



IMF Working Paper

Sudden Stops, Output Drops, and Credit Collapses

Jihad C. Dagher

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Prepared by Jihad C. Dagher¹

Authorized for distribution by Abdelhadi Yousef

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Abstract

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This paper proposes a tractable Sudden Stop model to explain the main patterns in firm level data in a sample of Southeast Asian firms during the Asian crisis. The model, which features trend shocks and financial frictions, is able to generate the main patterns observed in the sample during and following the Asian crisis, including the ensuing credit-less recovery, which are also patterns broadly shared by most Sudden Stop episodes as documented in Calvo et al. (2006). The model also proposes a novel explanation as to why small firms experience steeper declines than their larger peers as documented in this paper. This size effect is generated under the assumption that small firms are growth firms, to which there is support in the data. Trend shocks when combined with financial frictions in this model also generate strong leverage effects in line with what is observed in the sample, and with other observations from the literature.

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Author's E-Mail Address: jdagher@imf.org

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I. INTRODUCTION

In recent decades, a number of emerging markets have experienced episodes of dramatic reversals in international capital flows that were followed by economic crises, and deep contractions in output. During these crises, often referred to as Sudden Stops, firms' main predicament is the shortage of financing. A large body of empirical and theoretical research on Sudden stops places this problem at the heart of the severe drops in output that follow the current account reversals. Recoveries in output do follow nevertheless, and relatively quickly as data from these episode show.² However, such recoveries are more often than not *creditless* (see e.g. Calvo et al. (2006)). Examining a sample of Southeast Asian firms during the Asian crisis, this paper shows a strong dichotomy between the behavior of firms' sales on one side, and that of their market value and debt levels on the other. Concretely, the recovery can only be seen in the output, while other variables remain below their pre-crisis level for an extended period of time. This observation raises the question about the drivers of the recovery in such an environment, and, more fundamentally, about the nature of the underlying shock that generates these patterns.

This paper formulates a model where shocks to trend productivity can generate these features in a Sudden Stop model with financial frictions in the form of an endogenous borrowing constraint and a constraint on equity issuance. In a frictionless world, a negative trend shock leads in the model to a decline in firms' market value and affects only the growth rates of other variables. In the presence of frictions on the other hand, these shocks translate into tightened borrowing constraints which can lead to large output drops. As firms respond to margin calls from lenders, the initial adjustment in their capital structure is costly and leads to lower production capacity. This initial loss is recuperated in the years following the crisis as firms try to regain their optimal capital levels.³ This mechanism is different from the one in Mendoza (2005, 2009) where the fall and the recovery in output is to a large extent amplified by financial frictions but originally driven by a mean reverting TFP shock. Such TFP shocks lead to a procyclicality between output, credit and Tobin's Q. This model shows how even in the presence of a persistent readjustment in firms' market value a quick creditless recovery can ensue when such readjustment is driven by a trend shock, hence breaking a procyclicality that is at odds with our data and the patterns documented in Calvo et al. (2006). The model also shows that these shocks can reconcile the patterns in the aggregate data with two significant explanatory variables of firms' performance in the data, which are firms' size and leverage. A firm's size, which in the model is negatively correlated with its growth opportunities as in the data, affects the response of its market value to the aggregate shock. The intuition is the following: a larger share of smaller firms' market value is due to their growth opportunities and hence their market value are more volatile in response to trend shocks. A firm's leverage, on the other hand, amplifies the transmission or

²Calvo et al. (2006) find, in a sample of Sudden Stop episodes, that the recovery time to the pre-crisis output level averages around 2 years.

³It is equivalent to think about this fall in capital as being a fall in utilized capital, i.e., the fall being partly due to a fall in capacity utilization. However for the sake of simplicity the paper does not impose frictions on investment and it is assumed that firms operate at full capacity.

the multiplier mechanism between its market value and its financing opportunities. Since trend shocks lead to sizable variations in the market value of firms, the degree of a firm's leverage will have a significant impact on its output as observed in the data.

The economic importance of Sudden Stops and their frequency prompted much theoretical research. This literature has recognized the importance of financial frictions early on, as frictionless real business cycle models cannot generate sizable output contractions following a tightening of borrowing constraints (see e.g. Chari, Kehoe and McGratten (2005)). Therefore, various financial frictions were at the center stage of earlier sudden stop models (see e.g. Calvo (1998), Aghion, Bacchetta and Banerjee (2004), Caballero and Krishnamurthy (2001), Mendoza (2002)). Some of these models have also emphasized liability dollarization, which was until recently widespread in many emerging economies, and showed how a devaluation in this context could amplify shocks due to balance sheets effects. More recently, Mendoza (2005, 2009) formulates a model where sudden stops are a low probability equilibrium outcome of a business cycle model and can be generated following total factor productivity shocks of standard magnitudes.

The simple model formulated in this paper is at the crossroads of three main strands of literature. First, it is related to earlier Sudden Stop models, particularly in that the main mechanism in the model hinges on the existence of endogenous borrowing constraints. This amplification mechanism, common to Sudden Stop models, is borrowed from the literature on the financial accelerator in macroeconomic models (see for example Bernanke, Gertler and Gilchrist (1999), and Kiyotaki and Moore (1997)). This paper differs from existing Sudden Stop models, however, in that it emphasizes aspects in the recovery from a sudden stop as well as firm heterogeneity, and relies on trend productivity shocks to generate the observed patterns. In that respect the model is related to the literature that emphasizes the importance of trend shocks in explaining the business cycle in emerging markets, and in particular to Aguiar and Gopinath (2007).⁴ Trend shocks in this model are motivated by the permanent decline in both growth rates and asset prices in Southeast Asian economies following the crisis.⁵ The decline in growth rates following financial crises was also documented in earlier studies examining a larger sample of countries (see e.g. Cerra and Saxena (2008), and Ranciere et al. (2008)). Finally, the model also borrows its modeling of financial frictions on equity issuance from the literature on financial innovation and macroeconomic volatility, and particularly from Jermann and Quadrini (2005).⁶ Such modeling strategy, involves no loss of generality, and is suited for its tractability and interpretability as the model tries to account

⁴A growing empirical and theoretical literature underline the presence of trend shocks in emerging countries. See for example, Aguiar and Gopinath (2006) and Yue (2010) for the role of stochastic trends in matching debt, default, and interest related patterns in the data. On the empirical side, Cerra and Saxena (2008) finds that low-income and emerging market countries have a greater volatility in the permanent component of the shocks than high income countries.

