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Volatility of capital flows and financial liberalization: Do specific flows respond differently?

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ABSTRACT

This paper examines the volatility of capital flows following the liberalization of financial markets. Utilizing a panel data set of overlapping data, the paper focuses on the response of foreign direct investment, portfolio flows, and other debt flows to financial liberalization. The financial liberalization variable comes from the chronology and index developed by Kaminsky and Schmukler [Kaminsky, G.L. and Schmukler, S.L., 2003, Short-run pain, long-run gain: The effects of financial liberalization, IMF Working Paper WP/03/34.]. Different types of capital flows are found to respond differently to financial liberalization. Surprisingly, portfolio flows appear to show little response to capital liberalization while foreign direct investment flows show significant increases in volatility, particularly for the emerging markets considered.

1. Introduction

International capital flows are often thought to play a destabilizing role in developing economies, especially in the case of financial crises precipitated by sudden reversals of capital flows. At the same time, capital inflows may provide much needed capital that contributes to economic growth and development. Thus, international capital flows are typically viewed through a dual lens of costs and benefits. Recently, researchers have begun examining different types of capital flows in order to weigh these benefits and costs in a more comprehensive manner. A general empirical regularity arising from this research is that direct investment flows tend to be more stable than other forms of capital flows such as portfolio debt and equity flows. For example, Lipsey (1999, 2001) argues that direct investment has consistently been more stable during times of financial crisis relative to portfolio and other investment flows. Similarly, Albuquerque (2003) shows a large number of countries for which the variation in net foreign direct investment (FDI) inflows is smaller than that of other net inflows. Wei (2001) also finds that FDI is less volatile than international bank loans.[1]

In the ongoing discussions of the development and openness of financial markets, concern has arisen regarding the stability of capital flows and whether financial liberalization leads to greater volatility. This paper takes a closer look at the variation in capital flows and the linkages to financial liberalization. In particular, we examine the volatility of foreign direct investment (FDI), portfolio equity and debt, and other investment flows to gauge whether and how volatility is affected by financial liberalization. Rather than focusing on crisis periods or countries that are prone to crisis, we take a broader view to link financial liberalization to capital inflows for a set of 22 developing and developed economies utilizing a balanced panel data set of overlapping data from 1981–2000. As our

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[1] For additional evidence of the resilience of direct investment during crisis periods, also see Chuhan, Perez-Quiros, and Popper (1996), Frankel and Rose (1996) and Sarno and Taylor (1999). For an alternative view, see Claessens, Dooley, and Warner (1995) who show that different types of short-term versus long-term capital flows may exhibit similar time-series properties.

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measure of financial liberalization we use the index created by Kaminsky and Schmukler (2003), which captures liberalization of the domestic financial sector, openness of the capital account, and liberalization of equity markets. The underlying premise is that direct investment flows are likely to show less variation in the face of financial liberalization than other capital flows. Foreign direct investment arguably may be less susceptible to sudden reversals due to its longer-term, concentrated ownership nature.[2]

This paper fits into a broad set of literature pertaining to financial development and economic growth. Generally, financial development and economic growth are shown to be positively correlated, although there are mixed results as to causality.[3] Recent focus has shifted to examine how financial development may influence the volatility of various variables. A few recent papers attempt to address the question of volatility by focusing on the variability of consumption growth and/or output growth in relationship to financial market liberalization. Bekaert, Harvey, and Lundblad (2006) examine consumption growth volatility in response to equity market liberalization and capital account openness, controlling for a wide range of variables typically included in growth regressions. They show lower consumption growth volatility associated with financial liberalization.[4] Financial liberalization has also been linked to variability in equity markets. For example, Kaminsky and Schmukler (2003) analyze both short- and long-run effects of stock-market cycles following liberalization, with a finding of short-run increases in boom-bust cycles and long-run increases in market stability.

Our paper builds on this literature to examine how financial liberalization may impact the capital flows themselves, focusing on three primary forms of international capital flows: FDI, portfolio flows, and other investment flows. Utilizing the chronology and index of financial liberalization developed by Kaminsky and Schmukler (2003), this paper asks how the volatilities of specific capital inflows relative to GDP respond to liberalization. The basic regression uses the standard deviation of capital flows relative to GDP as the dependent variable. The benchmark explanatory variables consist of domestic growth, an index of world interest rates, an index of world growth, and the liberalization index. We then consider alternative definitions of capital flows and a broader set of control variables that may affect the volatility of capital flows. Notably, however, there is little agreement in the literature as to the relevant set of variables to include. This is in contrast to the literature on the level of capital flows, where important determinants include institutional quality, levels of economic development, and default history (see for example Prasad, Rajan, & Subramanian, 2007, and Reinhart & Rogoff, 2004). The control variables that we utilize are similar to those used in studies on the level of capital flows but are modified to address the volatility of such flows.

The question considered in this paper is most closely related to two recent studies, by Alfaro, Kalemli-Ozcan, and Volosovych (2007) and Broner and Rigobon (2004), both of which examine capital flow volatility over a single time period with a focus on the impact of institutional quality. Note that since we focus on volatility over five-year periods, we do not include institutional quality as these variables are typically slow to change. Further, the volatility measure we use here, the standard deviation of capital flows over rolling five-year periods, may highlight different aspects of capital movements than those examined by these previous studies. By contrast, Alfaro et al. (2007) calculate the standard deviation of capital flows over the period 1970–2000. Further, they focus exclusively on equity flows and emphasize the role that policy and institutions play in explaining the level and volatility of capital flows. Similarly, Broner and Rigobon (2004) measure capital flow volatility over the period 1990–2003. They compute volatility as the standard deviation of the residuals from a regression of a set of fundamental variables on capital flows, where capital flows are given by the capital account in the Balance of Payments. Comparing the standard deviation of the residuals across countries, they find that capital flows to emerging markets are 80% more volatile than those to mature markets.

Like Alfaro et al. (2007), Wei (2001, 2006) examines the role of institutions and argues that a country must cross a threshold level of appropriate institutions before it can benefit from financial globalization. He provides evidence of higher unconditional volatilities of international loans relative to FDI and relates these to differences in corruption and financial development. His regression analysis, however, focuses on the share of FDI or international bank loans relative to total foreign liabilities rather than on the volatilities of the different capital flows.

While Alfaro et al. focus primarily on the role of institutions, Broner and Rigobon provide some evidence on the role of financial development in capital flow volatility. However, their financial development indicator is specifically a domestic market measure and does not indicate international financial liberalization. Further, their measure of capital flows is a composite of all types of flows included in the capital account. Thus, Broner and Rigobon (2004) capture one aspect of capital liberalization (i.e., domestic market liberalization) but not the other aspects that we capture here by using the Kaminsky–Schmukler (2003) index. The Kaminsky–Schmukler index depicts the intensity of financial liberalization and is composed of components for liberalization of the capital account, the domestic financial system, and stock markets. Thus, the current study focuses on the volatility effects of a much broader measure of liberalization on the different capital flow components that make up the capital account.

[2] See Goldstein and Razin (2006) andAlbuquerque (2003) for models that explain the differences in volatility for FDI versus portfolio flows. Neither of these focus specifically on financial liberalization in explaining differential volatility. However, their emphasis on imperfect enforcement of financial contracts and inalienability of FDI (Albuquerque, 2003) and information differences leading to tradeoffs in management efficiency and control (Goldstein & Razin, 2006) may be related to financial liberalization. Also see Kaminsky (2006) for a summary of different models explaining currency crises, which provide additional theoretical motivation for international capital flows and the reversal of such flows. Note, however, that these crisis models are not directly applicable here since they do not focus on differential effects on capital flows. We take a reduced form approach here to empirically examine liberalization and differential effects on alternative types of capital flows.

