

# Fire-Sale FDI and Liquidity Crises\*

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## Abstract

In placing capital market imperfections at the center of emerging market crises, the theoretical literature has associated a liquidity crisis with low foreign investment and the exit of investors from the crisis economy. However, a liquidity crisis is equally consistent with an inflow of foreign capital in the form of mergers and acquisitions (M&A). To support this hypothesis, we use a firm-level dataset to show that foreign acquisitions *increased* by 88% in East Asia between 1996 and 1998, while intra-national merger activity declined. Firm liquidity plays a significant and sizeable role in explaining both the increase in foreign acquisitions and the decline in the price of acquisitions during the crisis. This effect is most prominent in the tradable sectors and represents a significant departure from the pattern of M&A observed both before and after the crisis. Quantitatively, the observed decline in liquidity can explain nearly 30% of the increase in foreign acquisition activity in the tradable sectors. We argue that the nature of M&A activity during the crisis contradicts productivity-based explanations of the East Asian crisis.

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# 1 Introduction

There is a growing theoretical literature that places capital market imperfections at the center of emerging market crises. A deterioration in access to liquidity is shown to induce and exacerbate a real crisis in emerging markets, even in the absence of a shock to fundamentals (Aghion, Bacchetta, and Banerjee (2000), Calvo and Mendoza (2000), Chang and Velasco (2001), Schneider and Tornell (2001), and Caballero and Krishnamurthy (2001).) This literature associates liquidity crises with low foreign investment and an exit of investors from the crisis economy. However, an equally plausible consequence of a liquidity crisis would involve the buy-out of domestic firms by foreign firms, an option that is usually ruled out or omitted from the recent crisis models. In this paper, we empirically investigate the behavior of mergers and acquisitions (M&A), both domestic and foreign, in East Asia during the crisis of 1997-98. We find that M&A activity is consistent with the tightening of liquidity constraints for domestically owned firms but runs counter to scenarios featuring a decline in fundamentals. Specifically, nations suffering dramatic reversals in portfolio equity and debt flows simultaneously experience an *increase* in foreign acquisitions, particularly of liquidity constrained firms, a phenomenon we describe as fire-sale foreign direct investment (FDI).

Since the reversal of capital flows constitutes the defining feature of recent crises in emerging markets, understanding the behavior of these flows is crucial to identifying the precipitating shocks. Any such analysis needs to confront the surprising stability of foreign direct investment inflows into emerging markets during crisis years, a sizeable component of which are M&A's (see Appendix D). This stability contrasts with the sharp reversals in portfolio flows and bank lending (see figure 1).

We begin our analysis in Section 2 by deriving testable implications for the behavior of mergers and acquisitions in response to a deterioration in liquidity. For this purpose, we introduce a stylized model of foreign acquisitions in emerging markets. An important assumption we make is that foreign firms bring access to greater liquidity than would otherwise be available to the acquired firm. We argue that foreign ownership brings transparency, relationships, and management that help bridge the gap between emerging markets

and deeper overseas financial markets. Such benefits are unlikely to result from portfolio flows due to the small and dispersed nature of portfolio transactions. The premise that a large foreign ownership stake mitigates capital market imperfections therefore implies an important distinction between portfolio capital and FDI.

The model of Section 2 generates several predictions regarding the number and prices of acquisitions during a liquidity crisis, both at the aggregate level and across firms. To test these predictions, we employ a firm level dataset on mergers and acquisitions that records all cross-border and within-country mergers and acquisitions from 1986 through 2001. The dataset includes firm level financial characteristics of the target firm and acquisition prices, providing us with a rich information set to analyze acquisition behavior. The empirical literature on cross-border mergers and acquisitions has been limited to developed country capital markets (Froot and Stein (1991) and Blonigen (1997)) and, to our knowledge, the nature of mergers and acquisitions in emerging markets has not been studied in detail.

The results of our empirical analysis are presented in Section 3. We find that the number of foreign mergers and acquisitions in East Asia *increased* by 88% between 1996 and the crisis year of 1998. Significantly, over the same period, domestic mergers and acquisition declined by 28%. In support of the liquidity hypothesis, we find that the effect of liquidity (proxied by cash flow or sales) on the probability of being acquired changes significantly during the crisis year. While during non-crisis years high cash flow is weakly associated with acquisition, in 1998 additional cash implies a *lower* probability of acquisition. A natural prediction of the model is that liquidity constraints should have a greater impact on firms in high-growth sectors. While the large real devaluation of East Asian currencies in 1997-98 and the simultaneous collapse of the domestic economies limited the cash flow of firms in the nontradable sectors, they also severely reduced the firms' growth prospects (Schneider and Tornell (2001) document the relatively quick recovery in the tradable sectors). Correspondingly, we find stronger and more consistent evidence of liquidity-based M&A in the tradable sectors. Our estimates indicate that the decline in firm liquidity between 1996 and 1998 can account for nearly 30% of the observed increase in acquisition activity in the

tradable sectors.

In regard to the price paid for an acquired firm, the median ratio of offer price to book value declined from 3.3 in 1996 to 1.3 in 1998. In support of the hypothesis that cash-strapped firms sell at a steeper discount during a liquidity crisis, cross-sectional regressions find that an additional dollar of cash has a larger impact on sale price in 1998 than in other years.<sup>1</sup> In fact, the elasticity of price-to-book with respect to cash flow is roughly 0.7 in 1998 while negligible during the other years of the sample. We find that the recorded change in firm liquidity can plausibly explain 37% of the observed drop in price between 1996 and 1998.

We also find that liquidity considerations were more important in driving foreign-domestic acquisitions than domestic-domestic acquisitions, consistent with our underlying premise regarding the advantages of foreign ownership. Finally, we divide our sample into sub-periods to determine the role of liquidity over time and find that liquidity effects are most prominent in 1998 and disappear by the year 2000. Given that liquidity shocks are typically thought to be short-lived, particularly in contrast to productivity shocks, we argue this is further support for the liquidity-sale hypothesis.

## 2 Model

This section presents a simple two-period model to spell out intuitively robust implications of a liquidity crisis. The goal of the model is to formalize testable predictions regarding the behavior of foreign acquisitions during a liquidity crisis.

The model makes a distinction between foreign ownership and domestic ownership. A domestic firm that is acquired by a foreign firm is assumed to gain access to superior technology and deeper credit markets. The first distinction captures the conventional wisdom

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<sup>1</sup>The possibility that firms were being sold at a discount due to illiquidity was raised early on by Krugman (1998) based on anecdotal evidence on acquisitions.

that foreign direct investment from industrialized countries to emerging markets involves significant technology transfer and improves the productivity of domestic industry.<sup>2</sup> As noted in the introduction, the second distinction rests on the premise that capital markets are deeper in industrialized countries and firms that are headquartered in such markets have greater access to outside funding. There are numerous theoretical models that provide microfoundations for borrowing constraints, such as imperfect and asymmetric information (see Bernanke, Gertler and Gilchrist (1998) for a survey of capital market imperfections and macroeconomics). As the goal of the paper is not to add to this already large theoretical literature, we will take as given that firms may face a borrowing constraint and this constraint is tighter for emerging market firms.

At the start of period one, a domestically owned firm,  $j$ , is characterized by an initial capital stock  $K_{j,1}$ , a borrowing constraint  $\bar{D}_j$ , and period-one profits  $\pi_{j,1}$ . In period 1, the firm chooses its optimal investment,  $I$ , subject to the borrowing constraint and anticipated period-two productivity,  $A_{j,2}$  (we assume perfect foresight). Firms are price takers and the price of additional capital is normalized to one. Any differences across firms in the price of output are folded into  $A_{j,2}$  (in particular, the differential impact of a real devaluation across firms will be captured by differences in  $A_{j,2}$ ). To simplify expressions, we assume that the interest rate and discount rate are zero.

The value of a firm under domestic ownership,  $V^D$ , can then be expressed as (dropping subscript  $j$ ):

$$\begin{aligned}
 V^D(K_1, A_2, \pi_1, \bar{D}) &= \max_I \{ \pi_1 - I + A_2 F(K_2) + (1 - \delta)K_2 \} & (1) \\
 \text{s.t. } K_2 &= (1 - \delta)K_1 + I \\
 I &\leq \bar{D} + \pi_1,
 \end{aligned}$$

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<sup>2</sup>Empirical evidence is however mixed. See Blomstrom and Wolff (1994) and Aitken and Harrison (1999). For the main predictions of our liquidity hypothesis the crucial assumption is the difference in access to liquidity. The assumption regarding productivity allows for acquisition of non-liquidity constrained firms in equilibrium.

where  $F' > 0$ ,  $F'' < 0$ , and  $\delta \in (0, 1)$  is the rate of capital depreciation. The difference between current profits and investment ( $\pi_1 - I$ ) represents retained earnings (if positive) or (the negative of) debt due in the final period. The first constraint is a standard capital accumulation equation. The second constraint captures the borrowing constraint.

The value to a foreign owner,  $V^F$ , of the same firm is given by

$$\begin{aligned} V^F(K_1, A_2, \pi_1) &= \max_I \{ \pi_1 - I + \phi A_2 F(K_2) + (1 - \delta)K_2 \} \\ \text{s.t. } K_2 &= (1 - \delta)K_1 + I \end{aligned} \quad (2)$$

where  $\phi > 1$  captures the superior productivity associated with foreign ownership and foreign owners are not subject to a borrowing constraint.<sup>3</sup> Clearly,  $V^F > V^D, \forall j$ . However, the transfer of ownership to the foreign acquirer entails a fixed reorganization cost  $\gamma$ , which may vary across domestic firms.<sup>4</sup> A foreign firm then acquires a domestic firm as long as the acquisition generates a positive surplus, that is  $S \equiv V^F - V^D - \gamma \geq 0$ . If acquired, the price paid for the firm is determined according to a Nash-bargaining solution :

$$P = \beta S + V^D = \beta (V^F - V^D - \gamma) + V^D, \quad (3)$$

where  $\beta \in (0, 1)$  captures the domestic owners bargaining power and  $V^D$  is the outside option for the domestic firm<sup>5</sup>.