⁵In Thailand, for example, stock market indices had not recovered to their pre-crisis level even by end-2007, before the recent 2008 global financial crisis sent the stocks plunging again.

⁶When not specified, the term "financial frictions" is henceforth loosely used to refer to the frictions on equity issuance. Borrowing constraints are also a form of financial frictions, but will often be referred to by their name instead to differentiate between the two kind of frictions.

for observations from a sample of publicly listed firms.⁷ It also helps emphasize the role of financial market frictions in the transmission of shocks from asset prices to the real economy.

The rest of this paper is organized as follows: Section 2 discusses the main empirical findings from the data; Section 3 presents the model, which is followed by simulations from quantitative exercises, and a discussion and further comparison with the data; and Section 4 concludes.

II. FROM SUDDEN STOPS TO OUTPUT RECOVERIES

A. Macro Evidence

Southeast Asian economies have enjoyed a long period of high and uninterrupted growth before a financial crisis, that started with the devaluation of the Thai Baht, hit the region during the second half of 1997. Following this devaluation, these economies experienced large losses in their output in 1998, and for some, these losses continued in 1999, before the economic activity started a strong recovery in 2000. Aggregate data from Indonesia, Malaysia and Thailand, show that these economies have exhibited to a great extent, during that episode, the main stylized facts of a Sudden Stop, which motivate the study of this sample in this paper. The three countries have experienced a strong reversal in current account. Following this reversal, real GDP has contracted by more than 10% in Indonesia and Thailand, and by around 7% in Malaysia (see Figure 3). Among the three countries, Indonesia's recovery was the slowest; its real GDP recovered to its pre-crisis level only by the end of 2003. The recovery of these economies took place without a recovery in credit, as shown in 1. Furthermore, the collapse in the market value of firms, as shown in Figure 2, was also very persistent.⁸ Another intriguing feature in the aggregate data is the decline in growth rates following the crisis. Table 2 shows a comparison of average growth rates for the three countries from before and after the crisis. For example, while Malaysia's real growth rate averaged around 9.5% between 1990 and 1996, it has fallen down to an average of 4.2% between 2000 and 2006. The decline is statistically significant, and sizeable, and can be observed in 3. This is in line with findings from other empirical studies (see e.g. Barro (2001), and Cerra and Saxena (2008)) that show a persistent decline in GDP growth rates following financial crises.

⁷If we assume instead that firms cannot issue equity, this would lead to a stronger amplification effect of growth shocks. The advantage of the current approach is that one can vary the parameter that determines the cost on equity issuance to compare the frictionless case with the fully constrained case.

⁸The indices shown in Figure 2 do not show a sign of recovery to their pre-crisis level until recently, in 2008, particularly in Indonesia and Malaysia, as the MSCI index of the Thai market is still, as of end-2009, significantly below its end-1996 level.

B. Micro Evidence

Sample selection and data The sample consists of 480 firms listed on the stock market in Indonesia, Malaysia and Thailand. Financial services firms are not included since their accounting practices are different from those of firms in other industries. The focus is on the period 1996–2003, a period that spans the pre-crisis year until the year in which output has recovered to its pre-crisis level in the three countries. Since the interest is in understanding the recovery of these firms, only surviving firms are selected making the sample a balanced panel. This also eases the interpretation of the results (as well as the graphs) which become independent of firm entry and exit.⁹ The data is obtained from Worldscope (Thomson Financial) and include information on firms' balance sheets, income statements, flow of funds as well as other information. Only companies for which the main balance sheet items are available are included. In particular, the main inclusion criteria are the availability of data on sales, assets, liabilities and market value. From the 480 firms in the sample, 102 firms are listed in Indonesia, 220 are listed in Malaysia and 158 are listed in Thailand.

The collapse in credit and asset prices Figure 4 shows the average of the main aggregate variables in the sample over the Sudden Stop episode. The upper left panel shows an index of the average sales. The biggest drop in sales occurred during 1998, at the height of the crisis. Sales fell by around 7%, and another contraction followed in 1999, bringing the total drop to around 10%. The upper right panel compares the index of sales with that of firms' average debt levels. There is a stark contrast between the recovery of sales and the significant and continuous collapse in debt until the last year in the sample. The lower left panel shows a collapse in investment, which later stabilized around its level in 1999, which consisted of a drop of around 60% from its 1997 level. The lower right panel contrasts the recovery in sales with the non-recovery of the index of firms' market value. The latter index is a beginning of year index since the fall in asset prices preceded the drop in other variables as in most crises; using 1997 as a reference will leave out a large part of the drop.¹⁰

The size and leverage effects These patterns of collapse and creditless recovery are quite uniform across firms of different characteristics. The magnitude of the impact of the crisis however, varies substantially, and is correlated with firms' characteristics. We identify the size and leverage of a firm as being characteristics that were significantly correlated with a firm's performance during the crisis.