[3] See Levine (2003, 2005) for a summary of studies connecting domestic financial development and economic growth. For studies on international financial liberalization and growth, see Bekaert, Harvey, and Lundblad (2005), and Edison, Levine, Ricci, and Sløk (2002). Eichengreen (2001) and Edison, Klein, Ricci, and Sløk (2002) survey the literature regarding the effects of capital account liberalization. Kose, Prasad, Rogoff, and Wei (2006) provide a recent summary of the existing empirical literature, arguing that the evidence linking international financial integration and economic growth is not robust. However, they also posit that the indirect benefits of integration may provide positive growth effects that require more refined estimation.

[4] Also see Kose et al. (2006) who provide summary evidence that reductions in consumption volatility may be less clear.

Table 1
Descriptive statistics (on five-year average flows and standard deviations).

		LIB	DIE	SDIE	PIL	SPIL	OIL	SOIL
Mature	Average	2.479	1.490	0.897	2.772	1.906	3.921	2.760
	Number of observations	448	396	396	396	396	396	396
	Correlation (lib and stdev)			0.262		0.192		0.104
	Correlation (flow and stdev)			0.885		0.694		0.700
	Correlation (lib and flow)			0.279		0.186		0.074
Emerging	Average	2.076	2.385	0.880	1.325	1.358	1.168	2.976
	Number of observations	319	269	269	220	220	265	265
	Correlation (lib and stdev)			0.469		0.261		0.084
	Correlation (flow and stdev)			0.284		0.519		−0.241
	Correlation (lib and flow)			0.410		0.351		−0.150

Notes: The averages reported are calculated over the five-year averages. The descriptive statistics calculated directly on the annual flows show similar relative sizes. Variable names: Lib is the liberalization index; average capital inflows and their corresponding average standard deviations are given by DIE (SDIE) — direct investment, PIL (SPIL) — portfolio flows, OIL (SOIL) — other flows.
Countries are initially classified according to their 1995 GNP per capita as defined in the 1997 World Development Indicators. Low income is $765 or less; lower middle income is $766–$3035; upper middle income is $3036–$9385; high income is $9,386 or more.
High income economies are then classified as Mature with all other economies classified as Emerging.
Mature: Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, Norway, Portugal, Spain, Sweden, UK, US Emerging: Argentina, Brazil, Chile, Colombia, Indonesia, Malaysia, Mexico, Peru, Philippines, Thailand, Venezuela

The general results of our regression analysis indicate that capital liberalization is associated with an increase in volatility for FDI flows for less developed economies. Other investment inflows (including general types of banking and other debt flows) show a mixed response with the potential for reductions in variability for the more developed markets. Portfolio capital flows, which consist of both portfolio equity and debt, tend to show insignificant responses for both the mature and emerging markets. Thus, our results provide some evidence in contrast to the general presupposition in that FDI flows tend to show a more volatile response to financial liberalization than portfolio flows.

The paper proceeds as follows. Section 2 describes the data and how the volatility measures are calculated. This section also contains initial summary statistics of the capital flow response for mature versus emerging economies. Section 3 delineates the empirical estimation technique while Section 4 presents the empirical results. Section 5 examines alternative measures of volatility and the relationship between the volatility and volume of capital flows. Section 6 briefly concludes and provides for some extensions.

2. Data and descriptive statistics

We initially utilize annual data from 1973–2000 on 26 countries, including 15 mature economies and 11 emerging markets. The set of countries chosen corresponds to those for which Kaminsky and Schmukler (2003) have computed a chronology of liberalization, leading to a new financial liberalization variable that captures the intensity of liberalization. This variable corresponds to liberalization of the capital account, the domestic financial system, and stock markets. For each component, a value of 1 indicates no liberalization, 2 indicates partial liberalization, and 3 indicates full liberalization. The components are then averaged to obtain the overall Financial Liberalization variable (also varying between 1 and 3). Given that capital flow data are only available annually, we average Kaminsky and Schmukler's monthly values over each year to get an annual value of the intensity of liberalization.[5]

We focus on three distinct private capital inflow variables relative to GDP: FDI, portfolio investment that includes both equity and debt (bond) investments, and other inflows that include bank loans and other short-term debt. To generate volatility measures of capital flows, we compute standard deviations of each capital flow relative to GDP over five-year overlapping periods. We also calculate average flows over each five-year overlapping period. Each of the capital flow series comes from the International Monetary Fund's International Financial Statistics (IFS). In the regression analysis, we account for the moving average component introduced by the overlapping data and utilize heteroskedastic-consistent standard errors following the procedure in Bekaert et al. (2006). We employ a range of control variables that may affect the variability of capital flows, including the growth of output in the domestic economy, worldwide growth, and an international interest rate.

To obtain a general idea of the size and volatility of capital flows, Table 1 presents basic statistics. We classify countries following Demirguc-Kunt and Levine (1999), who use 1995 GNP per capita and the following World Bank categories: High, Upper Middle, Lower Middle, and Low. High income economies are then classified as mature while the other categories are all classified as emerging. This provides the same classification as in Kaminsky and Schmukler (2003) for all countries except Korea, which we classify as mature (as do Demirguc-Kunt & Levine, 1999). Thus, the mature countries consist of: Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, Norway, Portugal, Spain, Sweden, United Kingdom, and United States. The emerging markets include: Argentina, Brazil, Chile, Colombia, Indonesia, Malaysia, Mexico, Peru, Philippines, Thailand, and Venezuela.

[5] See Kaminsky and Schmukler (2003) for the chronology of financial liberalization that went into forming the liberalization index and a discussion of alternative indexes. The index is available at http://www.worldbank.org/research/bios/schmuklerpdfs/financial_liberalization_index.xls. Note that in the figures in their paper, Kaminsky and Schmukler (2003) use one to indicate full liberalization and three to indicate full repression of the financial system. The available index, however, reverses these. We exclude Taiwan and Hong Kong from their list since capital flow data from the IFS are not available for these areas.

Table 1 depicts the three primary flow variables on which we focus, each calculated relative to GDP over five-year rolling periods. The specific capital inflows investigated follow that in Edison and Levine et al. (2002). FDI into the economy is given by DIE (direct investment in the economy, IFS 78bed), inward portfolio investment is given by PIL (portfolio investment liabilities, IFS 78bgd), and other inward flows are given by OIL (other investment liabilities, IFS 78bid). We focus on inward capital flows because 1.) they have the most data coverage in the IFS and, 2.) inward flows (and the reversal of such flows) have generated the most concern in the past. Table 1 also shows the volatility of each flow variable respectively as SDIE, SPIL, and SOIL, where volatility is defined as the standard deviation over rolling five-year periods. For example, DIE 1981 is the average FDI relative to GDP over 1977–1981 while SDIE 1981 is the standard deviation of FDI relative to GDP over 1977–1981.

Inward FDI averages 1.49 for the mature economies and 2.39 for the emerging markets. These numbers are interpreted as inflows of 0.0149 and 0.0239% of GDP, respectively.[6] Average portfolio flows (other flows) are 2.77 (2.76) for the mature economies and 1.33 (1.17) for the emerging markets. The unconditional volatility of flows is generally as expected with FDI showing the lowest average standard deviation. For the mature economies, the standard deviation of FDI is 0.897, of portfolio flows is 1.96, and of other flows is 2.76. For the emerging markets, the standard deviation of FDI is 0.88, of portfolio flows is 1.36, and of other flows is 2.98. For both groupings, portfolio flows are more volatile than FDI but less volatile than other flows. Average FDI is higher for the emerging nations and shows a slightly lower standard deviation than for the developed economies in the sample. While average portfolio flows for the emerging nations are lower than for the mature economies, they also show less volatility. The volatility for other capital flows is somewhat higher for the emerging markets but the data also show much less reliance on these flows by emerging markets relative to mature markets.

