Systemic Liquidity Shocks and the Composition of Foreign Capital: Theory and Evidence (Rough Draft)

by

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1. Introduction

To be completed

2. The Model

In the Razin and Goldstein (2006) there was no aggregate uncertainty with respect to the liquidity shocks which were purely idiosyncratic. That is, λ_H and λ_L were not only the probabilities of experiencing a liquidity shock for the two types of foreign investors; but also exactly the proportions of the two types of investors who actually experience a liquidity shock.

In this section we allude briefly to the possibility that the liquidity shocks are not idiosyncratic. Specifically, suppose that 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 λ_H of one type of investors have to liquidate their investment projects prematurely and a proportion λ_L 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.

The model discussed in the preceding sections assumed that $q = 1$. In this section we essentially 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 $\lambda_H^*(B)$ and $\lambda_H^{**}(B)$ shift upward. As expected, there is less FPI in each equilibrium [that is, (λ_H, B) configuration] and

the number of (λ_H, B) 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.

An implication of the analysis in is as follows. For given probabilities of the idiosyncratic liquidity shocks $(\lambda_L \ \ and \ \ L_H)$, the share of FPI (relative to FDI) in foreign investment rises with the probability of the aggregate liquidity shock *(q)* and with the production cost parameter *(B).*

A key macro-level implication of the Razin and Goldstein (2006) model is that country-wide financial shocks, that generate different liquidity needs across various liquidity-constrained foreign investors, raise the share of FPI, relative to FDI, in the total stock of foreign capital. The theory in chapter 2 is indeed geared toward explaining the allocation of the shock of foreign capital between portfolio and direct foreign investors. In this chapter 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).

3. Data

The IMF has issued a Survey Guide to assist reporting countries in preparing for the IMF's Coordinated Portfolio Investment Survey. But not all countries have reported statistics on FPI in detail. Overall, the IMF seems to have a fairly broad set of figures provided by recipient countries, although the country coverage is not complete and it is difficult to identify exactly the nationality of the purchaser or seller, or issuer if securities. Note that whereas the IMF data has

reasonable coverage of a country's FPI and FDI liabilities, its coverage of FPI and FDI assets is more limited in both the span of periods and the number of countries, with the majority of countries starting to report only after 1990. In this chapter, we use the recently available data on a country's stocks of FDI and FPI in market value, which are based on the IMF data, as compiled by Lane and Milesi-Ferretti (2006).

Table1 lists the countries covered in the sample for the period from 1990 to 2004. From this table, we can see that developed countries have more observations on average than developing and emerging economies do. Table 1 also shows that developed countries tend to have higher ratio of FPI/FDI, which may reflect factors other than liquidity. In the following, we will control for standard determinants of FPI/FDI, as well as unobservable country and time effects.

4. The Econometric Model

We investigate the effect of a country level liquidity shock on the FPI/FDI ratio in the host countries. The latter variable is the dependent variable in the reduced form equation:

$$\log(FPI / FDI)_{it} = \alpha + \beta X_{it} + \gamma P_{i,t+1} + \delta \log(GDP\ per\ capita)_{it} P_{i,t+1} + \varepsilon_{it} \qquad (1)$$

for host country i at time t.[1] (We also include country and time fixed effect variables.)
The vector X_{it} includes standard explanatory variables as follows. First, we put two variables – the log of the population and the log of GDP per capita (measured in constant US dollars) – to capture market size and the level of economic development. Note that GDP per capita may also be a proxy for some productivity parameter (the inverse of the parameter B of the preceding

[1] The log is the natural logarithm.

chapter). Another variable, which is included in the vector X_{it} , is the log of the stock market capitalization. This captures how advanced the country's stock market is. A more developed stock market has more established professional asset management (mutual funds and hedge funds, for instance), which could help foreign investors to enter domestic stock markets and therefore increase FPI inflow. In addition, a more developed domestic stock market can provide a larger scope for foreign investors to diversify the domestic idiosyncratic risks, which may then increase their incentives to make FPI. We also include a variable indicating trade openness. This is measured as the log of the sum of a country's imports and exports over its GDP. Imports can substitute horizontal FDI inflow, whereas exports may complement vertical FDI inflow. Thus, the effect of the trade openness variable is not clear-cut, as we do not have a good breakdown of FDI inflow into horizontal and vertical inflows.

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 equation (1) a variable, $P_{i,t+1}$, 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.