⁹The use of balanced panel is also common in the literature that studies firms' performance in emerging markets during a crisis since data on bankruptcies is not always readily available, and firms could delist for a host of other reasons. Given that the purpose of our study is not a systematic empirical analysis into the determinants of firms' performance during the crisis, a balanced panel is well suited for our analysis. We are also confident that the size and leverage effects are not tainted with a survivorship bias view their significance, the relatively small number of bankruptcies, and the other citations that we provide in support of such correlations

¹⁰Note that the crisis started during the second half of 1997, hence, end-1997 values of firms' market value will not reflect the pre-crisis levels

To illustrate the size effect, firms were ranked on the basis of the dollar amount of their fixed assets in end-1996. Figure 5 contrasts the behavior in the upper and lower third of the sample. The figure shows a drop in sales of around 15% for the smaller firms while it was below 8% for the larger firms. The recovery of sales was also slower for the small firms. Smaller firms had also to decrease their stock of debt significantly more than the larger firms. The difference between the average fall in the market value in both samples is also striking. Note that figure 5 shows the means of these financial variables, and a use of the median values instead would exhibit a similar size effect. While earlier empirical research from firm-level data during the Asian crisis episode have not systematically studied the relationship between size and performance, some studies do find this association (see e.g. Mitton (2002), Kim and Lee (2003)).¹¹

A leverage effect is also present in the data, in that more levered firms had a worse performance, on average, during the crisis. This relationship is, indeed, not necessarily surprising and has been underlined in earlier studies (see e.g. Mitton (2002), Claessens (2000)). What is particularly interesting, and will give strength to the arguments in the model in section 3, is the fact that firms with the lowest leverage ratios experienced little to any set back to their sales despite the fall in their market value. The two left panels of Figure 6 illustrate this by comparing the performance of firms with leverage below 0.2 (below the 10th percentile to that of the average firm in the sample (average leverage in the sample is 0.52). While the market value collapse is also strong in that sample, the fluctuations in their output do not necessarily suggest an economic crisis. Further evidence, that this paper argues could be brought to support the central role of firm leverage in determining performance, comes from data in Paulson and Townsend (2005). These data cover rural and semi-rural family businesses in Thailand. Paulson and Townsend (2005) found that these small businesses in Thailand did not experience any significant decrease in their income and profit levels. The right panel in Figure 6 shows the income of these small businesses was relatively resilient to the financial crisis. These small businesses are, indeed, very different from the firms studied in this paper. Nevertheless, one of their important characteristics, which is the fact that they carried virtually zero debt due to severe financial constraints, makes them relevant to the discussion of the leverage effect.

Regressions To confirm these patterns, this section estimates a simple regression with a measure of performance during the crisis as the endogenous variable and firm pre-crisis characteristics as exogenous variables. Two measures of performance are used: the change in sales and the change in the market value of a firm, between peak (end-1996) and trough (end-1998).¹²

¹¹Comparability with earlier studies is not always possible as the measures of performance as well as that of size differ across studies.

¹²Since the crisis started during 1997, this justifies the use of 1996 as the pre-crisis year. As for the trough, some recovery was seen in some sectors during 1999. This and the short-lived rebound in many stocks justify the use of 1998 as the trough.

The results from these regressions are shown in Table 1. The standard explanatory variables are from end-1996 and they are listed in the table. The first and second columns show regressions where the dependent variable is the change in log of sales and the change in the log of the market value, respectively, both between end-1996 and end-1998. The results suggest that larger firms, exporters, and lower leverage firms had a better performance during the crisis using both measures. The exporter effect is well documented and understood in the empirical and theoretical literature and is mainly due to the large devaluations associated with the Asian crisis and other sudden stops and financial crises. Unsurprisingly, firms that were more likely to be profitable at end-1996 (based on our profitability measure) performed better in terms of sales, and firms that had a higher investment ratio also did significantly better in terms of sales. The change in the market value is negatively correlated with investment on the other hand, suggesting that expectations from these investments were higher in the pre-crisis period than following the crisis. One might argue that the export dummy fails to capture the heterogeneity in export activity across firms and hence that could affect the conclusions herein, particularly on the size effect. For this reason, similar regressions are separately run in the tradable and non-tradable firms' subsamples. The results are shown in the last four columns. They show an interesting larger size effect on sales in the non-tradable sector suggesting that the size effect is not capturing a higher share in export activity. However the impact of size on a firm's value is not significant in the Tradable sector.

III. THE MODEL

This section presents a model of the production sector in a small open economy. It first describes the general environment, discusses the financial frictions in the model, then shows simulations under the assumption of homogeneous firms before introducing heterogeneity.

General environment The economy is populated by a continuum of firms indexed by j , where $j \in [0, 1]$. Firms decide on production and financing plans to maximize the lifetime value of dividends

$$V_{j,t} = E_t \sum_{k=t}^{\infty} \beta^{k-t} d_{j,k}. \quad (1)$$

Entrepreneurs discount time at rate $\beta < 1$. Firms are heterogeneous in technology level a_j . At any point in time t , $a_{j,t} \in \{a_S, a_L\}$. The proportion of firms with a low technology at time t , i.e., for which $a_{j,t} = a_S$, is η_t . The technology level $a_{j,t}$ follows a first-order Markov process with a transition matrix Π . That is firms receive a firm-specific technology which affects their productivity. We denote by $\Pi(S | L)$ the probability of observing $a_{j,t} = a_S$ when $a_{j,t-1} = a_L$ for any time t , and $\Pi(L | S)$ the probability of observing $a_{j,t} = a_L$ when $a_{j,t-1} = a_S$ for any time t . With no loss of generality, the sample is assumed to be stationary and therefore, given the transition matrix Π , η_0 is such that $\eta_t = \eta_0, \forall t$.¹³

¹³Since we assume a continuum of firms, by the law of large numbers the sample will be stationary, i.e., $\eta_t = \eta_0 \forall t$ if $\eta_0 = \frac{\Pi(S|L)}{\Pi(L|S) + \Pi(S|L)}$.

Firms are endowed with a decreasing returns to scale production technology:

$$y_{j,t} = a_{j,t} k_{j,t}^\alpha \Gamma_t^{1-\alpha} \quad (2)$$

where $\alpha \in (0, 1)$. The parameter Γ_t represents the stochastic trend in the economy which is the cumulative product of growth shocks. In particular, $\Gamma_t = \prod_{j=1}^t g_j$. The growth factor g is stochastic and follows a first order Markov process with transition probability $\Lambda(g, g')$. We assume that this growth factor takes values that are bigger than 1, making the economy experience an unbounded growth with fluctuations around a stochastic trend.