To obtain a first look at the relationship between capital volatility and capital liberalization, Table 1 depicts three other measures: 1) the correlation between the liberalization variable and standard deviation, 2) the correlation between average flows and standard deviation, and 3) the correlation between average flows and the liberalization variable. The first measure provides an initial look at how financial liberalization, as captured by the Kaminsky–Schmukler index, is related to the volatility of flows. Generally, the correlation between capital liberalization and standard deviation is positive but low with values consistently below 0.5. The correlations are somewhat larger for emerging economies than for mature economies for both portfolio flows and direct investment. The correlation for other capital flows is small for both categories of countries.

The second and third measures are based on an argument that the development of financial markets is captured by increased capital flows. In fact, the amount of capital flows is often taken as a *de facto* measure of financial integration (see Prasad, Rogoff, Wei, & Kose, 2004, who summarize alternative measures used, such as the gross stocks of foreign assets and liabilities as a share of GDP as developed by Lane & Milesi-Ferretti, 2001). The general supposition is that greater flows lead to greater volatility. For the mature economies, the correlation between average flows and standard deviation for all three types of flows is positive and above 0.5. The correlations between average flows and volatility are smaller for the emerging markets, with only portfolio flows showing a correlation close to that for the mature markets. The correlation for other flows for emerging countries turns negative. Finally, the third measure examines whether liberalization and average capital flows are related and shows that the correlation is small (below 0.5 in all cases) across the different types of capital flows and the country groupings.

The descriptive statistics are admittedly general as they do not control for any other influences on capital flows to the countries in question. They are suggestive, however, of the differences in volatility across mature and emerging economies and across the different types of capital flows. Generally, it appears that emerging economies rely more heavily on direct investment flows, which tend to be less volatile than portfolio flows but may respond more strongly to capital liberalization. The developed economies in the sample tend to rely more on other capital flows compared to direct and portfolio investment. These also tend to show the highest volatility but have little correlation with the liberalization of flows.[7] Using these average statistics as a guide, capital liberalization appears to have little association with average capital flow volatility. We explore this further in the next three sections.

3. Empirical estimation technique

Regressions take the following general form:

$$\mathrm{Stdev}_{i,t+k,k} = \alpha + \beta_1 \mathrm{Lib}_{i,t+k,k} + \beta_2' Q_{i,t+k,k} + \upsilon_{i,t+k,k} \tag{1}$$

where Stdev_i is calculated as the standard deviation of each capital flow relative to GDP estimated over $k = 5$ year rolling windows. Lib_i is the financial liberalization variable from Kaminsky and Schmukler (2003), and is included as the average liberalization over

[6] The series are first calculated as the inward capital flow (in millions U.S. dollars) divided by GDP (in millions U.S. dollars calculated based on national currency GDP converted into dollars at the nominal exchange rate; both from the IFS) and multiplied by 100. Thus, each flow variable can be interpreted as the percentage relative to GDP that is then scaled by 100 for readability. Both the five-year rolling average and the five-year rolling standard deviation are then calculated on this percentage variable.

[7] These initial statistics are consistent with the empirical regularities noted in Albuquerque (2003) and Goldstein and Razin (2006) that the share of FDI in total capital inflows is larger for developing countries than for developed countries and that FDI tends to be less volatile than other investment flows. Wei (2006) reports similar measures for a larger set of countries and shows higher volatility for loans relative to GDP than for either FDI or portfolio flows relative to GDP. His measures show that portfolio flows have the lowest volatility when measured using standard deviations but show higher volatility than FDI when using the coefficient of variation, which is likely due to division by a small mean.

each five-year period.[8] Q_i consists of a set of control variables for each country that may influence the volatility of capital flows. While a number of papers examine determinants of the level of capital inflows, few studies have focused specifically on the determinants of the volatility of capital flows. Thus, we utilize a set of control variables that are consistent with those used in studies on the levels of capital flows and that we conjecture may influence the volatility of flows. The benchmark specification controls for changes in world real interest rates (proxied by the US real federal funds rate), changes in world output growth (proxied by the index of industrial production for the industrial countries), and changes in domestic output growth (given by growth in real GDP per capita for each economy). This choice of control variables is similar to that in Kaminsky and Schmukler (2003), who focus on stock-market cycles and financial liberalization. The initial specification of Q_i consists of the standard deviation of each control variable over the same five-year period as the dependent variable. For comparison, we also consider the five-year averages of each control variable. Section 5 examines additional determinants of capital flow volatility, indicating that the level of flows may by an important determinant of volatility.

The empirical analysis is accomplished using pooled data to construct a five-year rolling standard deviation series for each of the capital flow variables. We use a balanced pool that attempts to capture the broadest coverage of countries and years for each variable. This limits the years considered to 1981–2000 and reduces the countries to 22, consisting of 13 mature and 9 emerging markets.[9] The use of overlapping observations, while allowing us to obtain a larger sample from limited time-series data, creates a problem for inference. The observations are no longer independent due to the induced serial correlation between the observations. The result is biased standard errors and possibly incorrect inferences. The moving average component that has been introduced into the residuals must be accounted for during the estimation process in order to correct for this bias. We follow the procedure in Bekaert et al. (2006; hereafter BHL), who develop a Generalized Method of Moments (GMM) estimator to account for the serial correlation induced by overlapping observations within a cross-section time-series framework. The GMM estimator of BHL (2006) builds on the Hansen–Hodrick (1980) and Newey–West (1987) correction procedures, and has the added benefit of accounting for country-specific heteroskedasticity and seemingly unrelated regression effects.

BHL (2006) conduct two Monte-Carlo experiments to explore finite sample properties of the behavior of the t-statistics on their liberalization variable. Results from both experiments indicate that higher (absolute) critical values are required relative to the asymptotic normal distribution. A cutoff of 3 is suggested for a 5% test. The liberalization variable used by BHL is a strict [0, 1] indicator variable whereas our study incorporates a liberalization variable with a larger range of values. Nevertheless, with a more limited sample of data and until a more formal Monte-Carlo analysis can be conducted, we adopt this cutoff rule as a good standard for significance. Further estimation details are available from the authors.

4. Benchmark regression results

4.1. Capital flow volatility

Tables 2A–2C provide the basic volatility results for the countries, subdivided into mature and emerging countries. For each table, the dependent variable is the standard deviation of: direct investment (SDIE Table 2A), other investment liabilities (SOIL Table 2B), and portfolio investment liabilities (SPIL Table 2C). We present results with the liberalization variable only (column 1), with the standard deviation controls (column 2), with fixed effects (column 3), and with either a time trend or a dummy variable controlling for the 1997 Asian financial crisis (columns 4 and 5). We have explored a number of alternative specifications that examine the inclusion of the trend and the 1997 dummy together both with and without the standard deviation controls and fixed effects regressions without the additional controls.[10] These alternative specifications give similar results for the sign, magnitude, and significance of the variables compared to those presented here.

Consider first the results on FDI in Table 2A (for SDIE). The overall impact of financial liberalization appears to be insignificant for the mature markets. By contrast, for the emerging markets, liberalization is associated with increases in the volatility of FDI, and is significant when neither the trend nor 1997 dummy term is included. We explore this result further below with a variety of alternative specifications providing evidence suggestive of significant increases in volatility of FDI following liberalization for the emerging markets. Note that here, the inclusion of the 1997 dummy (which is significant), eliminates the significance of the liberalization variable. In other specifications, however, the inclusion of the 1997 dummy does not eliminate the significance of the liberalization variable. The fixed effects regression further supports this inference, and collectively the results provide some evidence that FDI for the emerging markets responds with an increase in volatility following capital liberalization.

