	1232.04	1287.63	4850.11
	Annual forecast					4850.11
	Growth (annum)					19%
Africa*	Bond	7.30	141.60	134.24	153.84	436.98
	Equity	1138.06	856.69	785.89	729.01	3509.64
	Loan	1732.63	2074.82	2598.60	2623.22	9029.27
	Sum	2877.99	3073.11	3518.73	3506.07	12 975.89
	Annual forecast					12 975.89
	Growth (annum)					−5%
	TOTAL	53 855.30	53 133.41	53 207.13	58 224.03	218 419.88
	Annual forecast					218 419.88
	Changes in annual flow					6.87%

Table 1. (Continued)

(c)		2002				Total
		I	II	III	IV	
Latin America	Bond	11 213.3423	10 964.9642	10 783.2955	10 725.6206	43 687.22
	Equity	1392.36	1426.16	1450.49	1472.58	5741.59
	Loan	12 137.18	12 060.60	12 066.08	12 074.44	48 338.30
	Sum	24 742.89	24 451.72	24 299.86	24 272.64	97 767.11
	Annual forecast					97 767.11
	Growth (annum)					2%
Asia	Bond	8860.69	8499.64	8842.36	8088.44	34 291.14
	Equity	8177.92	8528.84	8113.64	9476.24	34 296.64
	Loan	11 585.22	11 968.52	12 603.11	12 396.40	48 553.26
	Sum	28 623.83	28 997.01	29 559.11	29 961.09	117 141.04
	Annual forecast					117 141.04
	Growth (annum)					18%
Eastern Europe*	Bond	143.68	144.18	144.40	144.52	576.77
	Equity	27.21	28.65	29.54	29.98	115.38
	Loan	691.89	696.16	704.59	715.01	2807.65
	Sum	862.78	868.99	878.53	889.51	3499.81
	Annual forecast					3499.81
	Growth (annum)					−42%
Middle East	Bond	550.01	564.32	580.70	597.48	2292.51
	Equity	153.72	154.19	155.82	158.09	621.81
	Loan	625.85	651.53	672.70	690.81	2640.90
	Sum	1329.58	1370.04	1409.22	1446.38	5555.22
	Annual forecast					5555.22
	Growth (annum)					15%
Africa*	Bond	128.67	90.67	51.53	20.03	290.90
	Equity	689.18	673.16	671.52	675.74	2709.60
	Loan	3024.99	3195.16	3336.46	3569.75	13 126.37
	Sum	3842.85	3959.00	4059.51	4265.51	16 126.88
	Annual forecast					16 126.88
	Growth (annum)					24%
	TOTAL	59 401.93	59 646.76	60 206.23	60 835.14	240 090.1
	Annual forecast					240 090.1
	Changes in annual flow					9.92%

Table 1. (Continued)

(d)		2003				Total
		I	II	III	IV	
Latin America	Bond	10 739.8872	10 797.8828	10 882.4547	10 965.7665	43 385.99
	Equity	1489.36	1503.72	1515.82	1528.00	6036.90
	Loan	12 126.37	12 199.96	12 287.22	12 380.00	48 993.56
	Sum	24 355.62	24 501.57	24 685.49	24 873.77	98 416.45
	Annual forecast					98 416.45
	Growth (annum)					1%
Asia	Bond	8343.96756	7946.23233	8576.00164	8475.51266	33 341.71
	Equity	9484.89	9627.45	9883.25	10 598.14	39 593.74
	Loan	12 421.56	11 999.58	12 154.81	12 129.82	48 705.77
	Sum	30 250.42	29 573.26	30 614.07	31 203.47	121 641.22
	Annual forecast					121 641.22
	Growth (annum)					4%
Eastern Europe*	Bond	145.13	146.05	147.03	147.93	586.14
	Equity	30.25	30.52	30.85	31.22	122.85
	Loan	730.72	746.62	764.75	783.38	3025.47
	Sum	906.11	923.19	942.63	962.54	3734.46
	Annual forecast					3734.46
	Growth (annum)					7%
Middle East	Bond	614.18	630.50	646.33	661.59	2552.60
	Equity	160.70	163.49	166.38	169.28	659.85
	Loan	707.11	722.14	736.24	749.55	2915.04
	Sum	1481.98	1516.14	1548.94	1580.42	6127.49
	Annual forecast					6127.49
	Growth (annum)					10%
Africa*	Bond	0.98	–	–	–	0.98
	Equity	680.04	682.69	684.65	687.62	2735.01
	Loan	3754.50	3999.06	4250.58	4493.60	16 497.74
	Sum	4435.52	4681.76	4935.23	5181.22	19 233.73
	Annual forecast					19 233.73
	Growth (annum)					19%
	TOTAL	61 429.64	61 195.91	62 726.37	63 801.43	249 153.35
	Annual forecast					249 153.35
	Changes in annual flow					4%

* Capital flows to Eastern Europe and Africa are dominated by Russia and South Africa, respectively.