Firm financing and frictions At the beginning of each period t , firms start with a level k_t of capital and b_t of debt accumulated from last period. After observing the aggregate productivity level Γ_t and after discovering its new technology level $a_{j,t}$ each firm decides on its investment, borrowing and its dividend payments. Dropping the index j for notational simplicity, the budget constraint of any firm is given by :

$$f(k_t, a_t, \Gamma_t) + (1 - \delta)k_t - k_{t+1} - b_t + \frac{b_{t+1}}{1 + r} = \varphi(d_t) \quad (3)$$

Where $\varphi(d_t)$ is the cost of paying dividends d_t which is given by:

$$\varphi(d_t) = \begin{cases} d_t + \frac{\kappa}{\Gamma_{t-1}}(d_t - \Gamma_{t-1}\bar{d})^2 & d_t \leq \Gamma_{t-1}\bar{d} \\ d_t & d_t \geq \Gamma_{t-1}\bar{d} \end{cases}$$

Since d_t is allowed to be negative, firms are allowed to raise funds through equity issuance. This function formalizes the frictions in equity financing in a similar way to Jermann and Quadrini(2005). Explicitly, this function captures not only the cost of issuing equity but also the cost from deviating from a long-run dividend payout target.¹⁴ In this setting, however, it can be interpreted as representing any cost involved in substituting equity for debt. The results shown later only hinge on equity financing being costly. Note that the presence of Γ_{t-1} in the denominator in the equation insures that the cost remains constant at the steady state.

Firms face endogenous borrowing constraints that limit their borrowing to a fraction of their expected market value in next period. The borrowing constraint is written as:

$$\phi b_{t+1} \leq EV(k_{t+1}, b_{t+1}, a_{t+1}, \Gamma_{t+1}) \quad (4)$$

This constraint imposes standard restrictions on firms' borrowing, limiting it to a fraction of its value. Most theoretical papers that study linkages between the financial sector and the real economy postulate that the availability of collateral imposes a constraint on firm financing. This constraint is also thought to bind harder in less financially developed countries. Recently, Atif and Mian(2010) show, using data on loans in 15 emerging markets, that the

¹⁴See, e.g., Chen and Ritter (2000) for a discussion on issuance costs. There is a growing evidence in the finance literature that managers prefer to smooth dividends, as first shown by Litner (1956). There is a theoretical literature that rationalizes dividend smoothing, see, for example, Miller and Rock (1985), Allen, Bernardo and Welch (2000), and Guttman, Kadan and Kandel (2007).

collateral cost is higher in less financially developed economies. They also show that with an increase in financial development, firms are more able to pledge firm-specific assets instead of non-firm specific assets such as land. Interestingly, they also find that with increased risk the composition of collateralizable assets shifts toward non-firm specific assets. In this paper, the collateral available for the firm its assets evaluated at its expected market value. Hence a decline in its value will automatically decrease the firm's borrowing capacity. This constraint can be interpreted as the incentive compatibility constraint from a bargaining problem between creditors and firms (see e.g. Jermann and Quadrini (2007)). Under this interpretation, $\frac{1}{\phi}$ would represent the bargaining power of the creditor. The higher is ϕ the lower is the degree of enforceability of the debt contract and the tighter is the constraint.

The firms' maximization problem The growth in the aggregate level of technology Γ_t implies that the variables in the model are non-stationary. To solve the model we detrend all the variables by the factor Γ_{t-1} which is the compounded growth up to $t - 1$.¹⁵ We denote by \hat{x} the detrended counterpart of x_t . We also denote by $s = (a_t, g_t)$ the state variable of individual and aggregate productivity. We can now write the maximization problem of the firm recursively where all variable are detrended. The firm chooses the equity payout, d , the new capital level, k' , and the new debt level, b' . The optimization problem is:

$$\hat{V}(\hat{k}, \hat{b}, s) = \max_{\hat{k}', \hat{b}', \hat{d}} \{ \hat{d} + \beta g E \hat{V}(\hat{k}', \hat{b}', s') \}$$

subject to:

$$f(\hat{k}, \hat{b}, s) + (1 - \delta)\hat{k} - \hat{b} - \hat{k}'g_t + \frac{\hat{b}'g}{1+r} = \hat{\varphi}(\hat{d})$$

$$gE\hat{V}(\hat{k}', \hat{b}', s') \geq \phi g \hat{b}'$$

$$\hat{\varphi}(\hat{d}_t) = \begin{cases} \hat{d} + \kappa(\hat{d} - \bar{d})^2 & \hat{d} \leq \bar{d} \\ \hat{d} & \hat{d} \geq \bar{d} \end{cases}$$

Taking the firm's interest rate as exogenous, and denoting by μ the Lagrange multiplier associated with the enforcement constraint, the first order conditions are:

$$\hat{\varphi}'_d(\hat{d})((\beta + \mu)E\hat{V}_k(\hat{k}', \hat{b}', s')) = 1 \quad (5)$$

$$(\beta + \mu)E\hat{V}_b(\hat{k}', \hat{b}', s') = \mu\phi - \frac{1}{\hat{\varphi}'_d(\hat{d})(1+r)} \quad (6)$$

¹⁵We detrend using the lag of the productivity trend so that the variables at time t that are in firms' information set a time $t - 1$ remain in this set. This choice does not affect the solution of the problem (see e.g. Aguiar and Gopinath (2007)).