Figure 2 identifies the range of firms acquired. The solid line denotes the combinations of future productivity ( $A_2$ ) and liquidity ( $l \equiv \pi_1 + \bar{D}$ ) which imply zero acquisition surplus, all else equal. Firms that lie above this line will be acquired. For high enough  $A_2$ , a domestic firm will be acquired regardless of liquidity due to the superiority (and complementarity with

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<sup>3</sup>We assume no constraint on foreign ownership's debt, but the important point is that the foreign firm enjoys a higher debt limit than the domestically owned firm.

<sup>4</sup>We assume the cost of reorganization does not vary according to foreign partner to avoid complications arising from optimal matching.

<sup>5</sup>Recall that the zero outside option for the foreign investor is only a simplifying assumption.

$A_2$ ) of foreign technology. As we reduce available liquidity for a given  $A_2$ , a domestically owned firm will eventually become constrained and have to forego profitable investment opportunities. This widens the gap between  $V^F$  and  $V^D$ , making the acquisition efficient.

In regard to price, an increase in  $A_2$ , all else equal, increases  $V^F$  more than  $V^D$  due to the superior technology employed by foreign ownership. This raises the surplus of the acquisition and therefore increases the price of the acquired firm. Similarly, extending additional liquidity to a constrained firm increases  $V^D$ , reducing the gap between  $V^F$  and  $V^D$  and raising the acquisition price. Of course, to an unconstrained firm additional liquidity has zero effect on the acquisition surplus.

## 2.1 Liquidity Crises and Testable Implications

Conceptually, we consider a liquidity crisis as a *ceteris paribus* decline in liquidity available to domestically owned firms. That is, conditional on firm characteristics, domestically owned firms as a group find it difficult to borrow during the crisis, a premise that is consistent with (but not necessarily implied by) the drop in capital inflows depicted in figure 1. We do not model the origins of this capital market imperfection and why it may have been exacerbated in 1997-1998, but instead derive its implications for cross-border acquisitions.

To be precise, we define a liquidity crisis as a “leftward shift” in the distribution of  $l$  across firms. Specifically, let  $G_0(l)$  denote the benchmark or “normal-period” cumulative distribution of liquidity, *conditional* on  $A_2$ ,  $\gamma$ , and other firm-specific characteristics (such as  $K_1$ ), which we summarize as “ $\theta$ ”. If  $G_1(l)$  is the equivalent distribution during a liquidity crisis, then our definition implies that  $G_0$  “first order stochastically dominates” (*fosd*)  $G_1$ . That is,  $G_1(l) \leq G_0(l) \forall l$ , with a strict inequality for a set of  $l$  with positive probability. An equivalent definition of *fosd* which we will use repeatedly is that  $\int f(l)dG_1 \leq \int f(l)dG_0$  for every nondecreasing function  $f(l)$ .

Our first comparative static involves the number of acquisitions. Let  $N_i$  denote the fraction<sup>6</sup> of firms acquired under  $G_i$ ,  $i = 0, 1$ , where 1 is the crisis distribution. That is,

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<sup>6</sup>We use terms such as “fraction” or “probability” of acquisition interchangeably with “number” of ac-

$$N_i \equiv \int \int_{S \geq 0} dG_i(l) dH(A_2, \gamma, \theta), \quad (4)$$

where  $H$  is the distribution of firm characteristics  $(A_2, \gamma, \theta)$ .

**Proposition 1** *If  $G_0$   $fosd$   $G_1$ , then  $N_0 \leq N_1$ .*

Proof: Let  $\mathbf{1}_{\{x\}}$  equal one if  $x$  is true and zero otherwise. Then

$$N_i = \int \int \mathbf{1}_{\{S \geq 0\}} dG_i(l) dH(A_2, \gamma, \theta). \quad (5)$$

Conditional on other firm characteristics,  $\mathbf{1}_{\{S \geq 0\}}$  is nonincreasing in  $l$ . The definition of *fosd* implies that  $\int \mathbf{1}_{\{S \geq 0\}} dG_0(l) - \int \mathbf{1}_{\{S \geq 0\}} dG_1(l) \leq 0$ . Integrating over other firm-specific characteristics preserves this inequality, implying that  $N_0 \leq N_1$ .

The intuition is straight forward: as more firms become constrained, more firms will be willing to pay the cost  $\gamma$  to gain access to foreign liquidity. While we do not model portfolio investment explicitly, it is clear that the increase in acquisitions derived above does not extend immediately to portfolio investment. As noted previously, we presume that portfolio investment does not relax liquidity constraints due to the small and anonymous nature of the transactions. Therefore, it would not be able to exploit the wedge between foreign and domestic borrowing constraints.

We will discuss alternatives to liquidity shocks as the source of crises in Section 4. However, in anticipation, we mention that the implications for  $N$  are the opposite if one interprets the Asian crisis as a productivity slowdown. Given that  $\mathbf{1}_{\{S \geq 0\}}$  is nondecreasing in  $A_2$ , a *fosd* shift down in productivity *reduces* the number of acquired firms. As will be discussed in Section 4, the dichotomy between a decline in liquidity versus a decline in productivity holds for many of the implications derived in this section.

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quisitions. The implication is that the measure of firms is held constant across comparative statics.



One regression we consider below involves the probability of acquisition conditional on observable firm characteristics. We take the cost of reorganization  $\gamma$  to be the source of unobserved, idiosyncratic variation across firms.<sup>7</sup> That is, if  $y = y(l, A_2, \theta)$  denotes the probability of acquisition conditional on firm characteristics and  $\gamma \sim \Gamma(\gamma)$ , then  $y = \int_{S \geq 0} d\Gamma$ . Recall that additional liquidity (to a constrained firm) lowers  $S$  while increased productivity increases the surplus of an acquisition. This implies:

$$\frac{\partial y}{\partial l} \quad \begin{cases} = 0, & \text{if unconstrained} \\ < 0, & \text{if constrained} \end{cases}$$

$$\frac{\partial y}{\partial A_2} > 0.$$

The population averages of the partial derivatives in (6) are obtained by taking expectations over firms. Let  $E_i(x) = \int \int x dG_i(l) dH(A_2, \theta)$ ,  $i = 0, 1$ , represent the population average of a random variable  $x$  during normal period ( $i = 0$ ) and during a liquidity crisis ( $i = 1$ ). Assuming the distribution of  $\gamma$  satisfies certain conditions (see Appendix B), we have

**Proposition 2** *If  $G_0$  fosd  $G_1$ , then (i)  $E_0\left(\frac{\partial y}{\partial l}\right) \geq E_1\left(\frac{\partial y}{\partial l}\right)$  and (ii)  $E_0\left(\frac{\partial y}{\partial A_2}\right) \leq E_1\left(\frac{\partial y}{\partial A_2}\right)$ .*

Proof: See Appendix B.

Proposition 2 states that, on average, additional liquidity has a more negative impact on the probability of acquisition during a liquidity crisis. Similarly, the sensitivity of the probability of acquisition to firm productivity increases during a liquidity crisis. When we estimate the probability of acquisition and constrain the coefficients on liquidity and future productivity to be the same across firms, the model predicts that the coefficient on liquidity falls and that on future productivity increases during a liquidity crisis.

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<sup>7</sup>In this section, we treat  $\gamma$  as orthogonal to other firm characteristics. In the empirical work, we control for underlying firm characteristics by including firm fixed effects.

In terms of the price of an acquisition, a liquidity crisis will lead to a fall in the average price of the domestic firm. That is, constrained firms have a less valuable outside option ( $V^D$ ), all else equal, and thus a lower price. The more constrained firms in the population, the lower the average price all else equal. Moreover, as noted at the end of the last subsection, liquidity influences the surplus of an acquisition only if the domestic firm is constrained. Thus, the average sensitivity of price to liquidity increases during a liquidity crisis. Conversely, an increase in  $A_2$  has a limited impact on  $V^D$  if a firm is constrained as it cannot make full use of the improved productivity. As the sensitivity of  $V^F$  to  $A_2$  remains the same regardless of domestic liquidity, the average price of an acquired firm is less sensitive to growth prospects during a liquidity crisis. Specifically:

**Proposition 3** *If  $G_0$  fofd  $G_1$ , then (i)  $E_0\left(\frac{\partial P}{\partial l}\right) \leq E_1\left(\frac{\partial P}{\partial l}\right)$  and (ii)  $E_0\left(\frac{\partial P}{\partial A_2}\right) \geq E_1\left(\frac{\partial P}{\partial A_2}\right)$ .*

Proof: See Appendix B.

The empirical implication of proposition 3 concerns a regression of price on liquidity and growth prospects, conditional on other firm characteristics. The coefficient on liquidity should increase and that on future productivity should decrease during a liquidity crisis.

Given the above discussion, the empirical predictions of a liquidity crisis can be summarized as follows.

- (i) The number of acquisitions increases during a liquidity crisis;
- (ii) On average, the sensitivity of the conditional probability of acquisition to firm liquidity declines (becomes more negative) during a liquidity crisis;
- (iii) On average, the sensitivity of the conditional probability of acquisition to future productivity increases during a liquidity crisis;
- (iv) The average price of an acquisition declines during a liquidity crisis;
- (v) On average, the sensitivity of the price of an acquisition to firm liquidity increases during a liquidity crisis;

(vi) On average, the sensitivity of the price of an acquisition to future productivity declines during a liquidity crisis.

## **3 Empirical Results**

### **3.1 A brief chronology of the Asian crisis**

Our empirical work focuses on five East Asian nations: South Korea, Thailand, Indonesia, Malaysia, and the Philippines. These were the nations hit hardest by the Asian crisis of 1997. As background, these five countries experienced relatively high growth rates in the 1980s and the first half of the 1990s (see Corsetti, Pesenti, and Roubini (1998)). This growth was accompanied by gradual but significant increases in foreign capital flows. Moreover, domestic bank lending increased dramatically in the early 1990s. In 1997, the domestic financial systems began to weaken in many East Asian economies, a development followed by large capital outflows. Thailand abandoned its currency peg in July of 1997, quickly followed by devaluations in Indonesia, Malaysia, and the Philippines. South Korea initially avoided the capital outflows experienced by the Southeast Asian countries. However, capital began to flow out of Korea in the fall of 1997 and it was forced to devalue its currency in November of that year. In all cases except the Philippines (which recorded zero growth), output contracted substantially in 1998, ranging from a 6% drop in Korea to a dramatic decline of 13% in Indonesia.

