Systemic Liquidity and the Composition of Foreign Investment: Theory and Empirical Evidence

Theory and Empirics

by

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December 2006

The key prediction of the model is that countries that have a high probability of an aggregate liquidity crisis will be the source of more FPI and less FDI. The intuition is that as the probability of an aggregate liquidity shock increases, agents know that they are more likely to need to sell the investment early, in which case, if they hold FDI, they will get a low price since buyers do not know whether they sell because of an individual liquidity need or because of adverse information on the productivity of the investment. As a result, the .attractiveness of FDI decreases, and the ratio of FPI to FDI increases

The Efficiency Advantage

“ Imagine a large company that has many relatively small shareholders.Then, each shareholder faces the following well-known free-rider problem:if the shareholder does something to improve the quality of management, then the benefits will be enjoyed by all shareholders. Unless the shareholder is altruistic, she will ignore this beneficial effect on other shareholders and so will under-invest in the activity of monitoring or improving management.” Oliver Hart.

The Disadvantage: A Premature Liquidation

However, when investors want to sell their investment prematurely, because of a liquidity shock,
they will get lower price if they are conceived
by the buyer to have more information.
Because, other investors know That the seller has information on the
Fundamentals and suspect
That the sales result from bad prospects of the project
Rather than liquidity shortage.

Liquidity Shocks and Resale Values

Three periods: 0, 1, 2; Project is initially sold in Period 0 and matures in Period 2.

$R = F(K)(1+\varepsilon)$ Production function

$cdf = G(\varepsilon), G(-1) = 0, G(+1) = 1, g(\varepsilon) = G'(\varepsilon)$ Distribution Function

$R = K(1+\varepsilon) - \frac{1}{2}AK^2$ Production Function: Special Form

In Period 1, after the realization of the productivity shock,
The manager observes the productivity parameter.
Thus, if the owner owns the asset as a Direct Investor, the chosen level of K is:

$$K^*(\varepsilon) = \frac{1+\varepsilon}{A}$$

Expected Return

$$E\left(\frac{(1+\varepsilon)(1+\varepsilon)}{A} - \frac{1}{2}A\left(\frac{1+\varepsilon}{A}\right)^2\right) = \frac{E(1+\varepsilon)^2}{2A}$$

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Portfolio Investor will instruct the manager to maximize the expected return, absent any information on the productivity parameter.

$$K = \frac{1}{A}$$

Expected return $$E\left(\frac{(1+\varepsilon)}{A} - \frac{1}{2A}\right) = \frac{E(1+2\varepsilon)}{2A}$$

Liquidity Shocks and Re-sales

Period-1Price is equal to the expected value of the asset from the buyer's viewpoint.

$threshold - \varepsilon = \underline{\varepsilon}_D$

Productivity level under which the direct owner Is selling with no liquidity shock

$probability = (1-\lambda)G(\underline{\varepsilon}_D)$

$$P_{1,D} = \frac{(1-\lambda)\int_{-1}^{\underline{\varepsilon}_D} \frac{(1+\varepsilon)^2}{2A} g(\varepsilon)d\varepsilon + \lambda \int_{-1}^{1} \frac{1+2\varepsilon}{2A} g(\varepsilon)d\varepsilon}{(1-\lambda)G(\underline{\varepsilon}_D) + \lambda}$$

$$P_{1,D} = \frac{(1+\underline{\varepsilon}_D)^2}{2A}$$

The owner sets the threshold so that she Is indifferent between the price paid by buyer And the return when continuing to hold the asset

If a Portfolio Investor sells the asset, everybody knows that it does so only because of the liquidity shock. Hence:

$$P_{1,P} = \int_{-1}^{-1} \frac{1+2\varepsilon}{2A} g(\varepsilon) d\varepsilon = \frac{1}{2A}$$

Since $\underline{\varepsilon}_D < 0 \Rightarrow P_{1,D} < \frac{1}{2A} = P_{1,P}$

Trade-off between Direct Investment and Portfolio Investment

Direct Investment

$$P_{1,D} = \frac{(1+\underline{\varepsilon}_D)^2}{2A}$$ ← Return when observing liquidity shock.

If investor does not observe liquidity shock:

$$return = \int_{-1}^{\underline{\varepsilon}_D} \frac{(1+\underline{\varepsilon}_D)^2}{2A} g(\varepsilon)d\varepsilon + \int_{\underline{\varepsilon}_D}^{1} \frac{(1+\varepsilon)^2}{2A} g(\varepsilon)d\varepsilon$$

Ex-Ante expected return on direct investment:

$$V_D = \lambda \frac{(1+\underline{\varepsilon}_D)^2}{2A} + (1-\lambda)\left(\int_{-1}^{\underline{\varepsilon}_D} \frac{(1+\underline{\varepsilon}_D)^2}{2A} g(\varepsilon)d\varepsilon + \int_{\underline{\varepsilon}_D}^{1} \frac{(1+\varepsilon)^2}{2A} g(\varepsilon)d\varepsilon \right)$$

Portfolio Investment

When a liquidity shock is observed, return is:

$$P_{1,P} = \frac{1}{2A}$$

When liquidity shock is not observed return is:

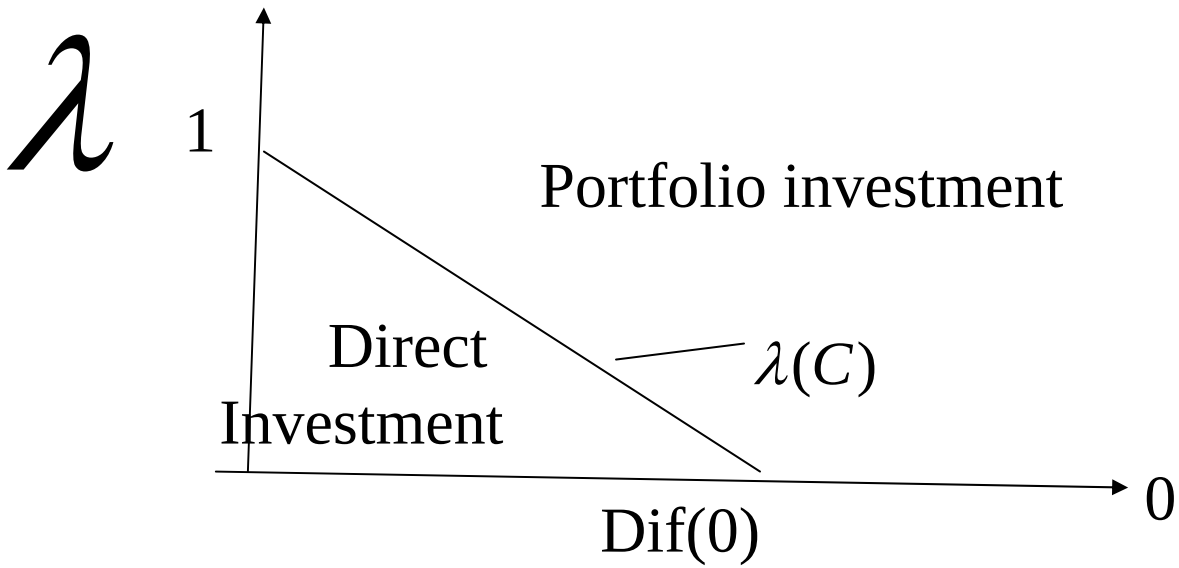
$$\frac{E(1 + 2\varepsilon)}{2A} = \frac{1}{2A}$$

Ex-ante expected return is:

$$V_P = \frac{1}{2A}$$

$$Dif(\lambda) \equiv V_D - V_P > C \Rightarrow$$ Firms sold to Direct Investor

$$Dif(\lambda) \equiv V_D - V_P < C \Rightarrow$$ Firms sold to Portfolio Investor



Probability of midstream sales

Direct Investment

Resale probability: $\lambda + (1-\lambda)G_{\underline{\varepsilon}_D}(\lambda)$

Portfolio Investment

Resale probability: λ

Only in a few cases, the probability
Of an early sale in an industry with
Direct investment is higher than for
An industry owned by portfolio investors.

Heterogeneous Investors

Different investors face a price which
Does not reflect their true liquidity-needs. This may generate
An incentive to signal the true parameter
By choosing a specific investment vehicle.

Suppose there is a continuum [0,1] of investors.
Proportion ½ of them have high
expected liquidity needs, λ_H, and proportion ½
have low expected liquidity needs, λ_L .

$$\lambda_H > \frac{1}{2} > \lambda_L$$

rational expectations equilibrium

Assuming that rational expectations hold in the market, λ_D has to be consistent with the equilibrium choice of investors between FDI and FPI. thus, it is given by the following equation:

$$\lambda_D = \frac{\lambda_H \lambda_{H,FDI} + \lambda_L \lambda_{L,FDI}}{\lambda_{H,FDI} + \lambda_{L,FDI}}$$

There are 4 potential equilibria:

1. All investors who acquire the firms are Direct Investors.
2. All investors who acquire the firms are Portfolio Investors.
3. λ_L investors who acquire the firms are Direct Investors, and λ_H investors who acquire the firms are Portfolio Investors.
4. λ_H investors who acquire the firms are Direct Investors, and λ_L investors who acquire the firms are Portfolio Investors.

All firms are acquired by Direct Investors

When investors resell, potential buyers assess a probability of ½ that the investor is selling because of liquidity needs, and a Probability of ½ that she is selling because she observed low productivity. Expected profits, ex-ante, for direct investors exceed expected profits for portfolio investors, for both high liquidity and low liquidity investors:

High-Liquidity -needs Investors:

$$(1-\lambda_H)\left(\frac{1+\underline{\varepsilon}_D(\frac{1}{2})}{2}\frac{(1+\underline{\varepsilon}_D(\frac{1}{2}))^2}{2A}+\frac{1}{2}\int_{\underline{\varepsilon}_D(\frac{1}{2})}^{1}\frac{(1+\varepsilon)^2}{2A}d\varepsilon\right)$$

$$+\lambda_H\frac{(1+\underline{\varepsilon}_D(\frac{1}{2}))^2}{2A}>$$

$$(1-\lambda_H)\left(\alpha\frac{1+\underline{\varepsilon}_P(\frac{1}{2})}{2}\frac{(1+\underline{\varepsilon}_P(\frac{1}{2}))^2}{2A}+\frac{1}{2}\int_{\underline{\varepsilon}_P(\frac{1}{2})}^{1}\frac{(1+\varepsilon)^2}{2A}d\varepsilon+(1-\alpha)\int_{-1}^{1}\frac{(1+2\varepsilon)}{2A}d\varepsilon\right)$$

$$+\lambda_H\frac{(1+\underline{\varepsilon}_P(\frac{1}{2}))^2}{2A}$$

Low-Liquidity-needs Investors:

$$(1-\lambda_L)\left(\frac{1+\underline{\varepsilon}_D(\frac{1}{2})}{2}\frac{(1+\underline{\varepsilon}_D(\frac{1}{2}))^2}{2A}+\frac{1}{2}\int_{\underline{\varepsilon}_D(\frac{1}{2})}^{1}\frac{(1+\varepsilon)^2}{2A}d\varepsilon\right)$$

$$+\lambda_L\frac{(1+\underline{\varepsilon}_D(\frac{1}{2}))^2}{2A}>$$

$$(1-\lambda_L)\left(\alpha\frac{1+\underline{\varepsilon}_P(\frac{1}{2})}{2}\frac{(1+\underline{\varepsilon}_P(\frac{1}{2}))^2}{2A}+\frac{1}{2}\int_{\underline{\varepsilon}_P(\frac{1}{2})}^{1}\frac{(1+\varepsilon)^2}{2A}d\varepsilon+(1-\alpha)\int_{-1}^{1}\frac{(1+2\varepsilon)}{2A}d\varepsilon\right)$$

$$+\lambda_L\frac{(1+\underline{\varepsilon}_P(\frac{1}{2}))^2}{2A}$$

The two conditions hold for some parameter values!

Interpretation

The reason for the existence of the pooled, only-FDI investment equilibrium is the strategic externalities between high-liquidity-need Investors.