The detailed derivations are shown in the appendix. Substituting the envelope condition with respect to \hat{b}' in (6) gives:

$$\mu = \frac{\frac{1}{\hat{\varphi}_d(\hat{d})} - \beta(1+r)E[\frac{1}{\hat{\varphi}_d(\hat{d})}]}{(1+r)(\phi + E[\frac{1}{\hat{\varphi}_d(\hat{d})})]} \quad (7)$$

The interpretation of equation (5) is simple. It equates the marginal utility of an increase in dividends with the marginal cost in terms of forgone future dividends due to the resulting decrease in investment. Equation (7) determines the multiplier on the borrowing constraint as a function of the interest rate, the discount factor, the marginal cost of dividends, and the tightness of the constraint (the parameter ϕ). To understand this relationship, it is useful to study the special case where $\kappa = 0$. In that frictionless case, the cost function on dividends can be written as $\hat{\varphi}(\hat{d}) = \hat{d}$, implying that $\hat{\varphi}_d(\hat{d}) = 1$ for all d . Under this assumption 7 reduces to:

$$\mu = \frac{1 - \beta(1+r)}{(\phi + 1)(1+r)} \quad (8)$$

meaning that $\mu > 0$, i.e., the borrowing constraint will be binding at the steady state if $\beta(1+r) < 1$ which is a common assumption in the literature. This paper will also adopt this assumption which significantly simplifies the analysis, also motivated by the fact that the focus in this analysis is on understanding data from the crisis episode, which we know was preceded by a period of substantial leveraging. However, this assumption is not a necessary one especially given the large fall in firms' market value during the crisis. In other words, if firms had some "borrowing space" it would have been more than depleted by the fall in their market value which is an upper limit on their borrowing capacity. On the other hand, assumptions that would lead to an equilibrium steady state in which firms' leverage is small allowing them to retain or increase their borrowing capacity after a negative shock, will go against the observations on the average firm from both the pre-crisis and crisis period.

A. The Case With No Idiosyncratic Shocks

This section studies the dynamics of the model for the case where all firms are homogeneous, i.e., $a_L = a_S$. This allows us to discuss the dynamics that, we argue, could explain the stylized facts from aggregate data in a parsimonious environment.

Proposition 1. *In the absence of aggregate and idiosyncratic risk, the de-trended capital level is independent of g .*

Proof. When $a_L = a_S$, the model is deterministic and $\hat{d}_t = \bar{d}$ for all t and therefore (8) holds at all times, and is independent of g . From (5) and the envelope condition we know that $\hat{f}_k(\hat{k}', s' = s) + (1 - \delta) = \frac{1}{\beta + \mu}$, that is, $\alpha(\frac{k}{g})^{\alpha-1} = \frac{1}{\beta + \mu} - (1 - \delta)$. This implies that $\frac{\hat{k}}{g}$, the detrended capital with the trend at time t , is independent of g . *Q.E.D.*

Proposition 1 is important for understanding the intuition behind the quantitative results despite it assuming away any uncertainty for simplicity. The main mechanism that will generate the creditless recovery, even under uncertainty, is due to a similar argument. The proposition shows that the detrended level of capital depends on parameters of the model but not the growth rate of the trend. This is not the case however for firms' market value and debt levels. It is clear that the detrended market value depends on the productivity trend and so is the debt level given the borrowing constraint. Therefore unexpected changes in the trend can lead to large corrections in the market value and debt levels but do not affect the optimal level of capital. This creates the dichotomy that is observed in the data and breaks the procyclicality generated by TFP level shocks.

Quantitative properties The model is parametrized on an annual basis to match the main characteristics of the median firm in the sample in year 1996. The growth rate is set to 5% which is the observed growth rate of sales of the median firm in 1996. In this model, and similarly to models that incorporate a stochastic trend in a business cycle model, βg is equivalent to the discount factor in the stationary models. Therefore β is set to 0.94 so that $\beta g = 0.98$. The interest rate is set equal to the ratio of interest payments to total debt adjusted for inflation in 1996. For the parametrization of the production function α is set to 0.71, which is the outcome of the regression of sales on the log of assets. This parameter is relatively stable over time in our sample. Furthermore, a value of 0.7 is standard in models without labor.¹⁶ The borrowing constraint parameter is set to $\phi = 9.85$ in order to match the median of the leverage ratios of firms in 1996 which was around 0.52.¹⁷ Firms' leverage increased significantly in 1997 when the median leverage reached 0.6. This increase is partly due to the devaluation that took place in 1997. Arguably therefore, the benchmark value does not reflect the liability dollarization in the sample, and a higher value for leverage could be warranted. However, since the higher is the leverage the stronger is the amplification of a negative shock on output, it is better to start with a conservative value and then show simulations for higher and lower leverage values. As for the parameter κ , which determines the financial frictions on equity financing, it does not affect the steady state values since \bar{d} is set such that $\hat{\varphi}(\hat{d}) = \hat{d}$ at the steady state. Without a guidance from the data on κ , it is better to use a conservative value, one that allows firms to use significant equity financing. For this, it is important to first note that κ also determines the lower bound on equity payouts. In particular, \hat{d} cannot be smaller than \hat{d}^* , which is the equity payout for which $\hat{\varphi}_{\hat{d}}(\hat{d}) = 0$. It is easy to see that any equity payout smaller or equal to \hat{d}^* , will be counterproductive leading to an increase in costs by an equal or larger amount of the issuance. This lower cutoff point is directly determined by κ . If $\kappa = 0$ then such cutoff point goes to $-\infty$, for which case there are no frictions on the equity payouts function. For $\kappa = 0.5$, the benchmark value that will be used here, $\hat{d}^* \approx -1$ which is, in absolute value, slightly larger than the steady state market value of the firm under the chosen parameters. Therefore this conservative value is used at

¹⁶See, e.g., Cooper and Ejarque, 2003, and Hennessey and Whited, 2006.

¹⁷When the transition probability is increased from 0% to 1.5% the parameter ϕ is set to 6.2 to match the leverage ratio of 0.52

first, while noting the fact that $\kappa = 50$ is the value for which $\hat{d}^* = 0$. The parameters from the benchmark calibration are shown in Table 3.