### **3.2 Data**

Our primary dataset is Thompson Financial Securities Data Company's (SDC) mergers and acquisition database, which contains dates and details of cross-border and domestic mergers and acquisitions. Primary source material includes news sources, SEC filings and their international counterparts, trade publications, wires and proprietary surveys of investment banks, law firms and other advisors. The database includes all corporate transactions involving at least 5% of the ownership of a company where the transaction was valued at \$1 million or more (after 1992, deals of any value are covered) or where the value of the

transaction was undisclosed. Public and private transactions are covered. SDC also reports numerous details about the target and acquiring firm, including income and balance sheet items, industry, and ownership. For each firm acquired, SDC reports five years of historical data, allowing the construction of a panel of acquired firms.

We begin our sample in 1986 (the first year for which data is available) and include all mergers and acquisitions through the end of 2001. The start date is not highly restrictive given that very few mergers occurred prior to this year. In total, we have close to 6,000 completed deals, roughly one third of which involve a foreign acquiror.<sup>8</sup> Forty-five percent of deals involve a private target, with public firms and subsidiaries accounting for a quarter each. The remainder consists of government firms (1%) and joint-ventures (4%). Many of the regressions below require income statement and balance sheet data that are unavailable for privately held firms. Therefore, the regression samples are weighted towards publicly held firms.

We take the announcement date as the date of the merger or acquisition. Although mergers may, in theory, be considered a mutual acquisition, SDC always identifies a “target firm” and acquiring firm(s). We use the term acquisition loosely to describe all purchases contained in the database, even though many transactions involve only a fraction of shares outstanding. Table 1 reports the distribution of the shares involved in cross-border acquisitions. The median purchase involves 49% of the firm, with over a quarter involving the entire firm. Ten percent of the deals fall short of meeting the usual FDI definition of 10% of outstanding equity.

To avoid limiting our sample to firms that were eventually acquired, we augment the SDC database with data on firms contained in Thompson Financial’s Worldscope database. This database consists of annual data on public companies in developed and emerging markets. Worldscope data is collected from corporate documents such as annual reports and press releases, exchange and regulatory agency filings, and newswires. The combined

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<sup>8</sup>A small fraction of target firms are defined as being “ultimately” owned by a foreign firm. Excluding such acquisitions does not change the results.

sample contains over 6,500 firms. We feel this set of firms accurately reflects the universe of firms relevant for a study of cross-border acquisition – the omitted firms being privately held enterprises that were never involved in an acquisition or smaller publicly held firms that do not merit inclusion in an international database.

Table 2 summarizes key financial details of the firms used in the regressions below. All variables are reported in (log) million dollars and the precise definitions of accounting terms are provided in Appendix A.

### 3.3 The Probability of Acquisition

The first prediction of our theoretical model is that the number of cross-border acquisitions should increase during a liquidity crisis. A simple plot of the number of acquisitions supports this prediction. Figure 3 plots the number of acquisitions of domestic firms by foreign companies (solid line) summed over the five Asian countries<sup>9</sup> and arranged by the year in which the acquisitions were announced.<sup>10</sup> The dashed line reports the number of acquisitions of domestic firms by domestic companies for comparison. The upward trend in mergers and acquisitions from the start of the period is apparent in the plot. Moreover, there is a sharp uptick in acquisitions by foreign companies in 1998, the first full year immediately after the onset of the crises in mid- and late-1997. There is an 88% increase in foreign acquisitions between 1996 and 1998, with most of the increase taking place in 1998. Interestingly, the number of acquisitions by other domestic firms declines by 28% over this same period. While not explicitly modeled in Section 2, a straight forward extension indicates that the drop in domestic-domestic acquisitions follows if the binding constraint on the number of domestic mergers is the pool of potential acquiring firms located within

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<sup>9</sup>The country-level times series of acquisitions look substantially like the aggregated data. Two exceptions are the fact that foreign acquisitions in Indonesia are constant between 1997 and 1998 and domestic-domestic acquisitions increase in Korea in 1998.

<sup>10</sup>Figure 3 includes all completed acquisitions. We include all purchases of the target's equity, regardless of the percentage of shares involved, as this value is missing for many acquisitions. Restricting to deals in which over fifty percent of the target's equity is purchased yields a similar picture.

the country.

Figure 4 plots the number of foreign-domestic acquisitions according to whether the target firm is involved in tradable (solid line) versus nontradable production. We define tradable sectors as manufacturing (3-digit SIC codes 200-399) and nontradable as the remaining sectors. While admittedly crude, this distinction captures the traditional wisdom that real devaluations impact manufacturing differently than services, retail, etc. One may consider such nonmanufacturing sectors as agriculture and natural resources to be tradable, but these sectors are a negligible percentage of the sample. Both tradable and nontradable sectors experience an increase in acquisitions in 1998, however, the number and percentage increase in foreign acquisitions in the tradable sectors (137%), was far greater than the increase in the nontradable sectors (63%). The large devaluation combined with the drop in domestic demand reduced cash flow for nontradable firms but also restricted investment opportunities, limiting the role for foreign capital despite the reduced sales revenue.

To explore more systematically whether liquidity is driving the patterns observed in figure 3, we estimate a number of linear probability regressions using the panel of firms described in Section 3.2. (See Appendix C for the results of logit and conditional logit regressions. The results stay substantially the same). Our probability regressions take the form:

$$y_{jict} = \alpha_0 + \alpha \mathbf{X}_{jict} + \delta \mathbf{X}_{jict} * D_{98} + \mathbf{D}_{jict} + \varepsilon_{jict}. \quad (6)$$

The dependent variable  $y_{jict}$  is an indicator variable which takes the value one if firm  $j$  in industry  $i$  in country  $c$  is acquired in year  $t$  by a foreign firm, and takes the value zero otherwise.<sup>11</sup> We explore acquisitions by other domestic firms in Section 3.5.2. Our regressors  $X$  are measures of firm liquidity and potential growth while  $\mathbf{D}$  is a vector of

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<sup>11</sup>SDC identifies the status of the acquisition at the date of announcement, with the vast majority of the sample being coded “Completed” or “Pending”. The results are similar if we include all announced acquisitions or include only those identified as completed. In our probability regressions, we report results for the sample restricted to completed acquisitions only.

“fixed-effect” dummy variables. We will discuss the content of  $\mathbf{X}$  and  $\mathbf{D}$  below. The variable  $D_{98}$  is a dummy variable for the year 1998. We take that year – the first full year after the devaluations of mid- and late-1997 – as our crisis period. In Section 3.5.1 we explore whether the crisis includes additional years as well. The vector  $\delta$  therefore represents the change in acquisition sensitivity to firm liquidity and growth during the crisis.

Our primary measure of firm liquidity is log cash flow reported for the most recent fiscal year. Cash flow is a traditional measure of liquidity and represents the flow of cash from operations available to a firm during a given year.<sup>12,13</sup> The definition of cash flow differs slightly between the SDC and Worldscope databases (see definitions in Appendix A). To verify this difference does not influence our estimates, we include results using net sales in place of cash flow. Net sales has a common definition in both databases and is highly correlated with cash flow. (Appendix C reports results using net worth as an alternative measure of liquidity.) One concern with the use of cash flow or sales as a measure of liquidity is that it may also be associated with other relevant (but unobserved) firm characteristics. We will correct for some of this omitted variable bias through fixed effects discussed below. To the extent that firm type is time varying and correlated with cash flow, higher cash flow may be associated with a higher probability of acquisition if it signals strong firm fundamentals. On the other hand, our liquidity model implies that higher cash flow should have a negative effect on the probability of being acquired, as the surplus generated from a merger is lower. To isolate the effect due to liquidity, we will compare the change in the coefficient of cash flow during the crisis year to the coefficient estimated from the rest of the sample.

Capital expenditures (investment) is used as a proxy for growth opportunities (as in Olley and Pakes (1996) and Pavcnik (2002)). That is, we assume that a firm that is investing in new physical capital faces relatively strong growth prospects. We do not use

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<sup>12</sup>Replacing log cash flow with the log ratio of cash flow to assets does not significantly change the analysis, but does reduce the sample size due to the fact that assets are not reported for every year. In any event, the firm fixed effects discussed below control for the average size of the firm.

<sup>13</sup>For surveys, see Bernanke et al (1998) and Hubbard (1998).

the more traditional measure of Tobin’s Q as many of our firm’s are not listed and the market prices we do observe are influenced by the potential/announcement effect of an acquisition. Replacing capital expenditures with sales growth to measure growth prospects yields similar results.

The probability of an acquisition obviously may vary with other characteristics of the firm not contained in the database. To limit the impact of omitted variables we include firm and year fixed effects, i.e.  $\mathbf{D} = (D_j, D_t)$  is a vector of firm and year dummies. Thus we only use the time series variation in firm characteristics in predicting the probability of acquisition. The fixed effect will not be sufficient if liquidity is correlated with omitted time-varying firm characteristics (year dummies control for any time-varying aggregate variables). However, we will compare the coefficient on cash flow for the crisis year with other years, differencing out the general correlation with omitted variables. The remaining bias, if any, will result from *changes* to the correlation in the crisis year (a possibility we will discuss in Section 4).

As an alternative to firm fixed effects, we also specify  $\mathbf{D}$  to be a vector of indicator variables  $\{D_{ict}\}$  representing the triplet of (industry, country, year). That is, we include indicator variables for industry (at the 3-digit SIC level), country and year and all interactions of these variables. This fixed effect controls for any changes in government policies, relative prices, economic prospects and other such omitted variables that may vary across industries, countries and across time.