An investor of this type benefits from having more investors of her type When attempting to resell, price does not move against her that much, because the “market” knows with high probability that the resale is due to liquidity needs.

When all high-liquidity -need investors acquire the firms, a single investor of this type knows that when resale contingency arises, price will be low, and she will choose to become a direct investor, self validating the behavior of investors of this type in the equilibrium. The low-liquidity-need Investors Care less about the resale contingency.

Interpretation

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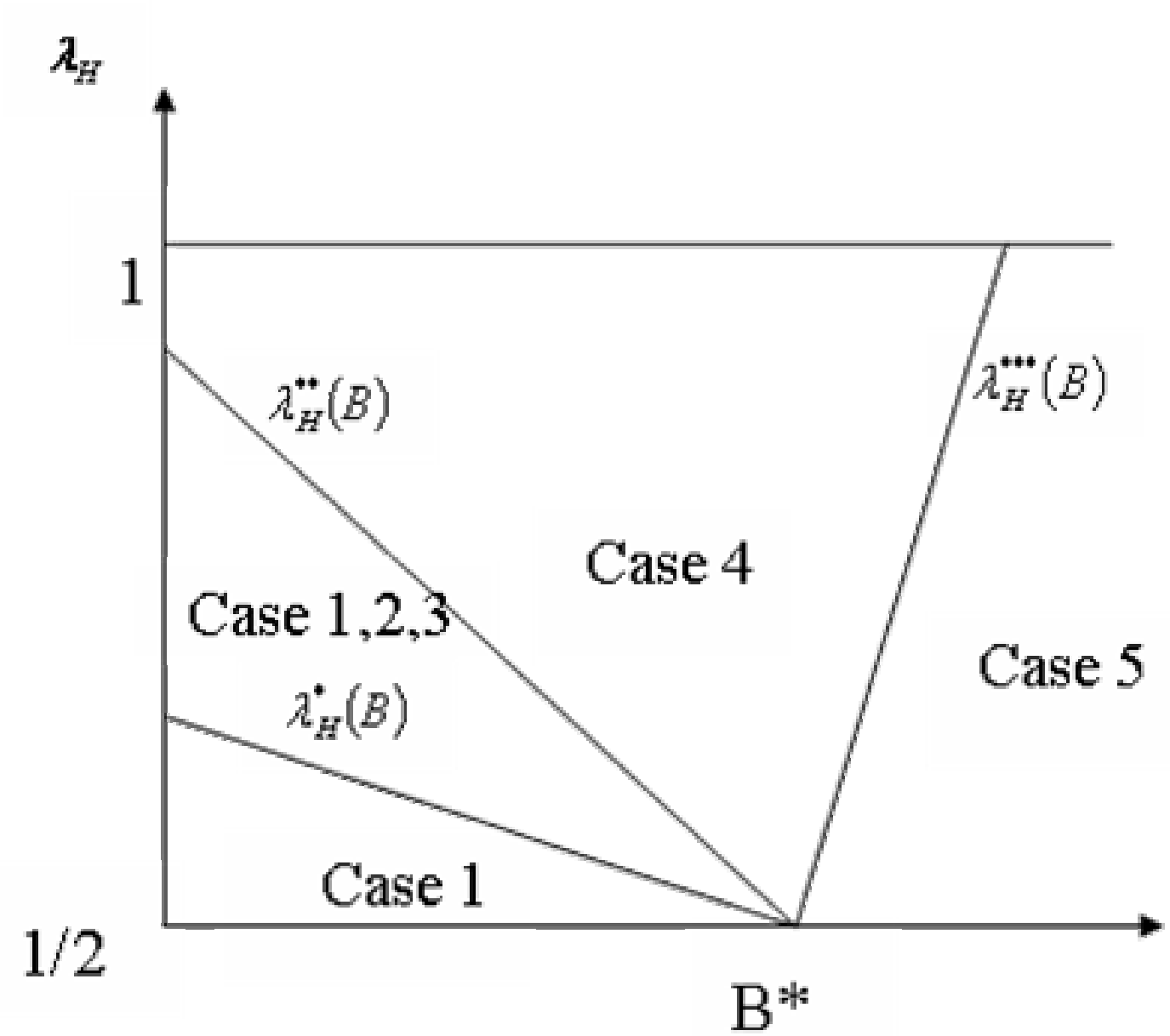
-need investors acquire the firms, a single investor of this type knows that when resale contingency arises, price will be low, and she will choose to become a direct investor, self validating the behavior of investors of this type in the equilibrium. The low-liquidity-need Investors Care less about the resale contingency.

Figure 2.1: The Allocation of investors between FDI and FPI


λ_H
1
$\lambda_H^{**}(B)$
$\lambda_H^{***}(B)$
Case 4
Case 1,2,3
Case 5
$\lambda_H^{*}(B)$
Case 1
1/2
B*

As we can see in the figure, the equilibrium patterns of investment are determined by the parameters A and λ_H.

Since $\lambda_H + \lambda_L + 1$, the value of λ_H also determines λ_L and thus can be interpreted as a measure for the difference in liquidity needs between the two types of investors.

In the figure we can see that there are four thresholds that are important for the characterization of the equilibrium outcomes.

Aggregate Liquidity Shocks

Suppose now that an aggregate liquidity shock occurs in period 1 with probability q. Once it occurs, it becomes common knowledge. Conditional on the realization of the aggregate liquidity shock, individual investors may be subject to a need to sell their investment at period 1 with probabilities as in the previous section. Conditional on the realization of an aggregate liquidity shock, the realizations of individual liquidity needs are independent of each other.

Aggregate Liquidity Shocks

There are two states of the world. In one state (which occurs with probability *q*) there is an aggregate shock that generates liquidity needs as described before. That is, in this state of the world a proportion of one type of investors have to liquidate their investment projects prematurely and a proportion of the other type have to do so as well. In the other state of the world (which occurs with probability *1-q*) there is no aggregate shock that generates liquidity needs and no foreign investor has to liquidate her investment project prematurely.