Inflows to Africa (heavily dominated by South Africa) grew rapidly in 2000 by 59% compared with 1999. This was due to over 300% growth in loan inflows despite drops in bond and equity flows. The level of inflow is projected to decline by about 5% during 2001, but growth is expected to pick up again in 2002–2003. South Africa has been experiencing a steady but increasing growth trend in capital inflows, and most of its domestic pull factors continue to look favourable over the next 3 years, which is forecast to generate a continuous inflow of capital to the country.

5. CAPITAL FLOW FORECASTS UNDER DIFFERENT SCENARIOS

Capital inflows to developing countries were forecast under two different types of low case scenarios: the 'partial derivative approach' and the 'integrated approach'. The partial derivative approach examines the capital flow forecasts under a negative shock to one global variable for 12 months while holding other global variables fixed. The second type of low case scenarios, the integrated approach, allows for the negative shock in one global variable to affect other global variables.

5.1. Partial derivative approach of low case scenario

In this exercise, we allowed for the negative shocks to one of the global variables to continue for 12 months, from July 2001 to June 2002. Negative shocks considered include (i) a rise in the US high-yield bond spread by 60 basis points; (ii) zero percentage growth in US industrial production; (iii) an increase of 30 basis points in the swap rate; (iv) a 2% rise in the US short-term interest rate; and (v) a combination of all of above. Except for the last scenario, each scenario was tested while holding all other global variables unchanged from the original scenario, thus conveying the idea of a partial derivative. The results of capital forecasts under low case scenarios, under the partial derivative approach, are compared with the original or baseline forecasts in Table 2.

Generally, shocks to global financial variables, including those to the US high-yield bond spread, swap rates and to US interest rates, caused a slight deviation of total capital flow forecasts from their original trends. However, flows soon began to revert to their original values. Although no countries reacted identically to the shocks, in the case of a 2% increase in the US short-term interest rate, the initial declines in capital inflows were mostly linked with decreases in the level of domestic credit, domestic industrial production, and stock prices. In particular, credit ratings declined for most of the developing countries under study. Movements in the level of domestic short-term interest rates showed mixed signals. A possible explanation for the recovery of capital inflows could be that countries experiencing higher domestic interest rates can attract foreign capital more easily. However, countries that experience lower interest rates are faced with lesser debt burden, which can spur domestic economic activity, leading to an improvement in credit ratings. These factors may then generate a resumed inflow of foreign capital, which leads to an accumulation of reserves, attracting further inflows.

However, in the case of shocks to global real factors, such as in the scenario with zero growth in US industrial production, the effects were quite different. Flows to most emerging markets dropped substantially, and continued to decline without signs of recovery, resulting as low as 10% less compared with the original scenario for Asia. The main reason for this appears to be due to the severe negative real impact on emerging markets which rely on the US (and developed countries in general) as a prime export destination. Also, developing countries import parts and intermediate goods from the US to produce final goods for re-export, and the activity of this sector would also be damaged by a marked slowdown in US activity, generating further negative multiplier effects.

The importance of the slowdown in the US economy to capital flows to developing countries may explain the slower than baseline forecast growth presented above for this year. In a companion paper (Mody *et al.*, 2001), where we examine flows based purely on their permanent and temporary

Table 2. Capital flow forecasts to emerging markets under partial derivative approach of low case scenario (% changes from baseline 1 scenario)