Note that the two alternative fixed effects,  $D_j$  and  $D_{ict}$ , imply very different regressions – the former is essentially comparing a firm to itself over time, the latter exploits the cross-section of companies in a particular 3-digit industry in a particular country in a particular year. Despite this difference, we show below that the conclusions from the two fixed-effect specifications are substantially the same.

The model of liquidity introduced in Section 2, and summarized in statements (ii) and (iii) at the end of Section 2.1, implies  $\delta_{\text{cash flow}} < 0$  and  $\delta_{\text{capital expenditures}} > 0$ . Tables 3



and 4 report the results of the benchmark probability regressions specified in (6). Standard errors adjusted for heteroscedasticity are reported in parentheses. In each table, columns (1) and (3) utilize firm and year fixed effects while (2) and (4) control for industry\*nation\*year interactions. Table 3 includes all completed foreign acquisitions and table 4 restricts the sample to acquisitions in which the target firm is in a tradable sector.

In specifications using all sectors, the dummy for 1998 interacted with liquidity is always negative, with the difference exceeding standard significance levels in two of four cases. The magnitude of the decline is similar across all specifications, as well. This pattern is much stronger in both magnitudes and statistical significance in the traded sectors (table 4). While liquidity plays a positive or negligible role in predicting acquisition in noncrisis years, liquidity's effect becomes significantly more negative in 1998. (The total effect of liquidity on acquisition is significantly negative in specifications 2-4 of table 4.)

Capital expenditure is intended to capture the growth prospects of a firm. The model predicts that the coefficient on this variable should increase during the crisis year. As with liquidity, the results are strongest for the tradable sectors. As predicted, the role of capital expenditure significantly increases during the crisis year in table 4. The magnitude of the increase in this relationship during the crisis,  $\delta_{\text{capital expenditure}}$ , relative to the base coefficient tends to be large.

### 3.4 Price of acquisitions

An important element of liquidity-forced sales is that constrained firms are being sold at a discount. In terms of Section 2's model, liquidity constrained firms have diminished outside options, reducing the Nash bargaining price of acquisition. Figure 5 plots the median ratio of the price of acquisition (offer price) to book value of assets against year of acquisition (solid line). The dashed line is the ratio of offer price to market price, where market price is defined as the closing share price four weeks prior to the announcement of the acquisition. The plot clearly indicates that the price of acquired firms (relative to book value) declines

dramatically in 1998. The market price also declines sharply, leaving the ratio of offer price to market price largely unchanged.

To determine whether liquidity plays a role in this price decline, we estimate for an acquired firm  $j$  in industry  $i$  in country  $c$  at time  $t$ ,

$$p_{jict} = \beta_0 + \beta \mathbf{X}_{jict} + \theta \mathbf{X}_{jict} * D_{98} + \mathbf{D}_{ict} + u_{jict}. \quad (7)$$

The dependent variable,  $p_{jict}$ , is the log ratio of offer price to book value reported by SDC and  $\mathbf{X}$ , as before, represents cash flow (or sales) and capital expenditures. As before, we control for industry, time, country variations by including an indicator for each variable and all its interactions. Since we have only one price observation per firm, we cannot use firm level fixed effects. However, we scale by log assets to control for the size of firms. According to statements (iv) and (v) in Section 2, we should expect  $\theta_{\text{cash flow}} > 0$  and  $\theta_{\text{capital expenditures}} > 0$ .<sup>14</sup>

Table 5 reports the results. Columns (1)-(3) use all acquisitions and columns (4)-(6) restrict the sample to tradable firms.<sup>15</sup> In all specifications, the evidence supports the importance of liquidity during the crisis. Consistent with our probability regressions, the effect is largest in the tradable sectors. In particular, the base coefficients on log cash flow and log sales are never significantly different from zero. However, the interaction with the 1998 dummy is always large and significantly positive, indicating that relative liquidity in 1998 exerted an unusually strong influence on the cross-section of prices.

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<sup>14</sup>Of course, the sample for our price regressions is restricted to firms that have been sold. However, this conditionality is explicit in the derivation of statements (iv) and (v) in Section 2.

<sup>15</sup>Since not every acquisition reports a transaction price, we augment the regression sample by pooling all (foreign and domestic) acquisitions for which there is data.

## 3.5 Further Tests

### 3.5.1 Testing across Sub-periods

To test if liquidity plays a role outside of 1998, we divide our tradable sample into sub-periods and estimate separate regressions for the periods 1986-1996, 1997, 1998, 1999, and 2000-2001.<sup>16</sup> The results, reported in Table 6, indicate that 1998 is indeed a unique year. This year is the only year in which both sales and capital expenditure enter significantly in the pattern predicted by our model. The coefficient on sales is large and negative in 1998. The only other year in which sales plays a significantly negative role is 1999 and the magnitude is reduced relative to that of 1998. As one would expect of a liquidity crisis (and unlike a shock to productivity), the effects are short-lived and are no longer present by 2000.

### 3.5.2 Domestic and Nontradable Acquisitions

Table 7 explores the role of liquidity and growth in acquisitions by domestic firms and acquisitions of firms in nontradable sectors. Recall from figure 3 that the number of foreign acquisitions increased in 1998, while domestic-domestic acquisitions declined. Similarly, table 7 documents additional differences between the two types of acquisitions. In particular, the change in the coefficient on sales during the crisis is negative, but smaller than those reported for foreign acquisitions in table 3 and not significantly different from zero. Similarly, the significantly positive increase in sensitivity to capital expenditures seen in foreign acquisitions during the crisis is not apparent in domestic acquisitions. These results suggest that liquidity considerations were more important in driving foreign-domestic acquisitions relative to domestic-domestic acquisitions. Similarly, liquidity and capital expenditures have little predictive power in regard to foreign acquisition of firms in nontradable sectors, as reported in columns (3) and (4) of table 7.

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<sup>16</sup>We only estimate industry\*nation\*year fixed effects as our year-by-year specifications have no time-series dimension.

### 3.5.3 Magnitudes

To assess the quantitative importance of the drop in liquidity in driving the increase in acquisition between 1996 and 1998, consider that the unconditional (tradable sample) probability of acquisition increased from 0.3% to 3.3%, an increase of 3 percentage points. Over the same period, median (and mean) log sales fell by roughly 0.35 (i.e. sales fell 35%). According to the 1998 estimates reported in table 6, this drop in log sales predicts an increase in the probability of acquisition of 0.8 percentage points, or roughly 27% of the observed increase.

From the price regressions, we have that the median log price to book declined from 1.54 in 1996 to 0.47 in 1998. If we use  $\log(\text{sales}/\text{assets})$ , where we normalize by assets to control for the size of the acquisition, the price regression sample median declines by 44% between 1996 and 1998. Table 5 reports an elasticity of 0.83, implying a drop in log price to book of 0.36, or 34% of the observed fall in log price. The median log price to book declined by 0.8 in the tradable sample, with a corresponding decline of 0.50 in  $\log(\text{sales}/\text{assets})$ . Our estimated elasticity of 1.8 implies a predicted decline of 0.9 in log price to book, or more than 100% of the observed fall. The estimated magnitude of the effect of liquidity on the price of acquisitions, however, should be viewed cautiously, given that the regression sample for which we have price data is limited<sup>17</sup> and the change in liquidity for all the firms acquired can be very different from that in the regression sample. For instance, median  $\log(\text{cash}/\text{assets})$  declined by 50% in the sample of firms that were acquired in 1998, as compared to 1996. However, in our regression sample  $\log(\text{cash}/\text{assets})$  increases slightly. This anomaly reflects the small number of firms that report a price and cash flow number.

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<sup>17</sup>While we have over 1,000 foreign and domestic deals (including both completed and pending deals) in 1996 and 1998, we have 61 firms in 1996 and 67 in 1998 that report both price and cash flow (for sales, the respective numbers are 67 and 81).

## 4 Discussion

The preceding section documents that the behavior of mergers and acquisitions during the Asia crisis is consistent with a liquidity crisis as defined in Section 2. One striking feature of the pattern of M&A is that liquidity effects are most prominent in acquisition of firms in the tradable sectors. Both in our sample of firms and in the economies in general, tradable sectors experienced relatively rapid recoveries in 1998 and 1999, as predicted by textbook models of real devaluations. As noted in Section 2, growth prospects are important in determining whether liquidity constraints bind. While nontradable sectors faced a drop in sales during the crisis, their weak prospects make them relatively less appealing to foreign acquirors.

Undoubtedly, tradable firms possess some advantages in attracting foreign investors. It might be argued that tradable firms were able to expand *because* they enjoyed continued access to foreign capital markets, making it problematic to argue such firms were constrained (e.g. Tornell and Westermann (2001)). However, our results are not inconsistent with this scenario. We test whether liquidity predicts which tradable firms are acquired in a crisis and find a large and significant effect. The fact that tradable firms were able to record relatively healthy growth rates in the years immediately after the devaluations implies that these firms were (at least partially) able to overcome any capital market imperfections; our results show that mergers with foreign firms was one mechanism through which firms ensured access to foreign capital markets.

In arguing that our results support a liquidity crisis interpretation of the Asian crisis, we need to consider whether alternative explanations explain the same set of facts. One plausible alternative hypothesis would be that the crisis was in response to a shock to productivity. This includes explanations based on herding, such as Chari and Kehoe (2001), in which investors perceive a negative shock to fundamentals.

In the terminology of Section 2, we can define a productivity crisis as a *fosd* shift down in the distribution of  $A_2$ . Such a drop in productivity leads to a fall in acquisitions as

few firms have sufficient potential to make it efficient to assess the superior technology or liquidity offered by a foreign partner.<sup>18</sup> Instead, we observe a dramatic *increase* in the number of acquisitions.