Interpretation

The idea that we are trying to capture with this specification is that individual investors are forced to sell their investments early at times when there are aggregate liquidity problems. In those times, some individual investors have deeper pockets than others, and thus are less exposed to the liquidity issues. Thus, once an aggregate liquidity shock occurs, λ_L investors, who have deeper pockets, are less likely to need to sell than λ_H investors.

If an aggregate liquidity shock does not occur, then it is known that no investor needs to sell in period 1 due to liquidity needs. This implies that the only reason to sell at that time is adverse information on the profitability of the project. As a result, the market breaks down due to the well-known lemons problem (see Akerlof (1970)). On the other hand, if a liquidity shock does happen, the expected payoffs from FDI and FPI are exactly the same as in case of idio-syncratic shocks section.

Aggregate and Idiosyncratic Shocks

- The model discussed in the preceding section assumed effectively that $q = 1$. We now extend the model to allow q to be anywhere between one and zero, inclusive. Figure 2.1 was drawn for the case $q = 1$. When q is below 1, the lines and shift upward; see Goldstein, Razin and Tong (2007). As expected, there is less FPI in each equilibrium and the number of configurations in which there is no FPI rises. In the extreme case where $q = 0$, no foreign investor will choose to make FPI, because there is no longer any liquidity cost associated with FDI, and there remains only the efficiency advantage of the latter .

- With the predicted probability of liquidity shocks, we can now estimate the regression equation. The results are presented in Table 3.3. Column (b) differs from column (a) in that it does not include the market capitalization variable, as the latter is not available in all of our observations. As our theory predicts, indeed a higher probability of an aggregate liquidity shock (the parameter q of the preceding chapter) increases the share of FPI, relative to FDI. The interaction term between the probability of an aggregate liquidity shock and GDP per capita is significant. This is indicative for a nonlinear effect of the aggregate liquidity shock and/or the GDP per capita on the ratio of FPI to FDI.

Data

- The theory is geared toward explaining the allocation of the shock of foreign capital between portfolio and direct foreign investors. Now we confront this hypothesis with the data. The latter consist of stocks of FPI and FDI in market value, that are compiled by Lane and Milesi-Ferretti (2006).See Summary Statistics.

Regression

$$\log(FPI / FDI) = \alpha + \beta X_{i,t} + \gamma \Pr ob_{i,t+1} + \delta Log(GDPpercapita) * \Pr ob_{i,t+1} + \varepsilon_{i,t}$$

The crux of our theory is that a higher probability of an aggregate liquidity shock (the variable q of the preceding chapter) increases the share of FPI, relative to FDI. Therefore we include in the regression a variable, Pi,t+1, to proxy this probability in period t+1, as perceived in period t.

We measure this probability by the probability of a 10% or more hike in the real interest rate in the next period.

We emphasize that we look at the probability of such a hike to occur irrespective of whether such a hike actually occurred.

We also include country and time fixed effect variables.

Probit

- To estimate the probability of a 10% or more hike of the real interest rate, we apply the following Probit model, similar to Razin and Rubinstein (2006).

$$I(AggregateLiquidityShock_{i,t+1}) = \begin{matrix} 1 \leftrightarrow y^*_{t+1} \geq 0 \\ 0 \leftrightarrow y^*_{t+1} \geq 0 \end{matrix}$$

$$y^*_{t+1} = \lambda Z_{i,t} + \upsilon_{i,t+1}$$

Table 1: Summary Statistics of ln(FPI/FDI) from 1990 –2004

Country Name	Obs	Mean	Country Name	Obs	Mean
United States	15	-0.56	Cambodia	8	-0.09
United Kingdom	15	-0.14	Taiwan Province of China	15	-1.14
Austria	15	-0.32	Hong Kong S.A.R. of China	15	-1.37
Belgium	15	-0.37	India	15	-0.67
Denmark	15	-0.69	Indonesia	4	-4.51
France	15	-1.57	Korea	15	-2.18
Germany	15	-0.28	Malaysia	15	-2.27
Italy	15	-0.40	Pakistan	3	-2.51
Luxembourg	5	-0.22	Philippines	15	-0.17
Netherlands	15	-0.58	Singapore	15	0.05
Norway	15	-0.88	Thailand	14	-3.66
Sweden	15	-1.11	Algeria	14	-7.45
Switzerland	15	-0.10	Botswana	11	-0.16
Canada	15	0.05	Congo, Republic of	10	0.30
Japan	15	-0.52	Benin	9	-3.63
Finland	15	-2.27	Gabon	7	-2.98
Greece	15	-0.62	Côte d'Ivoire	14	-1.07
Iceland	14	-0.24	Kenya	15	-3.48
Ireland	15	1.02	Libya	15	3.04
Malta	11	-1.39	Mali	8	-3.66
Portugal	15	-0.50	Mauritius	6	-1.38
Spain	15	-1.26	Niger	8	-5.38
Turkey	14	0.43	Rwanda	6	-0.33

Australia	15	-0.64	Senegal	15	-1.27
New Zealand	15	-0.72	Namibia	14	0.65
South Africa	15	-0.66	Swaziland	13	-3.94
Argentina	15	0.16	Togo	13	-1.95
Brazil	15	-2.91	Tunisia	15	2.08
Chile	15	-0.22	Burkina Faso	5	-2.04
Colombia	15	-0.91	Armenia	8	-1.58
Costa Rica	10	-1.04	Belarus	8	-1.13
Dominican Republic	9	-0.54	Kazakhstan	6	-0.28
El Salvador	4	0.58	Bulgaria	8	-0.52
Mexico	15	-0.40	Moldova	11	-3.99
Paraguay	15	-3.11	Russia	13	-4.70
Peru	15	0.73	China,P.R.: Mainland	15	-2.94
Uruguay	15	-0.22	Ukraine	9	-0.37
Venezuela, Rep. Bol.	15	-1.12	Czech Republic	12	0.33
Trinidad and Tobago	10	-2.32	Slovak Republic	12	1.22
Bahrain	15	0.60	Estonia	11	-2.00
Cyprus	6	0.04	Latvia	11	-1.20
Israel	15	-0.27	Hungary	14	-1.88
Jordan	8	1.79	Lithuania	12	-1.47
Lebanon	4	-0.06	Croatia	8	-3.11
Saudi Arabia	13	-0.89	Slovenia	11	-2.79
United Arab Emirates	15	5.66	Macedonia	7	2.01
Egypt	8	-0.16	Poland	7	-1.97
Bangladesh	5	-3.17	Romania	7	-2.86