	Scenarios*	2001						2002					
		M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6
Latin America	hy+60bp	−0.38	−0.01	0.00	0.08	−0.03	−0.05	−0.07	−0.06	−0.02	−0.02	−0.02	−0.02
	ip flat	–	−4.00	−4.84	−6.39	−5.54	−4.88	−4.82	−5.09	−5.26	−5.45	−5.65	−5.84
	sw+30bp	0.16	−0.06	0.01	0.02	−0.01	−0.00	0.03	0.01	0.00	0.01	0.01	0.01
	u1+2%	−0.00	0.00	−0.59	−0.11	0.01	−0.04	−0.20	−0.08	0.04	−0.05	−0.07	−0.04
	combination	−2.42	−0.04	−0.57	0.54	−0.01	−0.11	−0.17	−0.17	−0.05	0.02	0.03	0.02
Asia	hy+60bp	−2.95	−2.79	−3.16	−3.28	−2.99	−3.31	−3.56	−3.53	−3.60	−3.69	−3.69	−3.70
	ip flat	–	1.87	−0.88	−2.71	−4.91	−6.40	−6.46	−7.93	−8.83	−9.62	−10.20	−10.40
	sw+30bp	−0.25	0.08	0.12	0.08	0.10	0.04	0.03	0.08	0.09	0.05	0.04	0.04
	u1+2%	0.79	0.99	0.16	0.45	0.23	0.19	−0.27	−0.09	0.10	−0.06	−0.05	−0.04
	combination	−3.43	0.51	−0.08	−1.40	0.50	−0.14	−1.04	−0.49	−0.48	−0.64	−0.52	−0.45
Eastern Europe (Former Soviet Union inlc.)	hy+60bp	41.05	13.79	−0.34	−2.58	−0.61	−0.67	−2.31	−1.85	−0.93	−0.55	−0.27	−0.11
	ip flat	–	−34.70	22.44	25.15	49.06	47.78	43.67	40.11	38.67	37.46	37.25	37.60
	sw+30bp	−2.53	−6.52	0.27	−0.77	0.11	−0.17	0.41	0.14	0.01	0.00	0.03	0.03
	u1+2%	−5.74	21.59	−18.80	11.82	5.34	7.09	4.84	4.88	2.05	−0.20	−1.79	−2.34
	combination	36.56	77.87	0.79	−6.03	−4.62	−2.78	−10.12	−7.36	−3.33	−1.09	0.42	1.20
Middle East	hy+60bp	0.12	−0.31	−0.09	−0.08	−0.08	−0.08	0.01	0.05	0.06	0.05	0.05	0.05
	ip flat	–	−9.87	−8.73	−7.39	−5.76	−7.22	−7.95	−8.01	−7.54	−7.20	−6.92	−6.66
	sw+30bp	−0.98	−0.01	0.16	0.10	−0.10	−0.04	0.03	0.06	0.05	0.04	0.04	0.04
	u1+2%	−5.94	4.48	0.03	0.64	−0.54	0.59	0.78	0.78	0.42	0.40	0.42	0.43
	combination	0.06	−2.42	−0.42	−0.42	−0.44	−0.31	0.35	0.74	0.80	0.76	0.77	0.78
Africa	hy+60bp	−0.15	0.08	−0.17	0.01	−0.20	−0.07	−0.06	−0.07	−0.05	−0.03	−0.04	−0.03
	ip flat	–	−9.76	−5.73	−6.76	−6.15	−6.76	−7.20	−7.73	−7.46	−7.78	−7.75	−7.70
	sw+30bp	0.22	−0.29	0.05	0.10	0.04	0.14	0.09	0.08	0.09	0.07	0.06	0.07
	u1+2%	2.75	0.43	−0.46	−0.18	−0.11	−0.09	−0.14	0.13	0.06	0.10	0.13	0.10
	combination	−0.99	0.81	−0.41	1.15	−1.03	0.05	−0.15	0.22	0.17	0.23	0.21	0.25

* Negative Scenarios include (i) 60 b.p. higher US high-yield bond spread, (ii) 0% growth in US Industrial Production, (iii) 30 b.p. higher US swap rates, (iv) 2% increase in the US short-term interest rate, and (v) combination of all of the above.

time-series properties, we do forecast a slowdown for this year that is likely to be more in line with the actual flows. Hence, for forecasting purposes, both types of models are likely to be relevant.

5.2. Integrated approach of low case scenario

Low case scenarios were tested this time allowing for the simultaneous interaction among global variables for the same 12-month period. The scenarios were as before, i.e. (i) a rise in the US high-yield bond spread by 60 basis points; (ii) an increase of 30 basis points in the US swap rate; and (iii) a 2% rise in the US short-term interest rate. Each of these shocks would affect the rest of the global variables, i.e. EMBI, US high-yield bond spread, US industrial production, US swap rate and US interest rates. Hence, three sets of newly integrated global factors were produced for the scenarios and used to forecast future capital inflows to the emerging markets.