Table 2B shows the results for SOIL, the category of other flows, which includes a broad range of other debt securities, including liabilities of the monetary authority, general government, banks, and other sectors. Here, financial liberalization is associated with a decline in capital flow volatility for the mature economies, with a significant coefficient when neither the trend nor 1997 dummy are included (neither of which is significant). This result is tempered somewhat by the fixed effects regression, which shows a positive, but insignificant, coefficient on LIBA. We explore these contrasting results further below. The emerging markets show a positive (but insignificant) coefficient on LIBA for SOIL. Again, there is some contrast in results in that once fixed effects are added, LIBA becomes significant.

Table 2C provides evidence on portfolio flows (SPIL). Portfolio flows are often argued to be a highly volatile form of capital. It

[8] An alternative specification using the beginning of period value for the liberalization variable provides strikingly similar results.

[9] To calculate the standard deviation for the first year in the sample (1981), we need data starting in 1977. Thus, Mexico, Indonesia, and Denmark drop out of the sample due to missing data on capital flows prior to 1981. We also drop Canada from the sample since it shows no variation in the liberalization variable.

[10] Controlling individual time effects using time dummies for each period is not feasible due to the inclusion of cross-section-invariant control variables in the regressions.

Table 2A
Volatility regressions for LIBA (balanced sample 1981–2000).

SDIE (relative to GDP)										
	Mature markets					Emerging markets				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Constant	−0.1403 (−0.990)	0.7618 (2.606)		0.5126 (0.872)	0.7445 (1.288)	−0.3883 (−2.094)	0.9884 (3.002)		1.0494 (2.348)	0.7417 (2.939)
LIBA	0.1467 (2.713)	0.1080 (1.577)	0.1699 (2.202)	0.0106 (0.072)	0.0646 (0.442)	0.5483 (6.140)	0.3578 (3.635)	0.3834 (3.116)	0.2838 (1.466)	0.1151 (1.436)
FEDRSTDEV		−0.0982 (−1.872)	−0.0930 (−2.126)	−0.0419 (−0.429)	−0.0952 (−1.035)		−0.1572 (−2.957)	−0.1720 (−2.793)	−0.1631 (−1.691)	−0.1283 (−2.784)
INDGRSTDEV		−0.1861 (−2.611)	−0.2258 (−3.832)	−0.1255 (−0.971)	−0.1487 (−1.138)		−0.2341 (−2.971)	−0.2780 (−3.141)	−0.2380 (−2.045)	−0.0843 (−1.208)
GRGDPSTDEV		0.0078 (0.254)	−0.0081 (−0.279)	−0.0055 (−0.095)	−0.0070 (−0.120)		−0.0405 (−2.007)	−0.0339 (−1.108)	−0.0360 (−1.398)	−0.0227 (−1.490)
TREND				0.0313 (1.545)					0.0154 (0.591)	
1997 DUMMY					0.3022 (1.339)					0.8171 (7.144)

Notes: *t*-statistics are in parentheses. Based on Monte-Carlo simulation by Bekaert et al. (2006), a *t*-stat of greater than 3 is needed for 5% significance. All regressions are pooled regressions. Standard errors have been corrected for cross-sectional heteroskedasticity and account for overlapping observations using the Newey–West procedure. Fixed effects are included in column (3). The 1997 dummy includes all observations incorporating year 1997.
Mature markets include Finland, France, Germany, Ireland, Italy, Japan, Korea, Norway, Portugal, Spain, Sweden, United Kingdom and United States. (number of observations equals 260).
Emerging markets include Argentina, Brazil, Chile, Colombia, Malaysia, Peru, Philippines, Thailand and Venezuela. (number of observations equals 180).

Table 2B
Volatility regressions for LIBA (balanced pool 1981–2000).

SOIL (relative to GDP)										
	Mature markets					Emerging markets				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Constant	3.7109 (8.447)	4.8269 (10.178)		3.9555 (2.719)	3.8420 (1.555)	0.6683 (0.555)	−1.0821 (−0.579)		0.3896 (0.074)	−1.2592 (−0.635)
LIBA	−0.9098 (−5.859)	−0.7664 (−6.858)	0.0715 (0.448)	−0.5505 (−1.622)	−0.1342 (−0.214)	0.9277 (1.588)	0.7599 (1.262)	1.4989 (3.603)	1.1856 (0.635)	0.5731 (0.828)
FEDRSTDEV		−0.3540 (−3.974)	−0.1106 (−1.813)	−0.2234 (−0.862)	−0.2876 (−0.746)		−0.0743 (−0.258)	−0.0448 (−0.196)	−0.2595 (−0.236)	−0.0781 (−0.260)
INDGRSTDEV		−0.4542 (−3.754)	−0.3305 (−3.855)	−0.2999 (−0.852)	−0.3641 (−0.660)		0.4339 (1.065)	0.5493 (1.651)	0.2619 (0.191)	0.6442 (1.455)
GRGDPSTDEV		0.2101 (4.450)	0.1018 (2.210)	0.1074 (0.813)	0.1168 (0.485)		0.2966 (2.427)	0.6398 (5.055)	0.1710 (0.702)	0.2949 (2.297)
TREND				0.0371 (0.670)					−0.0936 (−0.326)	
1997 DUMMY					0.1340 (0.145)					0.8992 (1.095)

Notes: *t*-statistics are in parentheses. Based on Monte-Carlo simulation by Bekaert et al. (2006), a *t*-stat of greater than 3 is needed for 5% significance. All regressions are pooled regressions. Standard errors have been corrected for cross-sectional heteroskedasticity and account for overlapping observations using the Newey–West procedure. Fixed effects are included in column (3). The 1997 dummy includes all observations incorporating year 1997.
Mature markets include Finland, France, Germany, Ireland, Italy, Japan, Korea, Norway, Portugal, Spain, Sweden, United Kingdom and United States. (number of observations equals 260).
Emerging markets include Argentina, Brazil, Chile, Colombia, Peru, Philippines, Thailand and Venezuela. (number of observations equals 160).

Table 2C
Volatility regressions for LIBA (balanced pool 1981–2000).

SPIL (relative to GDP)										
	Mature markets					Emerging markets				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Constant	1.1954 (2.361)	1.3005 (1.422)		0.3762 (0.183)	1.1530 (0.522)	−1.4012 (−1.034)	−1.3851 (−1.021)		−1.6560 (−0.951)	−0.6282 (−0.537)
LIBA	−0.0616 (−0.333)	0.4861 (2.085)	0.4849 (1.831)	0.1767 (0.323)	0.4053 (0.719)	1.4368 (2.438)	0.6243 (1.699)	0.4723 (1.173)	1.1251 (1.758)	0.8027 (2.407)
FEDRSTDEV		−0.2900 (−1.884)	−0.2170 (−1.865)	−0.0964 (−0.281)	−0.2230 (−0.634)		−0.1084 (−0.476)	−0.1154 (−0.482)	−0.2688 (−0.762)	−0.1841 (−0.946)
INDGRSTDEV		−0.4205 (−2.063)	−0.3844 (−2.564)	−0.1814 (−0.402)	−0.3222 (−0.639)		0.4707 (1.399)	0.4843 (1.344)	0.3901 (0.869)	0.1323 (0.440)
GRGDPSTDEV		0.0994 (0.971)	0.0763 (0.871)	0.1046 (0.483)	0.0971 (0.436)		0.1586 (1.635)	0.1691 (1.372)	0.1861 (1.808)	0.1347 (1.487)
TREND				0.0921 (1.288)					−0.0442 (−0.485)	
1997 DUMMY					0.2868 (0.330)					−1.0266 (−1.844)

Notes: *t*-statistics are in parentheses. Based on Monte-Carlo simulation by Bekaert et al. (2006), a *t*-stat of greater than 3 is needed for 5% significance. All regressions are pooled regressions. Standard errors have been corrected for cross-sectional heteroskedasticity and account for overlapping observations using the Newey–West procedure. Fixed effects are included in column (3). The 1997 dummy includes all observations incorporating year 1997.
Mature markets include Finland, France, Germany, Ireland, Italy, Japan, Korea, Norway, Portugal, Spain, Sweden, United Kingdom and United States. (number of observations equals 260).
Emerging markets include Argentina, Malaysia and Thailand. (number of observations equals 60).

is interesting to note, then, that the coefficient on LIBA is positive but insignificant for both the mature and emerging markets in all specifications in Table 2C.