Table 2. Determinants of FPI/FDI

	Case 1	Case 1	Case 2	Case 2	Case 3	Case 3	Case 4	Case 4	Case 5	Case 5
	Coef.	St. err.	Coef.	St. err.	Coef.	St. err.	Coef.	St. err.	Coef.	St. err.
ln(Population)	**-2.94**	**0.81**	-1.25	0.71	**-1.99**	**0.87**	**-3.79**	**0.95**	**-2.84**	**1.15**
ln(GDP per capita)	-0.20	0.38	-0.65	0.34	-0.59	0.40	**-0.94**	**0.42**	**-0.84**	**0.43**
ln(Market Capitalization)	0.05	0.04	**0.09**	**0.05**	0.08	0.05	0.07	0.04	**0.09**	**0.05**
ln(Trade openness)	**-0.89**	**0.24**	-0.38	0.23	**-0.56**	**0.26**	-0.45	0.25	**-1.10**	**0.28**
ln(M3/GDP)	**-0.49**	**0.19**			-0.27	0.22	**-0.62**	**0.19**	**-0.92**	**0.23**
Liquidity Shock			0.25	0.13	0.25	0.14				
Fixed exchange regime							**0.32**	**0.13**		
Control on FDI outflow									**0.51**	**0.19**
Observations	831		860		721		583		414	
R-squared (within)	0.10		0.10		0.10		0.17		0.24	

Note: Coefficients different from zero at 5% level are highlighted in bold. Year and country fixed effects are included though not reported.

Table 3: Determinants of FPI/FDI

Table 3: Determinants of FPI/FDI
(Distinguished by Country Type)

	Coef.	St. Err.	Coef.	St. Err.
ln(Population)	**-4.95**	**1.43**	1.60	1.36
ln(GDP per capita)	0.28	0.63	0.45	0.47
ln(Market Capitalization)	0.10	0.08	**0.14**	**0.05**
ln(Trade openness)	**-1.98**	**0.34**	-0.34	0.32
ln(M3/GDP)	**-0.76**	**0.31**	**-0.52**	**0.24**
Observations	279		552	
R-squared	0.37		0.12	

Note: Coefficients different from zero at 5% level are highlighted in bold. Year and country fixed effects are included though not reported.

Table 4a. Probit Estimation of Liquidity Shock

Table 4a. Probit Estimation of Liquidity Shock		
	Coef.	St Err.
ln(Population)	**-0.06**	**0.03**
ln(GDP per capita)	0.01	0.04
ln(M3/GDP)	**-0.58**	**0.08**
Bank liquid reserves/assets	**0.006**	**0.003**
US real interest rate	**0.08**	**0.03**
Fixed exchange regime	-0.06	0.12
Constant	1.10	0.66
Observations	1665	
R-squared	0.10	
Note: Coefficients different from zero at 5% level are highlighted in bold.		

Table 4b. Determinants of FPI/FDI
(With Predicted Liquidity Shock)

Table 4b. Determinants of FPI/FDI (With Predicted Liquidity Shock)				
	Case 1	Case 1	Case 2	Case 2
	Coef.	St. err.	Coef.	St. err.
ln(Population)	**-3.11**	**0.81**	**-3.16**	**0.80**
ln(GDFP per capita)	-0.25	0.38	-0.28	0.36
ln(Market Capitalization)	0.05	0.04	0.05	0.04
ln(Trade openness)	**-0.93**	**0.24**	**-0.95**	**0.24**
ln(M3/GDP)	-0.11	0.29		
Predicted liquidity shock	3.71	2.16	**4.31**	**1.39**
Observations	829		829	
R-squared (within)	0.11		0.11	

Results

Probit Estimation

We use pooled specification to predict the liquidity crisis, in that fixed-effect Probit regressions are not identified due to incidental parameters problem. Table 3 presents the Probit estimation for all countries from 1970 to 2004, subject to data availability. As we expected, higher US interest rate has a strong spillover effect on the domestic interest rate. Lower sovereign rating raises the chance of liquidity crisis, as risky countries need to raise interest rates to attract capital flows. Higher M3/GDP weakly reduces the likelihood of an aggregated shock, as abundant money supply tends to increase inflation rate while lowering the nominal interest rate. Since both sovereign rating and U.S. interest rate are significant in the Probit estimation, we can then identify the effect of liquidity shock on FPI/FDI through functional form as well as exclusion restrictions. According to Table 3, the predicted probability of liquidity crises in the sample lies between 0.003 and 0.38.

FDI/FPI Determination

With the predicted probability of liquidity crises, we can now estimate equation (15). We take the log of the FPI/FDI ratio as our dependent variable, to reduce the impact of extreme values.

Table 4: Case 1

Table 4 reports the results with country and time fixed effects. As our theory predicts, a higher probability of an aggregated liquidity shock significantly increases the share of FPI, relative to FDI. Moreover, stock market capitalization increases FPI, while trade openness complements FDI.

lagged FPI/FDI

One might be concerned that lagged FPI/FDI could also affect current FPI/FDI. Hence we estimate, alternatively, the following dynamic panel regression. we use the Arellano-Bond dynamic GMM approach to estimate equation (17), which corrects the endogeneity problem.

Case 2 in Table 4

Case 2 in Table 4 reports the dynamic panel estimation. Dynamic estimation reduces the sample size, but reassuringly, results from fixed effect estimation still carry through. We find that higher probability of aggregated liquidity shocks increases FPI relative to FDI. Stock market capitalization and trade openness keep their signs and significance level. We also find that the one-year lagged FPI/FDI ratio is associated with current FPI/FDI ratio. But the estimated coefficient of the lagged FPI/FDI is around 0.50, which suggests that there is no panel unit root process for FPI/FDI. Additional Arellano-Bond tests strongly reject the hypothesis of no first-order autocorrelation in residuals, but fail to reject the hypothesis of no second-order autocorrelation. Hence, the estimations in Table 4 are valid and provide strong empirical support for our theory.