The results of capital forecasts under low case scenarios, allowing for full feedback among the variables—which we term the integrated approach—are compared with the original or baseline forecasts in Table 3.

A shock to the US high-yield bond spread by 60 basis points led to relatively significant decreases in the EMBI and in US industrial production, and an increase in the US swap rate. US interest rates declined slightly. Although the EMBI is positively related to changes in the US high-yield bond spread, its correlation with the changes in the Nasdaqindex has increased significantly in recent years (International Monetary Fund, 2000). Hence, it may be possible for the EMBI to decline while the US high-yield bond index increases. An increase in the US swap rate of 30 basis points yielded only minor changes to the rest of the global variables, while a 2% increase in US short-term interest rates led to a hike in the EMBI as well as increases in high-yield and swap spreads and a decrease in US industrial production.

Capital flows to Latin America were most sensitive to US interest rates, and they declined by a maximum of U$600 mn per month, or U$3700 mn per year (about 8% of total flows to the region). Asia was also heavily affected by changes in the US interest rate, but was more susceptible to the shock in the US high-yield spread, as it resulted in a maximum 10.4% reduction of inflows to the region. Flows to Eastern Europe and the former Soviet Union countries were also significantly affected by the shock in US interest rates and in the US high-yield spread. However, flows to the Middle Eastern countries were mostly indifferent to the changes in global factors except for the shock in the US interest rate. Finally, a projection of flows to Africa, dominated by South Africa, was in general relatively unaffected by any of above scenarios.

The analysis of the partial derivative and integrated approaches thus reveals that shifts in financial variables, US interest rates and high-yield spreads, do have an important effect on capital flows but that effect is significant when real activity also changes course. Regional differences in these influences reflect, in part, the degree of integration of the specific developing countries with the rest of the world.

6. SUMMARY AND CONCLUSION

The full, dynamic interaction between global and domestic factors in driving capital flows to emerging markets is a highly complex one. In this paper, we have shown how an empirically tractable forecasting framework, underpinned by a logically consistent theoretical framework, may be employed, based on the distinction between 'push' and 'pull' determinants of capital flows. In particular, we have examined the determinants of foreign capital inflows to 32 developing countries and provided forecasts of capital inflows for 2001 through 2003, investigating the relationship between push and pull factors on three types of capital flows (bond, equity and syndicated loans) to developing countries, and providing forecasts of future flows based on this relationship.

We considered in our set of country-specific factors the consumer price index, the level of domestic credit, the short-term debt to reserves ratio, the level of industrial production, the domestic short-term

Table 3. Capital flow forecasts to emerging markets under integrated approach of the low case scenarios (% of changes)