Generally, for the emerging markets, the coefficient on the liberalization variable is positive, indicating an increase in the standard deviation of each of the three capital flows. However, the significant impacts relate predominantly to FDI flows and not to the other two categories of flows. Based on data availability, however, the countries included in each set of regressions vary across the three dependent variables. There are 9 emerging markets included in the direct investment regressions, 8 included in the other investment liability regressions (Malaysia drops out of the sample due to missing data), and 3 included in the portfolio regressions (due to limited availability of data on portfolio flows). The sample of mature economies, however, consists of the same 13 countries in each balanced pool. For these countries, direct investment and portfolio flows appear to respond very little to capital liberalization as the coefficient on LIBA is small, positive, and insignificant in each specification. Other investment flows tend to show a strong negative significant response such that liberalization is associated with reductions in volatility, although the results here are mixed once the fixed effects are considered.

4.2. Control variables

The control variables vary in their statistical significance but are generally of the same sign and size throughout the various regressions. The chosen variables in this basic regression pick up some of the primary factors that drive capital flows and are similar to those in Kaminsky and Schmukler (2003). The world interest rate and industrial production growth rate can be considered 'push' factors while the domestic growth rate is a 'pull' factor. A number of previous studies have considered the forces that drive capital flows (see, for example, Montiel & Reinhart, 1999, for a discussion of the various 'push' and 'pull' factors). We consider a similar set of factors as being relevant for driving changes in capital flows (for example, Fernandez-Arias, 1996, finds that changes in international interest rates explain a large portion of surges in capital inflows). We acknowledge that institutional quality may also affect the volume and volatility of capital flows into a country. The papers by Alfaro et al. (2007) and Broner and Rigobon (2004) each include a measure of institutional quality in their capital flow volatility regressions, which are calculated over the span of their data. We do not include a specific institutional quality variable here because institutions are unlikely to change quickly, and thus show little variation over each rolling five-year period.

World interest rates are proxied by the real federal funds rate. Increases in the variability of the world interest rate (FEDRSTDEV) are associated with decreased variability in capital flows in any of the three forms. The change in world output growth is given by the standard deviation of industrial growth (INDGRSTDEV), calculated on the index of industrial production for the industrial countries (IFS 11066.IZF). The regression results generally show a reduction in variability in each capital flow for the mature economies (with significance or borderline significance in a number of cases). As industrial production becomes more variable in the industrial countries (i.e., for the mature economies at the same time), the capital flows into the mature economies become less variable. For the emerging economies, portfolio and other flows both increase in variability with the world growth variability (although the coefficient is insignificant) while direct investment flows decrease in variability (the coefficient is significant in the basic regression and when fixed effects are included).

The final control variable utilizes real GDP per capita for each economy to measure domestic growth (the variable used is the growth rate of real GDP using a chained real GDP calculation from the Penn World Tables, Heston, Summers, & Aten, 2002). The variable included in the basic regression is the standard deviation of real domestic growth over each five-year overlapping period (GRGDPSTDEV). While the results are mixed, the response to more variability in domestic growth is generally an increase in the variability of other flows for both mature and emerging markets. There is only a small response for the variability of both direct investment and portfolio flows, and in many cases the coefficient on domestic growth is insignificant.

As an alternative specification, we examine a different set of control variables based on the five-year averages, rather than the standard deviations, of the federal funds rate, industrial production, and domestic real GDP (see Appendix Tables 1A–1C). There are some notable differences across the two specifications. For both the mature and emerging markets, the coefficient on LIBA is now significantly positive for SDIE and remains so with fixed effects included. The coefficient becomes insignificant for mature markets once either the trend or the 1997 dummy is included (the trend/dummy terms are generally significant). For the emerging markets, however, the coefficient remains significant and positive with the trend/dummy included. Thus, this alternative set of controls further indicates that FDI for the emerging markets may become more volatile with financial liberalization. Also note that the coefficient for the emerging markets is larger than that for the mature markets.

The other primary difference with the alternative set of controls is that the coefficient on LIBA becomes insignificant in all specifications for the other capital flows (SOIL). By contrast to the previous results, this indicates that capital liberalization may not reduce the volatility of these other capital flows. More importantly, the differences in results across the two specifications call for further exploration of the choice of control variables and the general determinants of capital flow volatility. It is interesting to note, however, that the results for portfolio flows (SPIL) remain the same with an insignificant coefficient on LIBA for the emerging markets when either set of controls is included. The mature markets show a positive coefficient on LIBA that is significant with fixed effects included.

In a regression similar to those considered in this paper, Broner and Rigobon (2004) regress capital flow volatility (calculated as the standard deviation of capital flows between 1990 and 2003) on country characteristics consisting of per capita GDP, financial development (measured as private domestic credit to GDP or liquid liabilities to GDP in 1989), and institutional quality (measured using indicators from the International Country Risk Guide, as in Alfaro et al., 2007). Generally, they find that higher per capita GDP, greater financial development, and higher institutional quality provide for less volatile capital flows. The type and number of

Table 3A
SDIE — liberalization components.

	DFSA	DFSA	KAA	KAA
Constant	1.6393 (5.804)	0.6973 (2.135)	1.3155 (5.277)	0.8104 (2.479)
DFSA or KAA	0.0428 (0.620)	0.1019 (1.378)	0.3402 (4.067)	0.2450 (2.137)
FEDRSTDEV	−0.1414 (−2.804)	−0.1270 (−2.070)	−0.2161 (−3.602)	−0.1558 (−2.080)
INDGRSTDEV	−0.3065 (−4.663)	−0.0911 (−0.995)	−0.2367 (−2.781)	−0.1128 (−1.013)
GRGDPSTDEV	−0.0314 (−1.597)	−0.0111 (−0.497)	−0.0635 (−2.959)	−0.0363 (−1.373)
1997DUMMY		0.8564 (5.817)		0.6018 (3.131)

Emerging markets include Argentina, Brazil, Chile, Colombia, Malaysia, Peru, Philippines, Thailand and Venezuela.
DFSA indicates domestic financial sector liberalization; KAA indicates capital account liberalization.

explanatory variables included in our basic regressions are similar to those in Broner and Rigobon (2004) who consider the inclusion of both the level and the standard deviation of each variable on the right hand side of their regressions. They find that each level variable is individually significant (and each is associated with lower capital flow volatility) but none are significant when included together in the same regression. Broner and Rigobon (2004) then add the standard deviation of each variable along with its level, without the other controls. The standard deviation and level of each variable are both significant but are again insignificant when the other controls are included. Our regressions are similar except that we include either the standard deviation or the average level of each explanatory variable but not both together.

Alfaro et al. (2007) provide initial results on equity flow variability using a range of control variables that are consistent with those typically used in standard growth regressions (and similar to those used by BHL, 2006, in their study on real variability). They focus on three primary determinants of the volatility of equity inflows, namely institutional quality, inflation volatility, and bank credit. Their additional controls include human capital, distance, capital controls, sovereign risk, corporate taxes, French legal origin, and British legal origin. Their measure of volatility differs considerably from the one used here. Rather than five-year rolling standard deviations, they calculate the standard deviation of inflows of equity per capita over the entire sample period (1970–2000). They also consider broad changes in the explanatory variables and their effect on the change in inflows of total equity, where the changes are calculated between two periods: 1970–1993 and 1994–2000.