Robustness Checks

We add dummies for semi decades into out Probit estimation for interest rate hike. This helps capture unobservable global factors that may affect interest rate hike. We find that explanatory variables maintain their signs and significances in the Probit model. Then we plug this newly estimated probability into the pure fixed effect FPI/FDI model as well as the dynamic one. We find that the estimated probability still has significant explanatory powers in both models. For example, in the dynamic model, it has an estimated coefficient of 2.97 and a p-value of 0.000. Note that we cannot include in the Probit model time effects for every year, which would then perfectly predict U.S. annual interest rate.

Alternative Indicator of Liquidity Crises

An alternative Indicator of Liquidity Crises: the depreciation of real exchange rate as an alternative measurement of liquidity crisis.

The depreciation shrinks the purchasing power of domestic currency and thus decreases the ability of domestic firms to invest abroad. We use the real exchange rate vs. U.S. dollar, instead of the trade-weighted real effective exchange rate. One can collect the data for the latter from the IMF's International Financial Statistics, but will miss quite a few countries such as Brazil and Thailand. That is why we use the real exchange rate vs. dollar. We define currency crisis as the depreciation of more than 15% a year. This amounts to top 5% of the depreciation. Table 5 presents the frequency of currency crisis for the period from 1970 to 2004.

We first apply Probit model to predict the one-year ahead currency crisis. Based on the literature on currency crisis, we use the following explanatory variables: country population size, GDP per capita, GDP growth rate, money stock, U.S. interest rate, trade openness, and foreign reserves over imports. We do not include Standard and Poor's country rating here, because it shrinks sample size while having no explanatory power on currency crisis. Table 6 reports the Probit estimation from 140 countries from 1970 to 2004. We can see that higher GDP per capita, higher economic growth, higher reserves over imports and trade openness all contribute to the reduction of currency crises. U.S. interest rate, on the contrary, significantly increases the likelihood of currency crises. All these are intuitive and consistent with previous literature.

Based on Table 6, we construct the probability of currency crisis, and then examine its impact on FPI/FDI for the period from 1990 to 2004. Results are reported in Table 7 . Note that Table 7 covers more countries than Table 4, in that we do not include S&P's country rating as an predictor of currency crises. Case 1 is for the pure fixed effect model. We see that the higher the probability of currency crisis, the higher the ratio of FPI relative to FDI. Case 2 is for the dynamic panel model. Again, we can see that the past movement of FPI/FDI explains the current variation of FPI/FDI. Higher GDP per capita (proxy for labor cost) and trade openness decrease the share of FPI relative to FDI. Our key variable, the probability of currency crisis, still explains the choice between FDI and FPI, consistent with our theory as well as earlier results in Table 4.

Both case1 and 2 include year dummies to capture unobservable global factors as well as potential global trends. In both cases, there seems to be a trend of growing FPI relative to FDI, judging from point estimates. The inclusion of year dummies, however, could potentially bias down our estimation, because they also capture global liquidity shock caused by higher U.S. interest rate. Hence, we use a time trend variable instead of year fixed effects in the dynamic model (Case 3). We can see that there is indeed a significant time trend. Moreover, the coefficient of crisis probability now rises to 5.8. This confirms our argument that time fixed effects bias down the effect of currency crisis.

Conclusion

Theory

In this paper, we examine how the liquidity shock guides international investors in choosing between FPI and FDI. According to Goldstein and Razin (2006), FDI investors control the management of the firms; whereas FPI investors delegate decisions to managers. Consequently, direct investors are more informed than portfolio investors about the prospect of projects. This information enables them to manage their projects more efficiently. However, if investors need to sell their investments before maturity because of liquidity shocks, the price they can get will be lower when buyers know that they have more information on investment projects. We extend the Goldstein and Razin (2006) model by making the assumption that liquidity shocks to individual investors are triggered by some aggregate liquidity shock. A key prediction then is that countries that have a high probability of an aggregate liquidity crisis will be the source of more FPI and less FDI.

To test this hypothesis, we therefore apply a dynamic panel model to examine the variation of FPI relative to FDI for 140 source countries from 1990 to 2004. We use real interest rate hikes as a proxy for liquidity crises. Using a Probit specification, we estimate the probability of liquidity crises for each country and in every year of our sample. Then, we test the effect of this probability on the ratio between FPI and FDI generated by the source country. We find strong support for our model: a higher probability of a liquidity crisis, measured by the probability of an interest rate hike, has a significant positive effect on the ratio between FDI and FPI. We repeat this analysis using real exchange rate depreciation as an alternative indicator of a liquidity crisis, and get similar results. Hence, liquidity shocks do have strong effects on the composition of foreign investment, as predicted by our model.

Table 1. Summary Statistics of FPI/FDI

Table 1 presents the average of the log of FPI stock over FDI stock for 140 source countries for the period from 1990 to 2004. Obs is the number of non-missing observations for each source country. Countries with no observations at all during this period are not reported. Source: Lane and Milesi-Ferretti (2006).