Regarding the growth process g , the numerical exercise consist of choosing the high and low growth factors, g_H and g_L respectively, as well the as the transition probability between the two. Regarding the levels of the growth factors, what will matter for the results is the magnitude of the fall. The high growth factor is set to 1.05 to match the growth rate observed in the firm-level data in the pre-crisis year. The new low growth factor is set to 1.03 implying a decline of 2% in the growth rate. This magnitude of the fall is somewhere between what is suggested from the macro data from before and after the crisis (see Table 2 and Figure 3) that show a decline of around 3% on average, and the 1.5% fall observed in the firm level data. Regarding the transition probabilities between the high and low growth states, it is assumed that the state with low growth rate is an absorbing state, i.e., once this state is reached the economy stays there forever. This is done for two main reasons: first, one would like to check the robustness of this model against the precautionary savings argument, and hence the permanence of the shock only enhances this effect. Second, this is also motivated by the persistent lower growth rates observed in the region after the crisis. The probability of transitioning from the high to the low state is set to 1.5%. This probability is hard to gauge from the data, but the accelerating growth in stock market returns and credit before the crisis suggest that indeed this probability must be very low. The closest counterpart for this probability in the literature is the probability of Sudden Stops that was targeted in the calibration in Mendoza (2010), where it is set to 3.3% to match the frequency in the cross-country data in Calvo et al. (2006). Arguably, given that the crisis under study in East Asia was a first of its kind in the region, a lower frequency is justified in our case.¹⁸

Response to a negative shock to g This section studies the impact of a permanent negative shock to the growth rate of the trend. The upper panels of Figure 7 show the response of the variables in the model to the trend shock while the lower panels show median values from the data. The model simulations are shown for two different assumption on the transition probability between the high state and the low state, 1.5% and 0%.

The results from the model are shown in detrended form, and therefore when comparing the output performance one has to take into consideration that sales in the data are not detrended. For this reason, the figure also includes a graph (a dashed line) of sales detrended by a trend with a growth rate of 3%. The results show that a trend shock does a good job generating the patterns in the data even in the context of a simple model. First, qualitatively, the model generated this dichotomy between assets prices and credit on one side, and output on the other, as observed in the data. Hence, the creditless recovery is a direct outcome of this model. Quantitatively, a drop of 2% in the growth trend does generate, under the benchmark parameterization, a fall in V/K and B/Y of similar magnitudes to the data. When the sudden stop is fully unexpected, i.e., transition probability from high state to low state is zero, the fall

¹⁸When a transition probability of 3.3% is used in our case, the qualitative results are unaffected, but quantitatively the model generates smaller amplifications of a given shock under the banchmark conservative parameterization.

in all variables is larger. This is because when agents internalize the possibility of a sudden stop, the market value of firms adjust downward at the pre-crisis steady state and fall by less at the news of the new growth state. Note that under the current and similar parametrizations, the borrowing constraint is always binding, even when agents expect a sudden stop with a probability as high as 3%. In this model, due to the form of the borrowing constraint (becoming tighter the higher the expectation of a negative shock) and the mere possibility of debt-equity substitution, firms find it optimal to borrow to the limit as long as $\beta < 1 + r$.

The fall in output generated by the model is smaller than what is observed in the data. However, conservative values have been used for both the leverage and κ , and the effect of varying these assumptions would be discussed shortly.

Discussion The simulations suggest that a simple model that incorporates trend shocks can potentially explain some of the main stylized facts of sudden stops. Some of the patterns in the data, in particular, the dichotomy between output on one hand and debt levels on the other, cannot be accounted for in a standard business cycle model with TFP shocks. More specifically, only very persistent TFP shocks can generate this quasi-permanent downward adjustment in asset prices, yet such shocks would be inconsistent with a fast recovery in output. The model at hand is tractable and its dynamics are simple. Following a permanent drop in the growth rate, the detrended market value is abruptly and permanently adjusted downward. Due to binding borrowing constraints, this will also lead to a drop in debt levels. That is, firms would have to adjust their debt levels in one period to satisfy the new and tighter borrowing constraint. To do so, they could decrease their investment (or even disinvest) and/or they could decrease their payouts (or even issue new equity). If equity issuance did not involve direct costs it would be optimal for firms to maintain their capital levels which is what happens if $\kappa = 0$. However, with $\kappa > 0$, firms will decrease capital and equity payouts in a way to equalize their respective marginal costs. Once debt levels are adjusted firms will rebuild capital over time to reach the pre-crisis steady state as shown in the upper right panel. Following the recovery of output to its new trend, credit and investment are permanently lower due to the lower growth rate.

The assumption on $\beta(1 + r)$ being smaller than one is a convenient simplification, albeit, not a necessary one. In fact, it is easy to see that large drops in the market value can lead to drops in borrowing levels even when borrowing constraints are not binding as long as firms borrowing is beyond a certain level. Second, one could instead assume that the shock takes place at a non-steady state, a point at which firms are still building up their capital stock and are therefore more likely to have their borrowing constraint binding. Third, one could still forgo this assumption by incorporating exogenous exit rates, particularly ones where entrepreneurs get to consume the remaining equity in the firm when they exit. However, such modifications would only make the numerical solution (particularly with heterogeneous firms) more challenging without additional insight.

Financial frictions and leverage Just as in most sudden stops models, financial frictions are central in generating drops in output in the model. They are captured at the equity payout level in this setting. These frictions are meant to formalize costly adjustment in financing and

reflect more than just the cost of issuance as explained earlier. The parameter κ which determines the degree of frictions was set to a conservative value as explained earlier. Figure 11 shows the impact of the same shock discussed earlier for varying levels of κ . The results show a stronger impact on output for higher levels of κ .

In this model, output drops occur solely due to financial frictions, triggered by the need to decrease debt levels. The leverage effect is therefore very strong and, as shown in Figure 8, lower values of leverage significantly reduce the impact of the shock on output.