In relation to the question considered in this paper, Alfaro et al.'s (2007) results on the capital control variable, as a proxy for capital liberalization, may be illuminating. Their capital control variable is a general index calculated as the average of four dummy variables using information in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Generally they find that decreasing capital controls leads to higher inflows of equity. In terms of volatility, they find that institutional quality significantly reduces the volatility of equity inflows but that this becomes insignificant when the capital controls variable is included. The capital controls index itself is not significant for volatility. Bank credit and inflation volatility both significantly increase the volatility of equity inflows. The bank credit variable can be interpreted as a measure of financial liberalization. That is, financial liberalization may lead to higher bank-intermediated capital flows and greater bank credit, which may allow sudden capital flow reversals. Alfaro et al.'s work thus provides an alternative view of capital flow volatility that focuses on total equity

Table 3B
SOIL — liberalization components.

	DFSA	DFSA	KAA	KAA
Constant	0.6326 (0.455)	−1.2997 (−0.565)	−0.6756 (−0.443)	−1.1130 (−0.508)
DFSA or KAA	0.1527 (0.442)	0.3348 (0.637)	0.7607 (1.404)	0.6169 (0.738)
FEDRSTDEV	−0.0656 (−0.297)	0.0350 (0.091)	−0.1680 (−0.526)	−0.1144 (−0.254)
INDGRSTDEV	0.1124 (0.372)	0.7055 (1.247)	0.5655 (1.244)	0.6825 (1.014)
GRGDPSTDEV	0.2425 (2.944)	0.2905 (1.938)	0.2276 (1.605)	0.2980 (1.541)
1997DUMMY		1.6523 (1.718)		0.9766 (0.799)

Emerging markets include Argentina, Brazil, Chile, Colombia, Peru, Philippines, Thailand and Venezuela.

Table 3C
SPIL — liberalization components.

	DFSA	DFSA	KAA	KAA
Constant	−0.1982 (−0.149)	−0.0660 (−0.038)	−1.2830 (−0.998)	−0.1985 (−0.208)
DFSA or KAA	0.3387 (1.085)	0.5261 (1.080)	0.7232 (1.732)	0.9074 (2.879)
FEDRSTDEV	−0.2009 (−0.788)	−0.1885 (−0.568)	−0.1683 (−0.744)	−0.3412 (−1.835)
INDGRSTDEV	0.2970 (0.763)	0.1016 (0.205)	0.4370 (1.315)	0.0276 (0.096)
GRGDPSTDEV	0.1138 (1.011)	0.1696 (1.214)	0.1573 (1.615)	0.1334 (1.584)
1997DUMMY		−0.9194 (−0.993)		−1.1528 (−2.211)

Emerging markets include Argentina, Malaysia and Thailand.

Table 4
Volatility regressions (balanced sample 1981–2000); (capital flow relative to POP).

	SDIE	SDIE fixed effects	SOIL	SOIL fixed effects	SPIL	SPIL fixed effects
Mature markets						
Constant	1.6976 (2.358)		4.6312 (3.103)		2.7881 (1.500)	
LIBA	0.2614 (1.482)	0.3514 (1.463)	0.5898 (1.578)	1.6258 (3.639)	1.1681 (2.465)	1.6576 (3.083)
FEDRSTDEV	−0.1835 (−1.544)	−0.1978 (−1.792)	−0.4338 (−1.860)	−0.2620 (−1.569)	−0.4884 (−1.615)	−0.3447 (−1.374)
INDGRSTDEV	−0.4769 (−2.957)	−0.5617 (−3.818)	−1.1175 (−3.461)	−0.8541 (−3.820)	−1.1328 (−2.799)	−0.9661 (−2.969)
GRGDPSTDEV	−0.0960 (−1.321)	−0.0992 (−1.454)	−0.0356 (−0.252)	0.1180 (1.214)	0.0525 (0.263)	0.0484 (0.269)
Emerging markets						
Constant	−0.2566 (−1.502)		−1.1147 (−1.700)		−1.1092 (−1.244)	
LIBA	0.2434 (4.890)	0.1309 (3.252)	0.5070 (2.368)	0.5462 (5.867)	0.3431 (1.432)	0.3384 (1.268)
FEDRSTDEV	−0.0146 (−0.563)	−0.0377 (−1.655)	0.0306 (0.318)	0.0145 (0.290)	0.0224 (0.160)	0.0020 (0.014)
INDGRSTDEV	−0.0193 (−0.527)	−0.0844 (−2.552)	0.1008 (0.762)	0.1015 (1.408)	0.1790 (0.876)	0.1476 (0.727)
GRGDPSTDEV	0.0027 (0.303)	−0.0109 (−0.962)	0.1036 (2.351)	0.1380 (5.139)	0.1017 (1.535)	0.0679 (0.894)

See notes for Tables 2A–2C.

flows. The mixed results on the bank credit variable and the capital controls variable provide further impetus for a closer look at the different forms of capital flows as considered here.

5. Alternative specifications

5.1. Liberalization components and emerging markets

As an attempt to say something more about the effect of international financial market liberalization, we examine the separate components of the liberalization index. Specifically, the components consist of the domestic financial sector (DFS), the capital account (KA), and the stock market (SM). These are then averaged together to get the full liberalization index. There is not enough variation in the separate components for estimation for the mature markets. Further, the stock-market component does not show enough variation on its own for the emerging markets. Thus, this section examines only the domestic financial sector and the capital account liberalization components for the emerging markets. Tables 3A–3C show the basic results using the average value of the liberalization component over each five-year window (denoted DFSA and KAA to match the previous liberalization variable, LIBA). Alternative specifications provide similar results.

The results indicate that it is international capital liberalization and not domestic market liberalization that is associated with higher volatility in direct investment for the emerging markets. The capital account liberalization variable (KAA) is positive and significant for variation in direct investment (SDIE). Including the 1997 dummy (which is significant) weakens this significance but the magnitude of the coefficient on KAA remains the same. KAA is insignificant for portfolio and other flows. Domestic financial liberalization (DFSA) is insignificant in all specifications.

5.2. Alternative measure of volatility

While it is common in the literature to measure capital flows relative to GDP, as an alternative standardization for our measure of the variability in capital flows, we define the capital flows as per capita measures rather than in relation to the size of the economy.[11] Thus, we calculate the dependent variable as the standard deviation of the relevant capital flow divided by population. One reason to consider this alternative variable is to eliminate the movements in GDP in driving the standard deviation of capital flows. The use of per capita values also allows us to compare our results more directly with those of Alfaro et al. (2007) who measure capital flows in per capita terms.

Table 4 presents the main results for flows relative to population (POP) and can be compared to the results in Tables 2A–2C for flows relative to GDP (results with the trend and 1997 dummy are similar and are thus not shown in the table). The results are generally similar for direct investment and portfolio flows. The coefficient on LIBA is positive and significant for the emerging markets using SDIE relative to either GDP or population. The coefficient remains insignificant for the mature economies. Thus, the emerging markets appear to show a general increase in the volatility of FDI related to financial liberalization.

The emerging markets continue to show little response in terms of portfolio flows. The coefficient on LIBA is insignificant for the emerging markets for portfolio flows relative to POP and to GDP and is robust to the inclusion of fixed effects. The mature economies now show a positive response in terms of portfolio flows relative to population, with some indication of significance when fixed effects are included.

[11] We have also explored using the coefficient of variation (i.e., standard deviation divided by mean capital flows). This coefficient, however, is not well behaved here as the mean may be negative and/or small. See Wei (2006) who argues that the coefficient of variation may not provide appropriate standardization due to these concerns.

Table 5
Volatility and Volume regressions for (balanced sample 1981–2000).