Similarly, a productivity crisis yields counterfactual implications for the coefficients in our linear probability regressions. In particular, a general decline in productivity implies an increase in the coefficient on liquidity during the crisis. The intuition rests on the fact that a productivity crisis limits investment opportunities, reducing the number of firms that are liquidity constrained (holding constant the distribution of liquidity). As constrained firms exhibit a negative relationship between acquisition and cash flow, a reduction in the number of constrained firms leads to an increase in the average relationship between liquidity and acquisition.<sup>19</sup> The fact that the coefficient on liquidity falls during the crisis runs counter to this hypothesis.

Moreover, while a drop in productivity is consistent with the decline in the average sale price, it fails to predict that cash flow becomes more important during the crisis, as is the case empirically. Again, in a productivity crisis, few firms find themselves constrained, making cash flow less important in determining the price of a firm. However, our estimates indicate the role of liquidity in determining the price of an acquisition is enhanced during the Asian crisis.

A second concern with our interpretation of the data may be the imperfect proxies for liquidity and growth potential. In particular, as noted in Section 3, cash flow is correlated with firm fundamentals other than liquidity. The firm fixed effect controls for constant firm attributes. Of course, any time-varying omitted factors that are correlated with cash flow will be reflected in the base coefficient. However, the focus of this study is the *change* in the coefficient during 1998, which is sensitive only to the *change* in the correlation between

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<sup>18</sup>The proof of this follows directly from the fact that the surplus of a match is nondecreasing in  $A_2$ . Therefore, a *fosd* shift down in the distribution of  $A_2$  leads to a fall in the average surplus.

<sup>19</sup>To see this formally, note that in the model of Section 2,  $\frac{\partial^2 y}{\partial A_2 \partial l} \leq 0$ . Therefore, a *fosd* shift down in the distribution of  $A_2$  increases the average  $\frac{\partial y}{\partial l}$ .

cash flow and omitted variables. While such a change in the relationship between cash flow and firm fundamentals may occur, a mechanism that produces such a change as well as accounts for the other empirical results presented above is not readily apparent.

For instance, it is plausible that cash flow serves as a signal of the underlying productivity of a firm. This signal may become more informative during a crisis, perhaps due to the fact that performance in an extreme environment yields a better signal of the strength of a firm. That is, high cash flow in a crisis becomes a very positive signal about firm fundamentals. While this would accord with the price regressions in which cash-rich firms sold at an increased premium in 1998, the negative coefficient on crisis cash flow in table 3 would then imply that the increase in acquisitions in 1998 was motivated by increased purchases of firms suddenly revealed to be *low* productivity. Therefore, this mechanism not only rests on the hypothesized change in correlation, but additionally and less plausibly requires that foreign firms shop for low quality partners. (See Aitken and Harrison (1999) for evidence that foreign firms target high productivity domestic partners.) In general, we find hypotheses regarding cash flow as proxy for fundamentals fail to plausibly explain the entire set of facts documented in this paper.

Lastly, an issue to bear in mind is that government policies changed in the wake of the crisis, particularly regarding foreign capital. For example, South Korea relaxed many restrictions regarding foreign direct investment while Malaysia imposed additional controls on portfolio flows. This may have some impact on the aggregate M&A numbers. However, in our cross-sectional regressions, we include dummies for country\*year\*industry interactions. This controls for any policy changes at the (3-digit) industry level, allowing us to identify the effects of liquidity holding constant macro policies.

## 5 Conclusion

In this paper we investigate the relationship between liquidity crises and foreign acquisition activity. In the existing theoretical literature, this incentive for capital inflows has typically

been ruled out or omitted. We find that in the case of cross-border M&A in East Asian economies liquidity played a significant and sizeable role in explaining the dramatic increase in foreign acquisition activity and the consequent continued inflow of FDI during the Asian crisis. Similarly, firm liquidity is shown to predict the price of acquisition, linking the sharp fall in the median price of acquisitions to the decline in liquidity observed during the crisis. The effects are most prominent in the tradable sectors. Moreover, proxies for liquidity have a greater impact on the probability of acquisition and the price of acquisition in 1998 than in other years in the sample. This is consistent with a liquidity crisis being a short-term phenomenon. Lastly, as noted above, the implications of a liquidity crisis are directly contrary to that of a productivity slowdown, either real or perceived, and this latter hypothesis is thus contradicted by the data on M&A.



## Appendix

### A Definition of SDC Accounting Terms

**Assets:** Total balance sheet assets including, current assets, long-term investments and funds, net fixed assets, intangible assets, and deferred charges, as of the date of the most current financial information prior to the announcement of the transaction (million US\$). Equals total liabilities plus shareholders' equity plus minority interest.

**Capital Expenditure:** Gross purchases of property, plant, and equipment (million US\$). Does not include acquisition of other companies.

**Cash Flow:** SDC: Earnings before interest, taxes, depreciation and amortization for the most recent fiscal year prior to the announcement of the transaction (million US\$). Worldscope: Earnings before extraordinary items and preferred and common dividends, but after operating and non-operating income and expense, reserves, income taxes, minority interest and equity in earnings, plus all non-cash charges or credits.

**Liabilities:** All debt and obligations owed to creditors, including all current and long-term liabilities (million US\$).

**Net Worth:** Assets minus liabilities (million US\$).

**Offer Price/Book Value:** Offering price in the deal divided by target's book value per share as of the date of the most current financial information prior to the announcement of the transaction.

**Offer Price/Market Value:** Premium of offer price to target trading price 4 weeks prior to the original announcement date.

**Sales:** Primary source of revenue after taking into account returned goods and allowances for price reductions (million US\$). If not available, total revenues are used. For banks, net sales equals interest income plus non-interest income.

## B Additional Proofs

Proof of Proposition 2:

Define  $\gamma^* \equiv \{\gamma | S = 0\}$  to be the fixed cost at which the surplus of a match is zero. That is,  $\gamma^* = V^F - V^D$ . Then  $y = \int_{S \geq 0} d\Gamma = \int_{\underline{\gamma}}^{\gamma^*} d\Gamma = \Gamma(\gamma^*)$ , where we assume that  $\gamma^*$  always lies in the interior of the support of  $\gamma$ . Differentiation implies  $\frac{\partial y}{\partial l} = \Gamma'(\gamma^*) \left( \frac{\partial V^F}{\partial l} - \frac{\partial V^D}{\partial l} \right) \leq 0$ . Differentiating again implies  $\frac{\partial^2 y}{\partial l^2} = -\mathbf{1}_{\{constrained\}} A_2 F''(K_2) \Gamma'(\gamma^*) + \frac{\Gamma''(\gamma^*)}{(\Gamma'(\gamma^*))^2} \left( \frac{\partial y}{\partial l} \right)^2$ . The first term is nonnegative (and positive if the firm is constrained and  $\Gamma$  is increasing). The second term has the sign of  $\Gamma''$ . In the case that  $\gamma$  has a uniform distribution,  $\Gamma'' = 0$ . More generally, as long as  $\Gamma''$  is small over the support of  $\gamma^*$  (which is a subset of the support of  $\gamma$ ), then  $\frac{\partial^2 y}{\partial l^2} \geq 0$ . The usual stochastic dominance argument then implies (i) in proposition 2. Similarly,  $\frac{\partial y}{\partial A_2} = \Gamma'(\gamma^*) (\phi F(K_2^F) - F(K_2^D))$ , which is strictly positive (the superscripts on  $K_2$  indicate the capital stock under foreign and domestic ownership, respectively). Differentiating with respect to  $l$  gives:  $\frac{\partial^2 y}{\partial l \partial A_2} = -\mathbf{1}_{\{constrained\}} F'(K^D) \Gamma'(\gamma^*) + \frac{\Gamma''(\gamma^*)}{(\Gamma'(\gamma^*))^2} \left( \frac{\partial y}{\partial l} \right) \left( \frac{\partial y}{\partial A_2} \right)$ . The first term is nonpositive and strictly negative when the firm is constrained. Again, assuming that  $\Gamma$  is close to linear, then  $\frac{\partial^2 y}{\partial l \partial A_2} \leq 0$  and our stochastic dominance assumption then implies (ii).

Proof of Proposition 3:

Recall that  $P = \beta S + V^D = \beta (V^F - V^D - \gamma) + V^D$ . An increase in  $\pi$  raises  $V^F$  and an unconstrained  $V^D$  one for one by the amount of additional profit. If constrained,  $V^D$  increases by an additional  $(A_2 F'(l) - \delta)$ . Similarly, an increase in  $\bar{D}$  leaves  $V^F$  unchanged, but increases a constrained domestic firm by  $(A_2 F'(l) - \delta)$ . Given the concavity of  $F$ , this latter term is strictly decreasing in  $l$  over the constrained region (and zero otherwise). Therefore,  $\frac{\partial P}{\partial l}$  is nonincreasing in  $l$  and strictly decreasing over the constrained range. Our *fosd* assumption then implies (i). Similarly,  $\frac{\partial P}{\partial A_2} = \beta(F(K^F) + (1 - \beta)F(K^D))$ , and so  $\frac{\partial^2 P}{\partial l \partial A_2} = \mathbf{1}_{constrained}(1 - \beta)(F'(l)) \geq 0$ , with a strict inequality if constrained. Our *fosd* assumption then implies (ii).

## C Additional Regressions

In this appendix we present additional regression results to complement those presented in table 3. Table A1 includes log net worth as an alternative measure of liquidity in explaining the probability of acquisition. Net worth captures the general health of the firm’s balance sheet; a large literature links the balance sheet of a firm on the ability to borrow in external capital markets.<sup>20</sup> While the amount of outstanding debt on a firm’s balance sheet may also reflect access to credit markets (as large debt implies ability to borrow), the firm fixed effect will control for any permanent cross-sectional heterogeneity in access to credit.

As in table 3, the dependent variable equals one when a firm is acquired and zero otherwise. The independent variables are as defined in Appendix A. The first two columns of table A1 replace log sales with log net worth, using firm and industry\*nation\*year fixed effects, respectively. The last two columns include both log sales and log net worth. In all specifications, the point estimates support our earlier results – the coefficient on liquidity falls during a crisis and the coefficient on capital expenditures increases. The change in the coefficient on log net worth is significant when log sales is not included. If log sales is included, precision falls due to the correlation between the two measures of liquidity. Moreover, comparing table A1 with table 3, the estimated coefficients on log sales and log capital expenditures (both in normal periods and during the crisis) remain largely invariant to the inclusion of log net worth as an additional regressor.