Country Name	Obs	Mean	Country Name	Obs	Mean
United States	15	-0.56	Cambodia	8	-0.09
United Kingdom	15	-0.14	Taiwan Province of China	15	-1.14
Austria	15	-0.32	Hong Kong S.A.R. of China	15	-1.37
Belgium	15	-0.37	India	15	-0.67
Denmark	15	-0.69	Indonesia	4	-4.51
France	15	-1.57	Korea	15	-2.18
Germany	15	-0.28	Malaysia	15	-2.27
Italy	15	-0.40	Pakistan	3	-2.51
Luxembourg	5	-0.22	Philippines	15	-0.17
Netherlands	15	-0.58	Singapore	15	0.05
Norway	15	-0.88	Thailand	14	-3.66
Sweden	15	-1.11	Algeria	14	-7.45
Switzerland	15	-0.10	Botswana	11	-0.16
Canada	15	0.05	Congo, Republic of	10	0.30
Japan	15	-0.52	Benin	9	-3.63
Finland	15	-2.27	Gabon	7	-2.98
Greece	15	-0.62	Côte d'Ivoire	14	-1.07
Iceland	14	-0.24	Kenya	15	-3.48
Ireland	15	1.02	Libya	15	3.04
Malta	11	-1.39	Mali	8	-3.66
Portugal	15	-0.50	Mauritius	6	-1.38
Spain	15	-1.26	Niger	8	-5.38
Turkey	14	0.43	Rwanda	6	-0.33
Australia	15	-0.64	Senegal	15	-1.27
New Zealand	15	-0.72	Namibia	14	0.65
South Africa	15	-0.66	Swaziland	13	-3.94
Argentina	15	0.16	Togo	13	-1.95
Brazil	15	-2.91	Tunisia	15	2.08
Chile	15	-0.22	Burkina Faso	5	-2.04
Colombia	15	-0.91	Armenia	8	-1.58
Costa Rica	10	-1.04	Belarus	8	-1.13
Dominican Republic	9	-0.54	Kazakhstan	6	-0.28
El Salvador	4	0.58	Bulgaria	8	-0.52
Mexico	15	-0.40	Moldova	11	-3.99
Paraguay	15	-3.11	Russia	13	-4.70
Peru	15	0.73	China,P.R.: Mainland	15	-2.94
Uruguay	15	-0.22	Ukraine	9	-0.37
Venezuela, Rep. Bol.	15	-1.12	Czech Republic	12	0.33
Trinidad and Tobago	10	-2.32	Slovak Republic	12	1.22
Bahrain	15	0.60	Estonia	11	-2.00
Cyprus	6	0.04	Latvia	11	-1.20
Israel	15	-0.27	Hungary	14	-1.88
Jordan	8	1.79	Lithuania	12	-1.47
Lebanon	4	-0.06	Croatia	8	-3.11
Saudi Arabia	13	-0.89	Slovenia	11	-2.79
United Arab Emirates	15	5.66	Macedonia	7	2.01
Egypt	8	-0.16	Poland	7	-1.97
Bangladesh	5	-3.17	Romania	7	-2.86

Table 2: Frequency of Liquidity Crises

Table 2 reports the number of liquidity crises for 140 countries over the period from 1970 to 2004. The crisis is defined as a real interest rate rise of more than 4% a year. Source: World Development Indicators

Country	Freq	Country	Freq	Country	Freq
Albania	3	Germany	0	Nigeria	15
Algeria	3	Ghana	5	Norway	3
Angola	5	Greece	5	Oman	7
Argentina	2	Guatemala	5	Pakistan	0
Armenia	2	Guinea	4	Panama	2
Australia	1	Haiti	2	Papua New Guinea	8
Austria	0	Honduras	3	Paraguay	6
Azerbaijan	1	Hong Kong S.A.R. of	3	Peru	3
Bahrain	5	Hungary	2	Philippines	4
Bangladesh	4	Iceland	4	Poland	1
Belarus	5	India	2	Portugal	3
Belgium	0	Indonesia	2	Qatar	0
Benin	4	Iran, Islamic Republic of	0	Romania	0
Bolivia	6	Ireland	2	Russia	3
Bosnia and Herzegovina	1	Israel	5	Rwanda	3
Botswana	7	Italy	2	Saudi Arabia	0
Brazil	1	Jamaica	7	Senegal	1
Brunei Darussalam	0	Japan	1	Singapore	3
Bulgaria	4	Jordan	3	Slovak Republic	2
Burkina Faso	5	Kazakhstan	0	Slovenia	3
Cambodia	3	Kenya	5	South Africa	4
Cameroon	5	Korea	2	Spain	2
Canada	0	Kuwait	9	Sri Lanka	4
Chad	11	Kyrgyz Republic	3	Sudan	0
Chile	7	Lao People's Dem.Rep	4	Swaziland	10
China,P.R.: Mainland	5	Latvia	0	Sweden	2
Colombia	4	Lebanon	3	Switzerland	0
Congo, Dem. Rep. of	5	Libya	0	Syrian Arab Republic	7
Congo, Republic of	9	Lithuania	4	Tajikistan	2
Costa Rica	6	Luxembourg	0	Tanzania	1
Côte d'Ivoire	4	Macedonia	2	Thailand	2
Croatia	3	Madagascar	3	Togo	4
Cyprus	1	Malawi	11	Trinidad and Tobago	8
Czech Republic	2	Malaysia	2	Tunisia	2
Denmark	0	Mali	1	Turkey	0
Dominican Republic	4	Malta	4	Turkmenistan	0
Ecuador	12	Mauritius	1	Uganda	8
Egypt	6	Mexico	2	Ukraine	6
El Salvador	2	Moldova	5	United Arab Emirates	3
Equatorial Guinea	6	Morocco	2	United Kingdom	2
Estonia	4	Mozambique	1	United States	0
Ethiopia	7	Myanmar	0	Uruguay	9
Euro Area	0	Namibia	3	Uzbekistan	0
Fiji	8	Nepal	3	Venezuela, Rep. Bol.	8
Finland	1	Netherlands	1	Vietnam	0
France	0	New Zealand	1	Yemen, Republic of	3
Gabon	10	Nicaragua	4	Zambia	12
Georgia	2	Niger	6	Zimbabwe	9

Table 3: Probit Estimation of Aggregate Liquidity Crises

Table 3 estimates the probability of liquidity crises for 140 countries over the period 1970-2004. The dependent variable is the dummy indicator of liquidity crises defined as a real interest rate rise of more than 4% a year. Sovereign rating is from Standard and Poor's, while all other variables are from the WDI. A pooled Probit regression is estimated. * indicates significance at 5%.

	Coef.	Std. Err.
Population (log)	-0.06	0.05
GDP per capita (log)	-0.03	0.10
M3/GDP (log)	-0.21	0.15
U.S. real interest rate	0.18*	0.05
Sovereign rating	-0.15*	0.07
Constant	0.50	1.33
R-square	0.09	
Observations	634	

Table 4: Determinants of the Ratio of FPI over FDI

The dependent variable is the log of FPI stock over FDI stock, for 140 source countries over the period from 1990 to 2004. The estimated probability of liquidity crisis is based on the estimates from Table 3. All other explanatory variables are from the WDI. Case 1 is the panel estimation with country and year fixed effects. Case 2 adds a one-year-lagged dependent variable as an explanatory variable, and estimates a dynamic panel model. * indicates significance at 5%.