	Scenarios*	2001						2002							2003			
		M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6	QIII	QIV	QI	QII	QIII	QIV
Latin America	sw + 30bp	−0.28	0.04	−0.32	−0.56	−0.48	−0.54	−0.69	−0.80	−0.88	−0.97	−1.03	−1.05	−0.84	−0.76	−0.85	−0.88	−0.81	−0.65
	hy + 60bp	−1.52	−0.70	−1.10	−1.17	−1.35	−1.48	−1.71	−1.81	−1.82	−1.87	−1.94	−2.01	−1.50	−1.63	−1.38	−1.20	−0.89	−0.48
	ul + 2%	0.54	0.34	−1.40	−2.84	−3.04	−4.01	−4.85	−5.27	−6.01	−7.03	−7.53	−8.00	−7.71	−6.47	−6.14	−5.00	−3.99	−2.73
Asia	sw + 30bp	−0.63	−8.68	2.69	−1.86	−2.43	−0.66	−3.09	0.58	−2.54	−3.65	1.80	−3.41	−1.94	−1.58	−1.28	−0.98	−0.91	−1.00
	hy + 60bp	−1.22	−10.4	0.57	−4.48	−4.40	−2.31	−5.60	−1.97	−4.73	−6.27	−0.80	−5.63	−2.44	−1.62	−1.56	−1.34	−1.13	−1.03
	ul + 2%	1.04	−6.50	2.53	−0.41	−3.10	−2.56	−3.68	0.01	−3.25	−4.00	1.52	−3.95	−5.05	−2.55	−2.09	−2.39	−2.51	−2.65
Eastern Europe	sw + 30bp	0.43	0.59	0.92	0.50	0.14	−0.54	−0.83	−1.10	−1.39	−1.34	−1.46	−1.54	0.15	1.08	0.46	0.25	0.11	0.02
	hy + 60bp	−9.74	−7.24	−3.49	−5.96	−8.94	−10.9	−9.87	−9.66	−9.75	−9.57	−9.86	−10.1	−4.79	−2.01	0.85	2.16	3.06	3.71
	ul + 2%	2.31	5.24	11.0	1.39	−6.56	−1.33	−7.02	−14.0	−14.4	−17.5	−22.4	−21.1	−25.6	−29.6	−27.3	−22.3	−19.3	−16.6
Middle East	sw + 30bp	−0.80	−0.87	−0.61	−0.54	−0.79	−0.90	−0.80	−0.65	−0.52	−0.43	−0.33	−0.21	−0.65	0.17	−0.15	−0.20	−0.17	−0.08
	hy + 60bp	0.00	−0.01	−0.03	−0.03	−0.03	−0.03	−0.02	−0.02	−0.01	−0.01	−0.01	−0.01	1.07	3.33	2.38	0.65	−0.60	−1.22
	ul + 2%	−7.29	−3.46	−6.84	−6.11	−6.13	−5.82	−5.55	−5.13	−4.76	−4.08	−3.23	−2.31	7.21	7.02	6.84	5.68	4.31	3.52
Africa	sw + 30bp	0.25	0.02	0.28	0.20	0.10	0.04	−0.02	−0.09	−0.18	−0.32	−0.44	−0.55	−0.28	−0.21	−0.13	−0.09	−0.08	−0.06
	hy + 60	−0.55	0.91	0.13	−0.23	−0.89	−1.01	−0.59	−0.29	−0.19	−0.03	0.04	0.17	–	–	–	–	–	–
	ul + 2%	3.15	3.29	4.92	2.68	2.16	1.99	1.79	2.05	2.12	2.04	2.24	2.34	–	–	–	–	–	–

* Negative scenarios include (i) 60 b.p. higher US high-yield bond spread, (ii) 30 b.p. higher US swap rates, and (iii) 2% increase in the US short-term interest rate.

interest rate, credit rating, the reserves to import ratio and the level of the domestic stock market index. Global or 'push' factors taken into account in the model included global factors such as the strength of US output growth, US short-term and long-term interest rates, the Emerging Markets Bond Index (EMBI), the US swap rate and the US high-yield spread (as proxies for a measure of risk aversion). The forecasting model uses a dynamic vector error correction framework. The technique allows for causal interactions between capital inflows and domestic factors that influence such inflows. Global factors are forecast independently and their evolution influences capital flows into a country but the capital flows of an individual country are not allowed to influence the forecast of the global factors. Variance decomposition analysis suggested that domestic, or 'pull' factors were relatively more dominant in the determination of capital flows for the countries examined.

We also provided forecasts of capital flows to developing countries projected under different low case scenarios, both from a partial derivative approach and from an integrated approach. Under the partial derivative approach, shocks to global financial variables, including the US high-yield, swap rate and US interest rates, caused an immediate drop in inflows, but flows begin to recover after 6–8 months and to resume the original trend. Under the shock to global real factors, such as in the scenario with zero growth in US industrial production, the flows to emerging markets dropped substantially, and continued to decline without any signs of recovery. For the integrated low case scenario approach, changes in both US interest rates and US high-yield spreads had significant effects on capital flows to most emerging markets. However, these were mediated through significant shifts in US real activity.

In our discussion of the empirical framework, we discussed the importance of distinguishing between temporary and permanent components of capital flows and their underlying determinants. This suggests that there may be additional scope to providing accurate capital flow forecasts by applying time series models based on the distinction between the permanent and temporary components of a time series. This is issue is examined in a companion paper (Mody *et al*., 2001).

Moreover, while we have looked at the overall level of flows to a particular emerging market in the present analysis, we have not examined whether supply and demand for capital are being equated or not at any point in time. This is because we have been exclusively interested in forecasting. In fact, the issue of the supply and demand for capital cuts across the distinction between 'push' and 'pull' factors since, for example, the supply of capital may be determined by both push factors and pull factors. Once we begin to think about the supply of and demand for capital separately, rather than the total level of flows more generally, we can then begin to analyse the issue of whether countries are in any way capital-constrained at any point in time – i.e. cases where demand outstrips supply and there is a 'capital crunch'. One would expect the same sets of variables to be employed in an empirical analysis of this issue, but within a framework capable of answering fundamentally different questions from those posed in the present paper. Such an analysis is in fact the focus of further research by two of the present authors (Mody and Taylor, 2001).[3]

ACKNOWLEDGEMENTS

This paper was prepared for the World Bank's *Global Development Finance* report, and was supported by the Bank's Research Committee. However, the views expressed here should not be attributed either to the World Bank or to the International Monetary Fund. Kim was at the University of Warwick when this research was completed.