	SDIE	SDIE fixed effects	SOIL	SOIL fixed effects	SPIL	SPIL fixed effects
Mature markets (capital flow relative to GDP)						
Constant	0.0167 (0.192)		1.9838 (6.858)		0.1871 (0.551)	
LIBA	−0.0425 (−1.247)	−0.0735 (−2.065)	−0.5973 (−6.199)	0.6767 (5.121)	−0.0015 (−0.010)	−0.1938 (−0.695)
AVE(FLOW)	0.6642 (28.274)	0.8484 (30.848)	0.3799 (13.014)	0.2660 (7.511)	0.6837 (10.652)	0.6686 (8.630)
Mature markets (capital flow relative to POP)						
Constant	0.2518 (1.088)		1.3600 (2.925)		−0.1837 (−0.160)	
LIBA	−0.1924 (−2.092)	−0.5531 (−2.347)	−0.3236 (−1.920)	1.9096 (7.816)	0.1610 (0.354)	0.0097 (0.012)
AVE(FLOW)	0.8468 (42.422)	0.8869 (31.654)	0.4563 (19.911)	0.3870 (16.527)	0.7869 (12.416)	0.7837 (10.945)
Emerging markets (capital flow relative to GDP)						
Constant	−0.0164 (−0.086)		1.0076 (1.189)		−0.2284 (−0.251)	
LIBA	0.1172 (1.085)	0.0470 (0.428)	1.0976 (2.786)	1.5266 (2.924)	0.5966 (1.515)	0.4077 (1.524)
AVE(FLOW)	0.3395 (8.570)	0.4157 (8.319)	−0.2050 (−2.659)	−0.4668 (−4.444)	0.5379 (4.706)	0.5165 (5.754)
Emerging markets (capital flow relative to POP)						
Constant	−0.0893 (−0.860)		−0.5499 (−1.209)		−0.6696 (−2.158)	
LIBA	0.0787 (1.424)	0.0320 (1.211)	0.6447 (2.983)	0.3992 (4.781)	0.4359 (3.237)	0.0285 (0.442)
AVE(FLOW)	0.3484 (9.105)	0.4039 (12.621)	−0.4581 (−2.668)	−0.2494 (−2.691)	0.6380 (6.460)	0.7078 (5.556)

See notes for Tables 2A–2C.

The results are notably different for other capital flows. For the developed economies, when SOIL is measured relative to GDP, LIBA is negative and significant (tempered by a positive coefficient when fixed effects are included). When SOIL is measured relative to POP, the coefficient becomes positive (and significant with fixed effects). Thus, capital liberalization may not limit the volatility of these other flows, as was found relative to GDP. It is important to note that these others flows are a compilation of a mixture of types of flows (including longer-term debt, government, and monetary authority capital flows across borders), so that different aspects may be responding in the presence of the variety of controls considered here. For the emerging markets, the coefficient on LIBA for other flows is positive in each specification and is significant when fixed effects are included, thus providing some evidence of an increase in volatility for these other flows.

5.3. Relationship between the volatility and volume of capital

One final relationship that we explore is how the volume of capital flows may influence the volatility of flows. It is generally hypothesized that greater inflows of capital are accompanied by greater volatility of capital, and we saw this to some degree in the descriptive statistics in Section 2. Further, the volume of capital flows is often taken as a proxy for liberalization of flows (i.e., a *de facto* measure compared to the *de jure* measure given by the liberalization index). We explore this issue by including the volume of flows in place of the previous control variables. The volume of flows in each case is defined as the average over the same rolling five-year periods over which we calculate the standard deviation of flows. Thus, the results presented in Table 5 include AVEDIE, AVEOIL, and AVEPIL for the regressions on the standard deviations of direct investment, other investment, and portfolio investment, respectively. We continue to examine the relationship with capital liberalization so that LIBA is also included in these regressions. Thus, we do not proxy capital liberalization by the capital flows variable but include it as a potential determinant of capital flow volatility.[12] For consistency, we consider the dependent variable relative to GDP and relative to POP. The results presented in Table 5 include a constant, the liberalization variable, and the relevant capital flow. We also consider a fixed effects regression in each case. The inclusion of the trend term or the 1997 dummy have little effect on the relationship between average flows and the variability of flows and are thus not shown in the table.

As expected, the volume of capital flows and their standard deviation are generally positively related, with a highly significant coefficient on the average flow for both direct investment and portfolio flows for the mature and emerging countries.[13] This positive significant relationship also holds for other flows for the mature economies. The only exception is the emerging markets, which show a negative relationship between the average flows and the standard deviation for other investment flows. The coefficient, however, reveals only borderline significance in this case whereas it is highly significant in the cases where the

[12] Although the liberalization variable and capital flows are positively correlated, this correlation appears to be small, with a correlation below 0.5 for all types of capital flows (as reported in Table 1), thus reducing the risk of introducing multicollinearity. This approach is similar to that taken by Alfaro, et al. (2007) where they include capital flows as a control variable in addition to their variables of interest.

[13] These results are consistent with those on equity flows in Alfaro et al. (2007). For their primary regression on the volatility of flows, they normalize by mean gross flows, essentially calculating a coefficient of variation. In one set of regressions, however, they include equity inflows as an independent variable with standard deviation of equity flows relative to population as the dependent variable. In this case they find a highly significant positive coefficient on equity flows, thus indicating increases in volatility related to the volume of inflows as we find here. Note that we prefer to retain the capital flows as an explanatory variable rather than subsuming these effects into the dependent variable. Our measures also do not lend themselves to such normalization since the rolling five-year periods include some periods where mean flows are small or negative, leading to a coefficient of variation that is not well defined.

coefficient is positive. The fixed effects estimation provides a significant coefficient on the level of flows in one case, thus providing some evidence of a reduction in variability based on the size of flows for emerging markets.

The results are surprisingly consistent across the different specifications examined. Thus, the definition of volatility relative to GDP or relative to POP does not appear to affect the sign or significance of the volume of capital flows. There is some difference in magnitude, however, as the coefficient on the average flow is generally higher and more significant for volatility defined as a per capita value rather than defined relative to GDP. For direct investment (SDIE), the coefficient on average flows (AVEDIE) is higher for the mature economies than for the emerging economies. Thus, greater FDI flows to the mature economies are associated with larger increases in volatility than for the emerging markets. Portfolio flows (SPIL), on the other hand, appear to respond similarly to average flows (AVEPIL) across the mature and emerging economies.

In the majority of cases, the average capital flows subsume the effects from the liberalization variable. Generally, once we control for the volume of capital flows, liberalization, as measured here, has little additional effect. This is particularly true for direct investment and portfolio flows, with only one significant coefficient on LIBA (for portfolio flows on a per capita basis, although the result disappears once fixed effects are considered). Other flows show a significant coefficient on LIBA, and may switch signs, for the fixed effects regressions. For the emerging markets, LIBA is positive, with borderline significance that is strengthened by including fixed effects. For the mature markets, LIBA has a positive, significant coefficient in the fixed effects regressions but a negative coefficient using other controls.

6. Summary

This paper examines the volatility of capital flows following the liberalization of financial markets. Utilizing a panel data set of overlapping data from 1973–2000, the paper focuses on the response of foreign direct investment, portfolio flows, and other debt flows to financial liberalization. The financial liberalization variable employs the chronology and index developed by Kaminsky and Schmukler (2003). Diverse types of capital flows are found to respond differently to financial liberalization.

The results generally indicate that the standard deviations of FDI and portfolio flows increase as financial liberalization occurs. The coefficient on the financial liberalization variable, however, is significant in only a small number of cases. In particular, financial liberalization appears to have a significant positive effect on FDI inflows for the emerging markets, indicating increases in volatility associated with financial liberalization. Portfolio capital flows, consisting of both portfolio equity and debt, tend to show insignificant responses for the emerging markets across different specifications. The mature markets, on the other hand, show some increase in volatility of portfolio flows related to capital liberalization. Interestingly, the broad category of other capital inflows (including general types of banking and other debt flows) for mature markets may respond negatively to financial liberalization, indicating decreases in the volatility of capital flows. These other flows, however, are sensitive to the specification chosen, showing a positive coefficient on financial liberalization in a number of cases. For the emerging markets, other flows tend to show increases in volatility but with mixed significance depending on the specification.