B. Heterogeneous Firms and The Size Effect

Section 2 showed strong evidence of a size effect in that larger firms outperformed the smaller ones during the crisis episode in Indonesia, Malaysia and Thailand. Table 1 for example suggests that on average a twice larger firm had around 5% higher growth rate in sales between 1996 and 1998. This difference in performance is large and statistically significant. Furthermore, smaller firms had not only a worse performance in terms of sales but also their market value and their debt collapsed significantly more than the larger firms. This section shows how the model can explain this significant heterogeneity in performance that is due to size differences. The argument relies on small firms having a higher potential for growth. There is a strong evidence from a large body of empirical research that, on average, small firms tend to grow faster than the larger ones (see for example Hall, 1988; Evans, 1987).

The model introduces heterogeneity along the size dimension, as discussed earlier, by allowing firms with decreasing returns production technology to receive shocks to their technology level. It is assumed, for the sake of simplicity, that this technology level can only take two values a_S and a_L , with $a_S < a_L$. Therefore, at the conditional steady state, firms with the lower technology a_S are the small firms. Note that the conditional steady state refers to the state at which, if $a'_j = a_j$, then $\hat{x}' = \hat{x}$, where \hat{x} is any detrended variable in the model. Another simplifying assumption that is made in this section is that the Markov transition matrix, Π , is symmetric. This assumption does not involve a loss of generality. In fact, the results shown here will have the same qualitative properties as long as either of $\Pi(S/L)$ or $\Pi(L/S)$ is positive. This implication, nevertheless, helps in pinning down parameters at the calibration stage. For $\eta_0 = 1/2$, i.e., when the shares of small and large firms in the total sample are equal at time 0, $\eta_t = 1/2$ at any time t .

Amplification due to the growth option: A simple example Before showing the quantitative properties of the model with heterogeneous firms, a simple example can give the main intuition behind the result. It is clear to see, that in the model at hand, a larger drop in the market value implies a larger drop in output, everything else equal. Therefore, a theory behind the larger volatility in the market value of small firms, alone, can explain the findings in the data. This property follows directly from the assumption that these firms can grow to become large. To simplify the analysis, it is helpful to abstract from the main aspects of the model and assume that there are large firms and small firms in the economy, that distribute, at time t , dividends $d^L \Gamma_t$ and $d^S \Gamma_t$ respectively, where $d^L > d^S$. Γ_t is the stochastic trend that drives growth in the economy and has the same properties described above. At the beginning

of each period small firms can either remain small or become large with a probability p . Large firms remain large forever. Under this last assumption the market value of large firms is significantly simplified and can now be written as:

$$V^L = \sum_{j=0}^{\infty} (\beta g)^j d^L \quad (9)$$

The market value of the small firms is a function of V^L :

$$V^S = d^S + \beta g [pV^S + (1-p)V^L] \quad (10)$$

Proposition 2. *An unexpected permanent change in the trend's growth rate has a larger impact on the value of small firms, in that the absolute value of the percentage change in the market value of small firms is higher than the one for the large firms.*

Proof. It is straightforward to see that both V^S and V^L are both strictly increasing in g . Therefore it is enough to show that $\frac{V^S}{V^L}$ is strictly increasing in g to prove that the percentage change in V^S is higher in absolute value than the percentage change in V^L . Note that $V^L = \frac{d^L}{1-\beta g}$ and therefore:

$$\frac{V^S}{V^L} = \frac{\frac{d^S}{d^L} [1 - \beta g]}{1 - \beta g(1-p)} + \frac{\beta g p}{1 - \beta g(1-p)}$$

Which can be re-written as:

$$\frac{V^S}{V^L} = \frac{d^S}{d^L} \frac{1 - \beta g(1-p) \left[\frac{\frac{d^S}{d^L} - p}{\frac{d^S}{d^L} (1-p)} \right]}{1 - \beta g(1-p)} \quad (11)$$

From this equation it is clear that $\frac{V^S}{V^L}$ is strictly increasing in g as long as $\frac{d^S}{d^L} < 1$ which is always true by assumption.¹⁹ *Q.E.D.*

The intuition behind this result is simple. Compared to large firms, a sizable share of the small firms' market value is due to the expectations that the market place on future growth rates. Therefore changes in these expectations will have a larger impact on the market value of the small firms. In other words, small firms have a "growth option" which itself is a function of the future growth rates. That is unlike large firms, a fraction of the market value of the small firms reflects their future opportunities which have not realized yet. However these opportunities are very sensitive to changes in the growth rates which makes the market value of the small firms relatively more affected by these changes. Note that we have assumed that the large firms do not become smaller for simplicity. If this was possible, then the main logic would still apply. This is because such possibility would only decrease the volatility of the large firms. Since in the original model the borrowing constraint binds at the

¹⁹This follows from the fact that $\frac{1-x\alpha}{1-x}$ is increasing in x if $\alpha < 1$.

steady state, a larger change in the market value would induce a larger change in the debt level of a company. This directly implies that the small firms' production will also be more affected by changes in growth rate. In the following we compare the response of small firms and large firms to a trend shock in the original model.

Quantitative properties Parameters are chosen such that small and large firms in the model be representative of the lower and upper third in the sample (ranked by size) (see Figure 5). The firm-specific productivity parameter of larger firms, a_L , is normalized to one. Then, a_S is chosen such that the larger firm has three times more capital than the smaller firm. In the data, the smallest of the large firms' group has three times more capital than the largest of the small firms' subsample. That is, the size ratio chosen here is conservative.²⁰ The other central parameter that needs to be set is the probability of switching size, i.e., the probability of smaller firms becoming large and the probability of large firms becoming small. This parameter will determine the Tobin's Q of both the large and the small firms. For this, the probability p is set to match the ratio, in the data in 1996, of the Tobin's Q of the small firm to that of the large firms. This ratio is equal to 1.25. Note that given this heterogeneity, even when these firms are subject to the same degree of borrowing constraint they might accumulate different ratios of debt to capital. In particular, the fact that the small firm is a growth firm will allow it to carry more leverage for a given level of financial constraints, due to its higher ratio of market value to capital. However, since in the data the leverage of both large firms and small firms are not significantly different, the parameters ϕ_S and ϕ_L are chosen in way to set tighter constraint on the small firms to generate the same leverage ratio that is in the data which is around 0.52. This is done to separate the size from the leverage effect; indeed, if small firms were allowed to have a higher leverage this will further amplify the results. Finally, note that although a small firm can acquire a new technology overnight, due to the borrowing constraint it might not be able to accumulate the optimal capital in one period. That is, unlike the earlier simple example, in this case small firms have to follow a path to become large firms which starts at the period in which they acquire the new technology. The results are shown in Figure 9. The parameters' values are shown in Table 4. Note that for simplicity, we assume the trend shock in this exercise to be unanticipated.