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).[2]

[2] In the recent literature on financial and liquidity crises, these are triggered not only by the realization of fundamental shocks, but also by the degree to which market expectations about these fundamentals are coordinated; see Morris and Shin (2000). When all knowledge about the fundamentals is common knowledge, there is typically a multiplicity of equilibria. Therefore, one cannot attach a unique probability to the states of the world in which crises occur. In the absence of common knowledge, an individual market participant receives not only an independent and noisy signal about the fundamentals but also must have some uncertainty about the other market participants' expectations. Morris and Shin (2000) show how the market participants' knowledge about the statistical distributions of signals and market fundamentals helps to coordinate the behavior of market participants. The coordination of expectations induces a unique equilibrium in such a set up, in which there exists a threshold level of

$$I(Aggregate\ Liquidity\ Shock)_{i,t+1} = \begin{cases} 1\ if\ \ y^*_{i,t+1} > 0 \\ 0\ if\ \ y^*_{i,t+1} < 0 \end{cases}, \qquad (2)$$

where $y^*_{i,t+1}$ is a latent variable, which is a function of several explanatory variables:

$$y^*_{i,t+1} = \lambda Z_{it} + v_{it} \qquad (3)$$

and $v_{i,t}$ has a standard normal distribution. The vector Z_{it} includes the log of population, the log of GDP per capita, the M3/GDP ratio, the bank liquid reserves to bank assets ratio, a dummy for fixed exchange rate regime, and the real interest rate at the U.S. [3] Note that except for the first two variables, all other variables are not included in equation (l) to satisfy the exclusion restriction. These other variables are standard in the empirical literature on financial and liquidity crises. Furthermore, they are excluded from equation (1), as our theory indeed does not assign them a direct role in determining the ratio of FPI to FDI.

5. Results

The Probit estimation is reported in Table 2. One can see that a higher M3/GDP reduces the likelihood of an aggregate liquidity shock at the next year; bank's higher reserve/asset ratio shrinks the money supply and increases the probability of interest rate hike; and a higher US interest rate seems to have a strong spillover effect on the domestic interest rate. However, the exchange rate regime does not show any significant impact on the occurrence of an aggregate liquidity shock.

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the fundamental. As a consequence, the equilibrium macroeconomic performance can be specified as a one-to-one function of a fundamental ex-ante probability of the financial crisis, derived from the probability distribution of the fundamentals correlated with the macroeconomic performance. This gives a theoretical underpinning for the econometric model applied here.

[3] The ratio of bank liquid reserves to bank assets is the ratio of domestic currency holdings and deposits with the monetary authorities to claims on other governments, non-financial public enterprises, the private sector, and other banking institutions.

With the predicted probability of liquidity shocks, we can now estimate equation (1). The results are presented in Table 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.

3.5 Conclusion

In this paper we confronted the theory of the allocation of the foreign capital stock between the stock of FPI and the stock of FDI with panel data of about 100 countries from the year 1980 to 2004. We find that the choice between FPI and FDI in a given host country indeed is significantly influenced by the probability of that country experiencing an aggregate liquidity shock.

Table 1: Summary Statistics of the ratio[1] of FPI to FDI from 1990 –2004

Country Name	Observations	Mean	Country Name	Observations	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

[1] In logs

Table 2: Probit Estimation of Aggregate Liquidity Shocks

Population[1]	**-0.06** **(0.03)****
GDP per Capita[1]	0.01 (0.04)
M3/GDP[1]	**-0.58** **(0.08)****
Bank Liquid Reserves/Assets	**0.006** **(0.003)****
US Real Interest Rate	**0.08** **(0.03)****
Fixed Exchange Rate Regime	-0.06 (0.12)
Constant	1.10 (0.66)
Observations	1665
R^2	0.10

[1] In logs
** Significant at the 1% level
Standard errors in parentheses

Table3: Determinants of the Ratio of FPI to FDI

	(a)	(b)
Predicted Probability of Aggregate Liquidity Shock	**11.34 (5.14)****	**17.70 (4.47)****
GDP per Capita[1]	0.27 (0.40)	0.26 (0.35)
(Predicted Probability of Aggregate Liquidity Shock)X(GDP per Capita[1])	**-1.86 (0.71)****	**-2.68 (0.66)****
Market Capitalization[1]	**0.20 (0.05)****	
Trade Openness[1]	-0.47 (0.25)	-0.47 (0.24)
Population[1]	**2.89 (0.83)****	**1.27 (0.75)***
Observations	830	1081
R^2	0.18	0.83

[1] In logs
* Significant at the 5% level
** Significant at the 1% level
Standard errors in parentheses
All regressions include country and time effects