	Case 1		**Case 2**	
	Coef	St. err.	Coef	St. err.
Log of FPI/FDI (one lag)			0.54*	0.04
Population (log)	-4.77*	0.98	-2.41*	0.87
GDP per capita (log)	0.29	0.38	-0.08	0.30
Stock market capitalization	0.34*	0.07	0.20*	0.06
Trade openness (log)	-0.98*	0.27	-0.61*	0.21
Probability of liquidity crisis	4.39*	1.08	3.28*	0.95
Observations	543		476	

Table 5: Frequency of Currency Crises

Table 5 reports the number of currency crises for 140 countries over the period from 1970 to 2004. The crisis is defined as a real exchange rate depreciation of more than 15% a year. Source: World Development Indicators.

Country	Freq	Country	Freq	Country	Freq
Albania	0	Ghana	7	Norway	0
Algeria	2	Greece	0	Oman	0
Angola	3	Guatemala	2	Pakistan	1
Argentina	5	Guinea	0	Panama	0
Armenia	0	Haiti	1	Papua New Guinea	1
Australia	0	Honduras	1	Paraguay	5
Austria	1	Hong Kong	0	Peru	2
Azerbaijan	0	Hungary	0	Philippines	1
Bahrain	0	Iceland	0	Poland	1
Bangladesh	0	India	1	Portugal	0
Belarus	3	Indonesia	3	Qatar	0
Belgium	1	Iran, Islamic Republic of	2	Romania	1
Benin	1	Ireland	1	Russia	2
Bolivia	2	Israel	0	Rwanda	1
Bosnia and Herzegovina	0	Italy	2	Saudi Arabia	0
Botswana	1	Jamaica	2	Senegal	2
Brazil	3	Japan	0	Singapore	0
Brunei Darussalam	0	Jordan	1	Slovak Republic	0
Bulgaria	3	Kazakhstan	1	Slovenia	0
Burkina Faso	3	Kenya	1	South Africa	2
Cambodia	0	Korea	1	Spain	2
Cameroon	2	Kuwait	1	Sri Lanka	2
Canada	0	Kyrgyz Republic	1	Sudan	4
Chad	1	Lao People's Dem.Rep	1	Swaziland	2
Chile	5	Latvia	0	Sweden	1
China,P.R.: Mainland	2	Lebanon	2	Switzerland	0
Colombia	0	Libya	0	Syrian Arab Republic	1
Congo, Dem. Rep. of	8	Lithuania	0	Tajikistan	0
Congo, Republic of	1	Luxembourg	1	Tanzania	3
Costa Rica	1	Macedonia	1	Thailand	1
Côte d'Ivoire	2	Madagascar	5	Togo	2
Croatia	0	Malawi	2	Trinidad and Tobago	1
Cyprus	0	Malaysia	1	Tunisia	0
Czech Republic	0	Mali	1	Turkey	3
Denmark	1	Malta	0	Turkmenistan	0
Dominican Republic	2	Mauritius	0	Uganda	7
Ecuador	2	Mexico	3	Ukraine	1
Egypt	4	Moldova	1	United Arab Emirates	0
El Salvador	1	Morocco	1	United Kingdom	0
Equatorial Guinea	1	Mozambique	3	United States	0
Estonia	0	Myanmar	0	Uruguay	4
Ethiopia	2	Namibia	0	Uzbekistan	0
Fiji	1	Nepal	1	Venezuela, Rep. Bol.	4
Finland	1	Netherlands	1	Vietnam	0
France	1	New Zealand	1	Yemen, Republic of	3
Gabon	3	Nicaragua	2	Yugoslavia	0
Georgia	1	Niger	2	Zambia	1
Germany	0	Nigeria	4	Zimbabwe	3

Table 6: Probit Estimation of Currency Crises

Table 6 estimates the probability of currency crises for 140 countries over the period 1970-2004. The dependent variable is the dummy indicator of currency crises defined as a real exchange rate depreciation of more than 15% a year. All explanatory variables are from the WDI. A pooled Probit regression is estimated. * indicates significance at 5%.

	Coef.	Std. Err.
Population (log)	0.00	0.03
GDP per capita (log)	-0.11*	0.03
M3/GDP (log)	-0.05	0.04
U.S. real interest rate	0.06*	0.02
Reserve over imports	-0.04*	0.02
GDP growth rate	-3.42*	0.80
Trade openness	-0.005*	0.002
Constant	-0.40	0.64
R-square	0.07	
Observations	2663	

Table 7: Determinants of the Ratio of FPI over FDI

The dependent variable is the log of FPI stock over FDI stock, for 140 source countries over the period from 1990 to 2004. The estimated probability of currency crises is based on the estimates from Table 6. All other explanatory variables are from the WDI. Case 1 is the panel estimation with country and year fixed effects. Case 2 adds a one-year-lagged dependent variable as an explanatory variable, and estimates a dynamic panel model. Case 3 replaces the year fixed effects in Case 2 with a time trend. Standard errors are in parentheses. * indicates significance at 5%.

	Case 1	**Case 2**	**Case 3**
Log of FPI/FDI (one lag)		0.74*	0.72*
		(0.03)	(0.03)
Population (log)	-0.50*	0.03	-0.29
	(0.94)	(0.84)	(0.84)
GDP per capita (log)	-0.07	-0.60*	-0.55
	(0.039	(0.30)	(0.30)
Stock market capitalization	0.07	-0.01	0.03
	(0.05)	(0.04)	(0.04)
Trade openness (log)	-0.93*	-0.39*	-0.41*
	(0.26)	(0.19)	(0.18)
Growth rate	4.32*	1.70	1.99*
	(11.49)	(1.08)	(0.92)
Time trend (t)			0.04*
			(0.02)
Probability of currency crisis	7.53*	4.77*	5.78*
	(3.41)	(2.41)	(1.83)
Observations	752	671	671