Table A2 presents the results from logit and conditional logit regressions to complement the linear probability results presented in table 3. The first column confirms that the sensitivity to liquidity and capital expenditure changes significantly during the crisis. For each coefficient we have computed the sample average of the implied slope (i.e.  $\frac{\partial y}{\partial X}$ ).<sup>21</sup>

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<sup>20</sup>See Bernanke et al (1998).

<sup>21</sup>As is now standard, we compute the slope taking the sample average of the marginal effect evaluated at each observation (see Green (2000) p. 816). The alternative procedure uses the density evaluated at the average value of the independent variables. This latter calculation yields nearly identical marginal effects for our sample.

These marginal effects are similar (although slightly smaller in magnitude) to the slopes obtained in the linear probability regressions (table 3).

The conditional logit specification estimates the probability of acquisition *conditional* on the number of acquisitions observed within the group, where column 2 uses the firm to define a group and column 3 uses industry\*nation\*year triplets as the group. One issue with the conditional logit is that all groups in which the total number of acquisitions is zero are dropped, limiting the sample size and reducing efficiency if there is no underlying group heterogeneity. In column 2 we see that sensitivities to liquidity change significantly during the crisis in a manner that support the results of table 3. In both specifications of the conditional logit, the point estimates are very close to those in the unconditional logit. In this regard, the conditional logit estimates do not indicate a bias in the unconditional logit and a Hausman test fails to reject that the estimates are identical.<sup>22</sup>

## D M&A and FDI

This appendix compares the magnitude of M&A activity to total FDI inflows, highlighting the difficulties in making a direct comparison. FDI inflow is defined as the purchase by a foreign entity of 10% or more of outstanding equity of a domestic firm, plus additional inflows from the foreign parent to the domestic firm (through debt or equity) once the initial equity purchase occurs. FDI encompasses the establishment of new firms (greenfield investment) as well as purchases of existing firms. Conceptually, one may consider a cross-border acquisition that involves 10% or more of equity as FDI. However, it may not be treated as such in balance of payments (BoP) accounting. For example, if an acquisition uses funds raised in the domestic market (a debt outflow matched by an equity inflow) or involves a swap of equity (an equity outflow matched by an equity inflow), the net effect on the BoP is zero and the transaction is not registered as FDI. Therefore, M&A is not a strict subset of FDI. (See World Investment Report (2000) for a full discussion).

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<sup>22</sup>A Hausman test is the appropriate test in this context as the logit is efficient in the absence of group heterogeneity but inconsistent otherwise, while the conditional logit is consistent in either case.

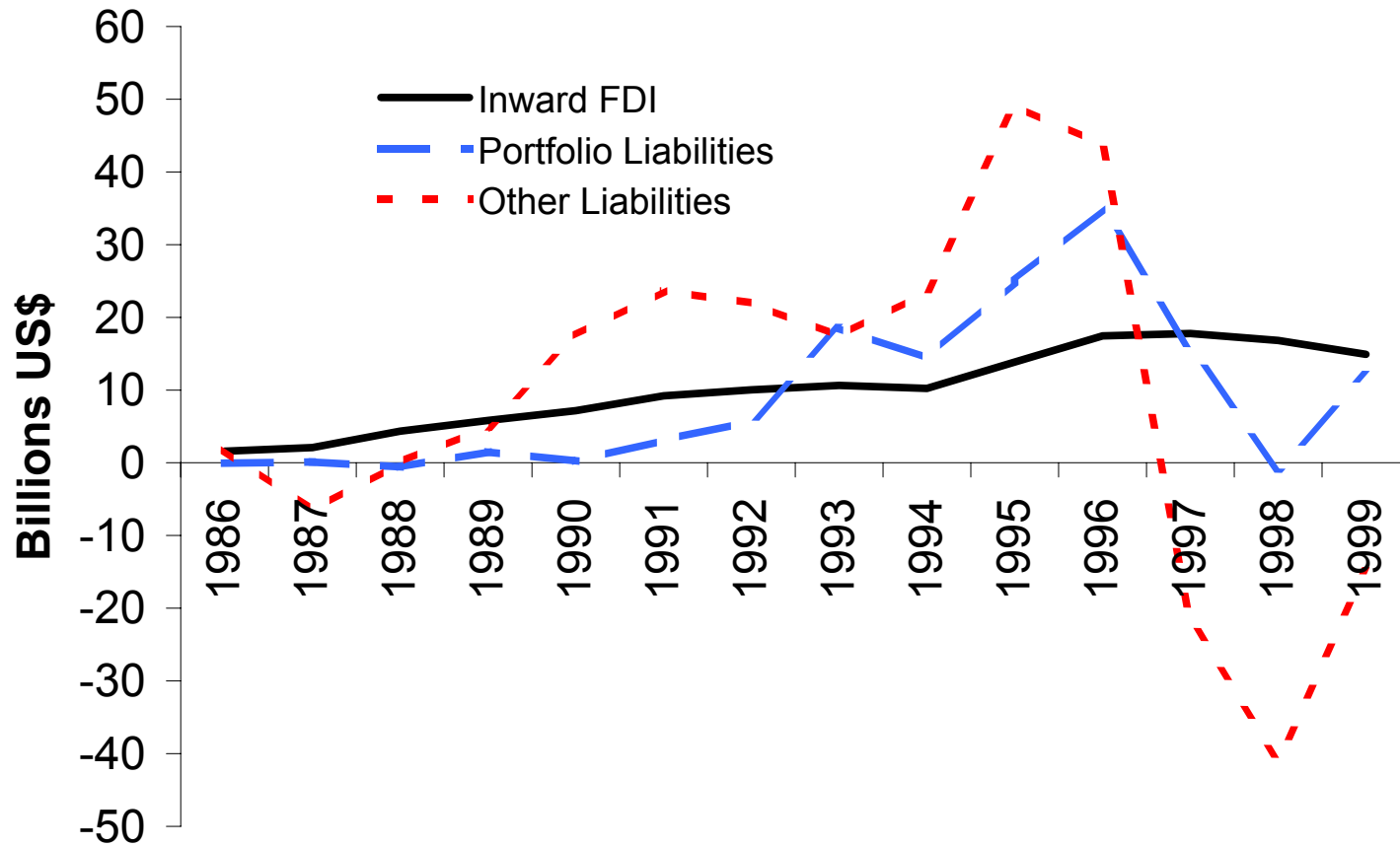
In table A3, we express the value of M&A (that involve more than 10% of equity) as a fraction of FDI. As discussed in the previous paragraph, this ratio is not bounded above by one. The first two columns of numbers are taken from the UN's World Investment Report (2000). The final two columns uses the amount of the acquisition price that was paid in cash as reported by SDC. This excludes any equity swaps, but may include locally raised cash. By both measures, M&A as a percentage of FDI was substantial for the East Asian Economies during the crisis. The share is also higher for the year 1998 as compared to the average of the 3 years.

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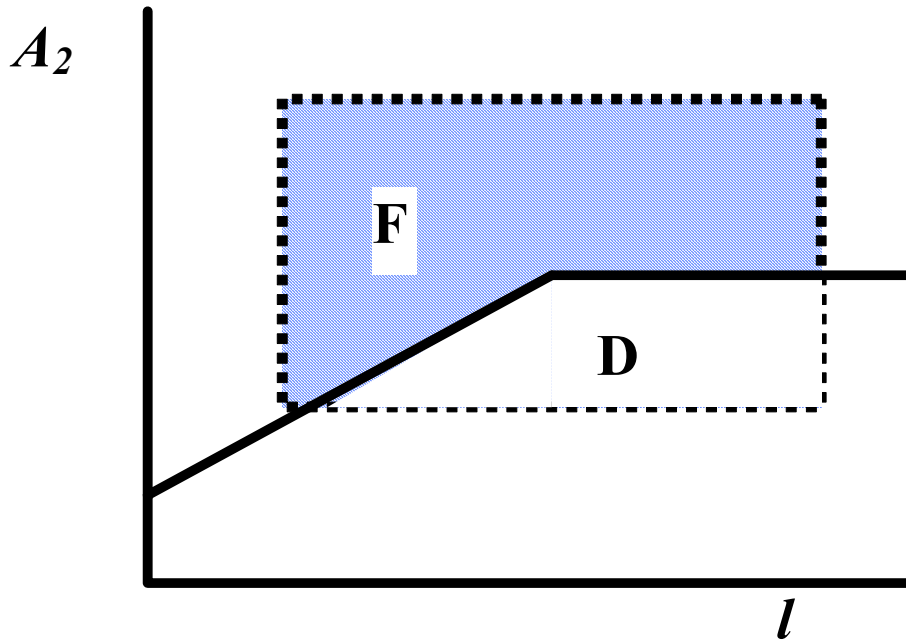
# Figure 1: Capital Inflows into East Asia



Source: IFS. Net inflows (liabilities) summed over the five East Asia nations. Categories are as defined by IFS.