The calculation of the variability of capital flows as per capita values as compared to values relative to GDP provide generally similar results, indicating that either specification may be used. More importantly, however, the amount of flows may indicate varying effects from financial liberalization. The volume of flows, which others have argued is a *de facto* measure for financial liberalization, indicates increased volatility from increased capital flows with larger increases in volatility for the mature economies compared to the emerging economies. The results indicate a need for additional research on the calculations of volatility and the types of financial liberalization as well as further consideration of the variables that are important for explaining the volatility versus the volume of flows. For example, there may be a combined effect from capital liberalization and institutional quality. Thus, countries with better domestic institutions may be able to take advantage of larger capital flows due to capital liberalization without facing adverse volatility effects. Finally, a larger set of emerging markets is needed to clarify the responses of portfolio flows to capital liberalization.

We focus here on capital flows since we are interested in how these flows fluctuate over the periods considered. This limits how we may divide up the flows, e.g., into portfolio flows versus direct investment flows. An alternative would be to consider debt flows versus equity flows, where equity flows may be more stable generally than debt flows. For example, using data on the stocks of debt and equity (as compiled by Lane & Milesi-Ferretti, 2006) may provide an alternative focus to consider how these stocks change over time and their volatility in the face of financial liberalization. We leave this for future work.

We take a reduced form approach that may be consistent with a number of alternative theories on different forms of international capital flows. For example, Goldstein and Razin (2006) develop a model to jointly explain FDI and foreign portfolio investment (FPI). To explain the smaller volatility of net FDI inflows and the greater reliance on FDI by developing economies, they develop a model embodying differences in ownership and control between FDI and FPI. Albuquerque (2003), on the other hand, models expropriation risk and the inalienability of FDI as an alternative explanation of differential volatility. Thus, additional theoretical research that links financial development to the explanations in these models may prove useful in explaining the volatility of capital flows.

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Appendix A

Table 1A
Volatility regressions for LIBA (with average controls); (balanced sample 1981–2000).

SDIE (relative to GDP)										
	Mature markets					Emerging markets				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Constant	− 0.1403	− 0.9942		− 1.0956	− 1.2344	− 0.3883	− 2.2435		− 1.7496	− 1.8255
	(− 0.9904)	(− 2.1017)		(− 1.7482)	(− 1.1690)	(− 2.0939)	(− 7.0842)		(− 4.9278)	(− 5.1616)
LIBA	0.1467	0.4676	0.5816	0.2311	0.6490	0.5483	0.9552	0.8118	0.7302	0.7580
	(2.7126)	(3.1654)	(4.6612)	(0.9560)	(1.9093)	(6.1396)	(8.9799)	(7.4430)	(4.1391)	(5.7947)
FEDRAVE		− 0.0370	− 0.0251	0.0255	− 0.0231		0.2060	0.0966	0.1581	0.2132
		(− 0.6594)	(− 0.7562)	(0.3211)	(− 0.1783)		(4.5915)	(2.0991)	(3.8003)	(5.0983)
INDGRAVE		0.0551	− 0.0067	0.0053	− 0.1568		0.2016	0.2106	0.1694	0.1379
		(0.6408)	(− 0.1219)	(0.0473)	(− 0.8178)		(4.2215)	(4.4546)	(3.4713)	(2.7031)
GRGDPAVE		0.1264	0.1533	0.1482	0.2396		0.0732	0.0083	0.0599	0.0903
		(2.1670)	(3.1004)	(2.0029)	(2.4335)		(3.9486)	(0.3204)	(3.2320)	(5.0646)
TREND				0.0592					0.0161	
				(2.4504)					(1.0863)	
1997					1.6473					0.3696
DUMMY					(3.3944)					(2.4489)

See notes to Table 2A.

Table 1B
Volatility regressions for LIBA (with average controls); (balanced pool 1981–2000).

SOIL (relative to GDP)										
	Mature markets					Emerging markets				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Constant	3.7109	1.7151		0.9768	0.2135	0.6683	− 0.7083		− 0.6706	− 0.2554
	(8.4473)	(1.5199)		(0.5148)	(0.0883)	(0.5554)	(− 0.3361)		(− 0.3690)	(− 0.0993)
LIBA	− 0.9098	− 0.0937	0.6171	− 0.1377	0.8961	0.9277	1.1792	0.7332	1.3455	1.0802
	(− 5.8593)	(− 0.2560)	(2.5172)	(− 0.1869)	(1.1646)	(1.5881)	(1.7190)	(1.9792)	(1.5566)	(1.4631)
FEDRAVE		− 0.0883	− 0.0201	0.0019	− 0.1044		0.4592	0.2515	0.4171	0.1469
		(− 0.7820)	(− 0.3581)	(0.0088)	(− 0.3588)		(1.4583)	(1.6703)	(1.7751)	(0.4764)
INDGRAVE		0.0390	− 0.0248	− 0.1372	− 0.5817		− 0.2270	− 0.3216	− 0.2357	0.1109
		(0.2285)	(− 0.2556)	(− 0.4408)	(− 1.3490)		(− 0.6695)	(− 1.9069)	(− 0.8887)	(0.3741)
GRGDPAVE		0.2168	0.0654	0.3825	0.7356		− 0.0086	− 0.1229	− 0.0240	− 0.0580
		(1.5775)	(0.6956)	(1.8325)	(3.2144)		(− 0.0649)	(− 1.5003)	(− 0.2243)	(− 0.5966)
TREND				0.0936					− 0.0366	
				(1.3897)					(− 0.4705)	
1997					2.1115					− 1.5564
DUMMY					(1.9568)					(− 1.6903)

See notes to Table 2B.

Table 1C
Volatility regressions for LIBA (with average controls); (balanced pool 1981–2000).

SPIL (relative to GDP)										
	Mature markets					Emerging markets				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Constant	1.1954	− 2.0537		− 2.2323	− 5.6829	− 1.4012	− 1.3302		− 1.8081	− 3.3150
	(2.3609)	(− 1.1984)		(− 0.8824)	(− 1.3210)	(− 1.0338)	(− 0.6943)		(− 0.4687)	(− 1.2404)
LIBA	− 0.0616	1.2833	1.5918	0.8234	2.2580	1.4368	1.2540	1.0555	1.3765	1.8604
	(− 0.3333)	(2.2568)	(3.4348)	(0.8341)	(1.6288)	(2.4382)	(2.3478)	(1.9347)	(0.9916)	(2.4129)
FEDRAVE		− 0.2186	− 0.1469	− 0.0653	− 0.0175		0.0525	0.3755	0.1735	0.1834
		(− 1.3316)	(− 1.3894)	(− 0.2378)	(− 0.0344)		(0.2042)	(1.3732)	(0.3691)	(0.5849)
INDGRAVE		− 0.0442	− 0.0892	− 0.2368	− 0.9098		− 0.0433	− 0.0286	− 0.1056	0.1796
		(− 0.1749)	(− 0.4808)	(− 0.6010)	(− 1.2080)		(− 0.1635)	(− 0.1104)	(− 0.2204)	(0.5000)
GRGDPAVE		0.3307	0.2179	0.4721	1.3780		0.0818	0.2939	0.1117	0.1058
		(1.5291)	(1.1845)	(1.5838)	(3.2629)		(0.7880)	(2.4020)	(0.6220)	(0.8799)
TREND				0.1066					− 0.0241	
				(1.2666)					(− 0.1808)	
1997					2.5635					− 1.3435
DUMMY					(1.3500)					(− 1.3046)

See notes to Table 2C.

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