APPENDIX A

All data were obtained from the World Bank data bank. Table 4 lists the original source in each case.

Table 4. Data description

Variables	Units	Periodicity	Source	Series (ticker symbol)
International reserves	US$ million	Monthly	IFS	.1..DZF
Consumer Price Index	–	Monthly	IFS	64...ZF
Claims on private sector	Local currency million	Monthly	IFS	22D..ZF
Discount/Bank rate (end of period)	–	Monthly	IFS	60...ZF
Deposit rate (period average)	–	Monthly	IFS	60L..ZF
Imports, C.I.F	US$ million	Monthly	IFS	71..DZF
US industrial production index, seasonally adjusted (1995 = 100)	–	Monthly	IFS	66..IZF
US Generic government yields (1-year)		Monthly	Bloomberg Data service	USGG12M ⟨Index⟩
US Generic government yields (10-year)		Monthly	Bloomberg Data service	USGG10YR ⟨Index⟩
EMBI Sovereign spreads	100 basis points	Monthly	Bloomberg Data service	JPSSPRD ⟨Index⟩
US swap spreads	100 basis points	Monthly	Bloomberg Data service	USSP10 ⟨Index⟩
Gross loan flows	US$ million	Monthly	Euromoney loanware	
Gross bond flows	US$ million	Monthly	Euromoney bondware	
Gross equity flows	US$ million	Monthly	Euromoney bondware	
Short-term debt	US$ million	Quarterly	BIS	Table 9A
Local stock market index	Local currency	Monthly	Datastream	
Industrial production index, seasonally adjusted (1997 = 100)	Local currency	Monthly	DECPG GEP database	
IIR credit ratings	–	Semi-annual	Institutional investor	(Mar. & Sept. issues)

NOTES

1. For recent econometric studies of capital flows to emerging markets, see Taylor and Sarno (1997), and Sarno and Taylor (1999a,b).
2. Detailed results of the variance decomposition analysis are available on request.
3. Mody and Taylor (2001) argue that capital rationing may apply at the international level in the same way that credit rationing may apply at the national level (see e.g. Stiglitz and Weiss, 1981).

REFERENCES

Daveri F. 1995. Costs of entry and exit from financial markets and capital flows to developing countries. *World Development* **23**: 1375–1385.

Engle RF, Granger CWJ. 1987. Co-integration and error correction representation, estimation, and testing. *Econometrica* **55**: 251–276.

Fernandez-Arias E, Montiel PJ. 1996. The surge in capital inflows to developing countries: An analytical overview. *World Bank Economic Review* **10**: 51–77.

Granger CWJ. 1983. Co-integrated variables and error correcting models. *Mimeo*, University of California, San Diego.

International Monetary Fund. 2000. *International Capital Markets: Developments, Prospects, and Policy Issues*. International Monetary Fund: Washington, DC.

Mody A, Taylor MP, Kim JY. 2001. Forecasting capital flows to emerging markets: A time-series Kalman-filtering approach. In *Mimeo*. World Bank: Washington, DC.

Mody A, Taylor MP. 2001. Modelling international capital crunches. *Mimeo*, World Bank.

Sarno L, Taylor MP. 1999a. Hot money, accounting labels, and the persistence of capital flows to developing countries: An empirical investigation. *Journal of Development Economics* **59**: 337–364.
Sarno L, Taylor MP. 1999b. Moral hazard, asset price bubbles, capital flows and the East Asian crisis: The first tests. *Journal of International Money and Finance* **18**: 637–657.
Taylor MP, Sarno L. 1997. Capital flows to developing countries: Long- and short-term determinants. *World Bank Economic Review* **11**: 451–470.
Stiglitz JE, Weiss A. 1981. Credit ratings in markets with imperfect information. *American Economic Review* **9**: 109–129.
World Bank. 1997. *The Road to Financial Integration: Private Capital Flows to Developing Countries*. World Bank: Washington, DC.