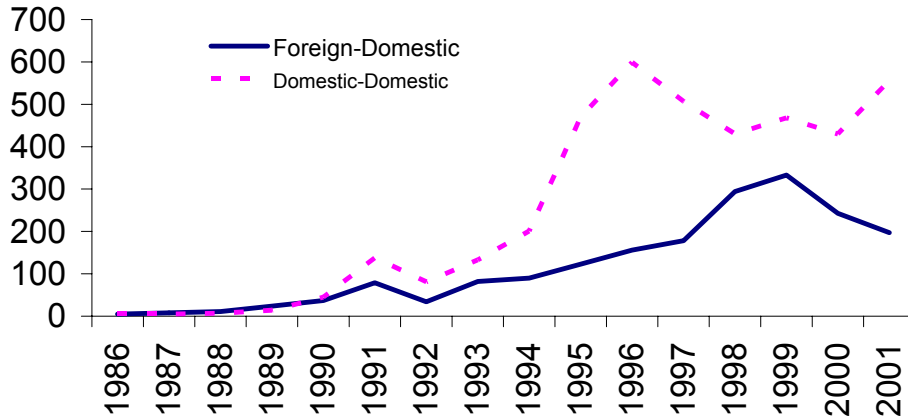


Figure 2: Range of Foreign Acquisition



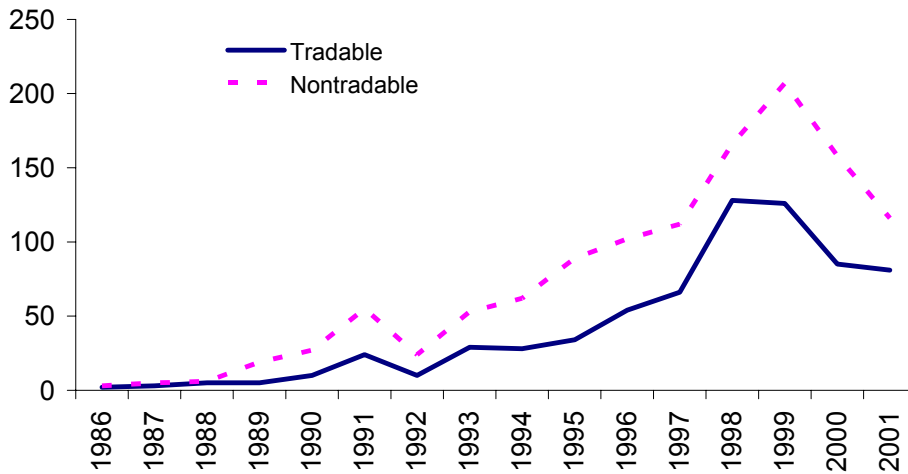
$A_2$  and  $l$  refer to productivity and liquidity, respectively, as defined in the text. The area within the box represents the support of firms at the start of period one. The solid line represents pairs of productivity and liquidity for which the surplus of foreign acquisition is zero (drawn for a fixed  $\gamma$ ). The shaded area denoted “F” represents firms for which acquisition is efficient; firms within the region denoted “D” remain domestically owned.

**Figure 3: Completed Acquisitions -- Foreign and Domestic**



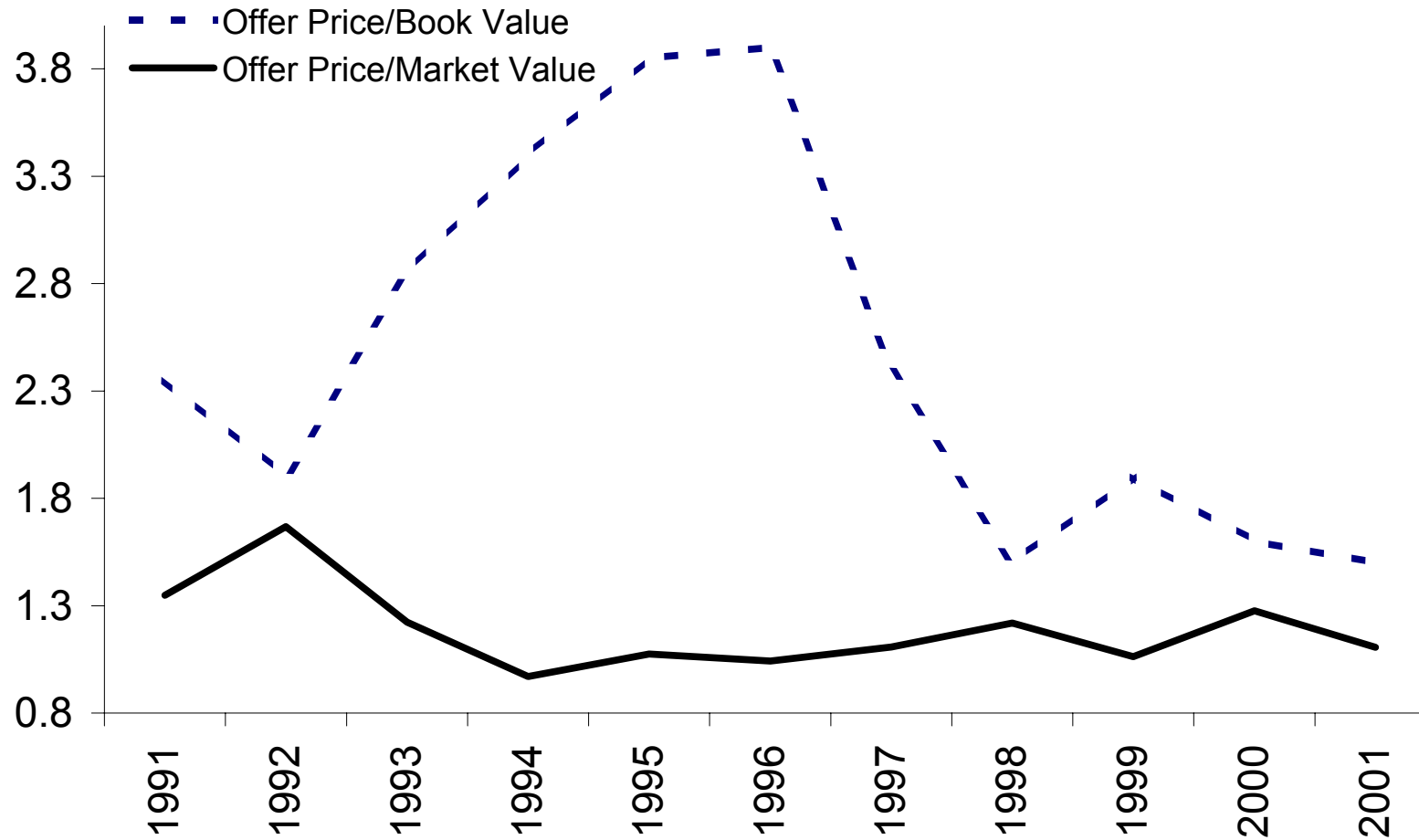
This figure depicts the number of completed acquisitions announced in the relevant year summed over the five East Asian nations. The solid line represents acquisitions by entities based outside the country of the acquired firm. The dashed line represents cases in which the acquiring firm and the target firm are based in the same country.

**Figure 4: Completed Acquisitions: Tradable vs. Nontradable**



This figure depicts the number of completed acquisitions by foreign firms broken down by industry of acquired (target) firm. Tradable is defined as manufacturing and includes acquired firms with primary SIC code between 200 and 399. Acquired firms which list their primary industry outside this range are classified as nontradable.

**Figure 5: Median Ratio of Offer Price to Book Value**



Median offer price to book value (solid line) and offer price to market value (dotted line) as defined in text.

**Table 1: Distribution of Shares Acquired**

	Foreign Acquisitions		All Acquisitions	
	1986-2001	1998	1986-2001	1998
Mean	52.67	56.01	60.64	61.96
Standard Deviation	35.19	34.98	36.45	36.39
Percentiles				
10%	9	10	10	10
25%	20	24	25	28
50%	49	50	60	60
75%	100	100	100	100
Number of Acquisitions	1894	294	5983	724

Note: 90% of our sample acquisitions involve the purchase of at least 10% of equity, qualifying as FDI. The distribution of shares does not differ between that for all the years in our sample and for 1998.

**Table 2: Descriptive Statistics of the Target Firm**

	Foreign Acquisitions		All Acquisitions	
	1986-2001	1998	1986-2001	1998
Median Log Sales	4.67	4.59	4.52	4.52
Median Log Capital Expenditure	2.56	3.18	1.88	1.83
Median Log Cash Flow	3.49	3.50	2.58	2.74
Median Log Net Worth	4.36	4.29	4.30	4.33
Median Log Assets	5.51	5.10	5.27	5.38

Note: The median values for the sample excluding 1998 are very similar to the median values for the entire sample reported here.

**Table 3: Probability of Acquisition by Foreign Company**  
(Linear Probability Regression)

	(1)	(2)	(3)	(4)
ln(Cash Flow)	0.0081 *** (0.0024)	0.0026 (0.0027)		
* Year 1998	-0.0102 * (0.0054)	-0.0101 (0.0094)		
ln(Sales)			0.0018 (0.0042)	-0.0023 (0.0034)
* Year 1998			-0.0094 ** (0.0046)	-0.0096 (0.0084)
ln(Capital Expenditure)	0.0065 *** (0.0019)	0.0017 (0.0025)	0.0038 ** (0.0016)	0.0036 (0.0025)
* Year 1998	0.0065 (0.0046)	0.0112 (0.0094)	0.0063 (0.0039)	0.0100 (0.0071)
Constant	-0.0754 (0.1952)	0.0089 (0.0054)	-0.0333 (0.4306)	0.0278 ** (0.0118)
Firm & Year Fixed Effects	Yes	No	Yes	No
Year*Nation*Industry Fixed Effects	No	Yes	No	Yes
Adjusted R2	0.09	0.10	0.14	0.15
Observations	8,406	8,406	9,812	9,812
Mean Dependent Variable	0.02	0.02	0.02	0.02

Note: Robust standard errors are in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Year\*Nation\*Industry fixed effects include fixed effects for each year, country and industry at the 3-digit SIC code, and all interactions of these variables. The dependent variable takes the value 1 when a domestic company is acquired by a foreign company. Acquisitions only include completed transactions.

**Table 4: Probability of Acquisition by Foreign Company: Tradable Firms**  
(Linear Probability Regression)

	(1)	(2)	(3)	(4)
ln(Cash Flow)	0.0094 *** (0.0033)	0.0015 (0.0033)		
* Year 1998	-0.0144 ** (0.0067)	-0.0217 * (0.0111)		
ln(Sales)			-0.0007 (0.0062)	-0.0038 (0.0039)
* Year 1998			-0.0191 ** (0.0093)	-0.0181 * (0.0108)
ln(Capital Expenditure)	0.0085** (0.0028)	0.0056 * (0.0030)	0.0077 *** (0.0023)	0.0073 *** (0.0026)
* Year 1998	0.0085 (0.0060)	0.0196 ** (0.0097)	0.0123 * (0.0067)	0.0172 * (0.0088)
Constant	-0.0091 * (0.0081)	0.0043 (0.0068)	-0.0468 *** (0.0099)	0.0291 ** (0.0148)
Firm & Year Fixed Effects	Yes	No	Yes	No
Year*Nation*Industry Fixed Effects	No	Yes	No	Yes
Adjusted R2	0.06	0.15	0.13	0.21
Observations	4808	4808	5614	5614
Mean Dependent Variable	0.017	0.017	0.019	0.019

Note: Robust standard errors are in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Year\*Nation\*Industry fixed effects include fixed effects for each year, country and industry at the 3-digit SIC code, and all interactions of these variables. The dependent variable takes the value 1 when a domestic company is acquired by a foreign company. Acquisitions only include completed transactions. Tradable and nontradable refer to the sector of the target (acquired) firm. All industries that defined as manufacturing (SIC codes 200-399) are included in tradables.

**Table 5: Price of Acquisition by Foreign Company**

	Dependent Variable: ln(Offer Price/ Book Value)					
	All Sectors			Tradable Sectors		
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Cash Flow)	-0.0371 (0.1230)			-0.0139 (0.3255)		
* Year 1998	0.6970 *** (0.2370)			1.1569 * (0.5841)		
ln(Sales)		-0.0400 (0.0714)			0.1153 (0.1721)	
* Year 1998		0.6663 * (0.3652)			1.5202 ** (0.6966)	
ln(Capital Expenditure)	-0.0145 (0.0792)	-0.0239 (0.0718)		-0.0921 (0.2069)	-0.1316 (0.1449)	
* Year 1998	-0.0276 (0.1444)	-0.1572 (0.2133)		-0.5489 (0.5391)	-1.1807 * (0.6985)	
ln(Sales/Assets)			0.0277 (0.0756)			0.2600 (0.1671)
* Year 1998			0.8029** (0.3753)			1.5399*** (0.4030)
ln(Capital Expenditure/Assets)			-0.0085 (0.0946)			-0.0414 (0.1943)
* Year 1998			0.0527 (0.2330)			-0.9257 (0.8897)
Constant	0.6960 *** (0.2301)	0.7069 ** (0.2995)	0.8702*** (0.2991)	0.7165 (0.5899)	-0.0136 (0.5688)	0.5382 (0.5653)
Year*Nation*Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.67	0.59	0.56	0.67	0.58	0.55
Observations	559	707	706	256	323	322
Mean Dependent Variable	0.80	0.79	0.78	0.70	0.71	0.69

Note: Robust standard errors are in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Year\*Nation\*Industry fixed effects include fixed effects for each year, country and industry at the 3-digit SIC code, and all interactions of these variables. We include all acquisitions for which there is data on the price of the transaction. All industries that defined as manufacturing (SIC codes 200-399) are included in tradables.



**Table 6: Breakdown by Periods**  
**Probability of Acquisition by Foreign Company of Tradable Firms**  
 (Linear Probability Regression)

	1986-1996	1997	1998	1999	2000-2001
ln(Sales)	-0.0052 (0.0041)	-0.0136 (0.0155)	-0.0219 ** (0.0097)	-0.0155 * (0.0082)	0.0139 * (0.0083)
ln(Capital Expenditure)	0.0024 (0.0026)	0.0064 (0.0082)	0.0245 *** (0.0082)	0.0115 (0.0071)	0.0088 ** (0.0044)
Constant	0.0270 * (0.0164)	0.0616 (0.0566)	0.0934 *** (0.0353)	0.0801** (0.0314)	-0.0361 (0.0345)
Year*Nation*Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.25	0.00	0.22	0.12	0.47
Observations	2431	612	667	862	1042
Mean Dependent Variable	0.007	0.013	0.033	0.024	0.033

Note: Robust standard errors are in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Year\*Nation\*Industry fixed effects include fixed effects for each year, country and industry at the 3-digit SIC code, and all interactions of these variables. The dependent variable takes the value 1 when a domestic company is acquired by a foreign company. Acquisitions only include completed transactions. Tradable and nontradable refer to the sector of the target (acquired) firm. All industries that defined as manufacturing (SIC codes 200-399) are included in tradables.

**Table 7: Probability of Acquisition**  
(Linear Probability Regression)

	Acquisition by Domestic Firm		Acquisition of Nontraded Firm	
	(1)	(2)	(3)	(4)
ln(Sales)	0.0302 *** (0.0074)	0.0041 (0.0049)	0.0039 (0.0057)	-0.0012 (0.0056)
* Year 1998	-0.0022 (0.0056)	-0.0114 (0.0121)	-0.0038 (0.0047)	-0.0040 (0.0130)
ln(Capital Expenditure)	-0.0007 (0.0025)	0.0066 (0.0078)	0.0003 (0.0022)	-0.0008 (0.0045)
* Year 1998	-0.0008 (0.0039)	0.0107 (0.0169)	0.0026 (0.0048)	0.0026 (0.0117)
Constant	-0.1427 (0.0991)	0.0316 *** (0.0062)	-0.6754** (0.2698)	0.0317 * (0.0182)
Firm & Year Fixed Effects	Yes	No	Yes	No
Year*Nation*Industry Fixed Effects	No	Yes	No	Yes
Adjusted R2	0.13	0.02	0.20	0.07
Observations	5614	5614	4198	4198
Mean Dependent Variable	0.03	0.03	0.024	0.024

Note: Robust standard errors are in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Year\*Nation\*Industry fixed effects include fixed effects for each year, country and industry at the 3-digit SIC code, and all interactions of these variables. The dependent variable takes the value 1 when a domestic company is acquired by a domestic company in columns (1) and (2) and by a foreign company in columns (3) and (4). Only completed acquisitions are included. Tradable and nontradable refer to the sector of the target (acquired) firm. All industries that are not defined as manufacturing (SIC codes 200-399) are included in nontradables.

**Table A1: Probability of Acquisition by Foreign Company:  
Net Worth as a proxy for liquidity  
(Linear Probability Regression)**

	(1)	(2)	(3)	(4)
ln(Net Worth)	0.0054 * (0.0030)	0.0022 (0.0027)	0.0003 (0.0028)	0.0023 (0.0035)
* Year 1998	-0.0102 ** (0.0048)	-0.0132 * (0.0072)	-0.0054 (0.0052)	-0.0090 (0.0099)
ln(Sales)			0.0034 (0.0050)	-0.0030 (0.0046)
* Year 1998			-0.0087 (0.0053)	-0.0090 (0.0122)
ln(Capital Expenditure)	0.0057 *** (0.0017)	0.0012 (0.0022)	0.0040 ** (0.0018)	0.0030 (0.0030)
* Year 1998	0.0063 (0.0040)	0.0107 * (0.0065)	0.0085 * (0.0047)	0.0137 * (0.0082)
Constant	-0.1006 (0.1721)	0.0123 (0.0090)	-0.0284 (0.4059)	0.0256 ** (0.0131)
P-Value of test: ln(Net Worth)*D <sub>98</sub> & ln(Sales)*D <sub>98</sub> =0			0.06	0.16
Firm & Year Fixed Effects	Yes	No	Yes	No
Year*Nation*Industry Fixed Effects	No	Yes	No	Yes
Adjusted R2	0.11	0.11	0.14	0.14
Observations	9,763	9,763	9,039	9,039
Mean Dependent Variable	0.02	0.02	0.02	0.02

Note: Robust standard errors are in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Year\*Nation\*Industry fixed effects include fixed effects for each year, country and industry at the 3-digit SIC code, and all interactions of these variables. The dependent variable takes the value 1 when a domestic company is acquired by a foreign company. Only completed acquisitions are included. Net worth is defined as (assets - liabilities).

**Table A2: Probability of Acquisition by Foreign Company**  
(Logit and Conditional Logit)

	Logit	Conditional Logit	
ln(Sales)	-0.186 *** (0.061) [slope: -0.004]	-0.206 (0.176)	-0.133 (0.108)
* Year 1998	-0.232 * (0.133) [slope: -0.005]	-0.388 * (0.206)	-0.159 (0.280)
ln(Capital Expenditure)	0.192 *** (0.051) [slope: 0.004]	0.194 * (0.10)	0.176 ** (0.080)
* Year 1998	0.270 ** (0.121) [slope: 0.005]	0.345 (0.167)	0.301 (0.205)
Year Indicator 1998	0.862 * (0.477) [slope: 0.017]	NA	NA
P-Value Hausman Test		0.84	0.92
Firm & Year Fixed Effects	No	Yes	No
Year*Nation*Industry Fixed Effects	No	No	Yes
Pseudo R2	0.02	0.19	0.04
Observations	9,812	1014	742
Mean Dependent Variable			

Note: Standard errors are in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Year\*Nation\*Industry fixed effects include fixed effects for each year, country and industry at the 3-digit SIC code, and all interactions of these variables. Slope refers to the average marginal change in the probability of acquisition due to a change in the regressor. Hausman test refers to comparison of conditional and unconditional logit.

**Table A3: Mergers and Acquisitions as a Percentage of FDI Inflows into East Asia**

	World Investment Report (2000)		Authors' Calculations	
	1996-1998 (1)	1998 (2)	1996-1998 (3)	1998 (4)
South Korea	51%	76%	73%	119%
Philippines	144%	109%	74%	120%
Malaysia	13%	41%	12%	34%
Thailand	30%	43%	37%	44%
Indonesia	15%	683/-356†	25%	1076/-356†

Note: World Investment Report (2000) refers to UN calculations of cross-border M&A that they estimate is comparable to FDI. Authors' calculations refer to the cash component of acquisitions as reported by SDC. Only those mergers involving at least 10% of equity are included. The denominator in all cases is net inflows of FDI as reported by the International Financial Statistics. †Indonesia experienced negative net inflows of FDI in 1998 of 356 million US dollars and positive inflow of acquisitions of USD 683 million in the UN sample and USD 1076 million in our sample.