The upper panel in the figure shows that both the the market value of the large and the small firm decrease following a 1.5% permanent negative shock to the growth rate, but that the drop in the market value of small firms is significantly larger. This is where the size effect comes in play. Its impact on the other variables, notably the output, is only due to the difference in the market value's reaction to the shock. The lower panel shows the reaction of the output. The detrended output of the small firm drops significantly more, before it recovers relatively quickly to the pre-crisis level. Based on the assumptions in this paper alone, only trend shocks, as opposed to TFP level shocks, can generate this size effect. This is because, unlike the growth shock, a TFP shock affects directly the firm's output and subsequent changes in the market value are led by the output drop. The story proposed by the model is one based on the assumption that small firms are growth firms, and one where the amplification

²⁰Since the model is solved in a non linear way through iterations over the grid, keeping the size difference to a minimum significantly shortens the computational time.

mechanisms of firms' leverage play a central role. Were small firms to be significantly less leveraged, the leverage effect would have likely compensated the size effect; however, the data do not suggest a lower leverage for small firms. When heterogeneity is added to the model, it allows for various effects that could stem from differences in borrowing decisions between small and large firms. In fact, the condition that $\beta(1+r) < 1$ is no longer sufficient for firms to borrow to the limit as in the case with homogeneous firms. For example, for significantly higher values of p , small firms see a benefit of not borrowing to limit, so when the likely switch to a higher level takes place, they are able to finance the necessary increase in capital to reach the new optimal level in a minimal time. However, such values of p would generate much larger differences in Tobin's Q compared to what is observed in the data. As for the larger firms, they will borrow to the limit, for an even larger range of probabilities. This is because their switch to a lower size involves selling of existing capital, which is optimal under their new technology levels, hence they have no motives for precautionary action.

The growth effect: back to the data The model suggests that the underperformance of small firms is related to their growth option. This characteristic of small firms results in a more responsive market value to changes in trend growth. Larger adjustments in a firm's value consequently lead to a larger drop in output. Testing the validity of this channel in the data, however, is challenging for two main reasons. First, the data do not provide a direct or unequivocal measure of growth opportunities. While Tobin's Q might be the best available measure, and a variable that has a direct counterpart in the model, it is often correlated with current firms' performance and other information related to its current investment levels. Second, assuming that a direct measure of growth opportunities is available, the model only predicts that its positive relationship with future performance will be weakened; whether higher growth opportunities will lead to lower performance overall depends on the importance of the negative trend shock.²¹ With this in mind, a proxy of Tobin's Q (the ratio of market value to total assets in 1996, V/K) is introduced as an explanatory variable in the same regressions shown in Section 2. Table 5 shows the results from these regressions. The first two columns in the table recapitulate the results from earlier regressions in section 2. The third and fourth columns introduce Q as an explanatory variable to the same regression. In the regressions with the change in sales as the dependent variable, in column 3, introducing Q to the earlier regressions leads to a negative and significant coefficient. However, the size effect remains positive and significant, although its coefficient decreases in magnitude by around 15% with the introduction of Q , and it is now only significant at the 10%. In the fourth column, where the dependent variable is the change in value, the introduction of Q leads to a negative coefficient yet not significant. The coefficient on size also decreases by around 11%, but remains significant. In the fifth and sixth columns, the size is excluded and replaced by Q . This leads to negative and significant coefficients in both regressions. Overall, the results from these regressions are supportive of the model's prediction. Both measures of performance reflect, to a degree, a "growth effect", but the size effect is still significantly present in the regressions where the change in sales is the endogenous variable. Whether this is due to the problems with measuring growth opportunities as discussed earlier, or to

²¹In each period in the model a fraction of small firms receive a new and better technology. This creates a positive relationship between growth opportunities and next period's performance in a non-crisis environment.

other effects that are not controlled for in the regression (e.g. ownership, relationship with banks, or corporate governance) is something that is hard to gauge with the limited available data. Nevertheless, the mere finding of a negative relationship between growth opportunities and performance during the crisis is surprising given that higher Tobin's Q is a predictor of good performance. This new finding documented in this paper, is predicted by the model when trend shocks are the main driving force behind the collapse in firms' market value.

IV. CONCLUDING REMARKS

This paper studied firms' recovery from a Sudden Stop in a sample of publicly listed firms in Southeast Asia. The data show an unambiguous dichotomy between the behavior of sales, which recover relatively swiftly, and that of Tobin's Q, debt levels, and investment which show a persistent collapse and remain well below their pre-crisis levels. Although these patterns were shared by most firms in the sample, the data show significant heterogeneity, notably between firms of different size and different pre-crisis leverage. The paper formulates a model that can account for these patterns. The model has two main novel features. First it incorporate trend shocks in a model with financial frictions in the form of an endogenous borrowing constraint and a constraint on equity issuance. These shocks are motivated by the persistent decline in post-crisis growth rates in the data, as well as the quasi-permanent collapse in asset prices. Standard TFP shocks cannot generate such patterns. Once trend shocks are taken into account, the model shows that they can rationalize the main observations from both the aggregate as well as the firm-level data. The simulations show how a permanent decline in trend productivity, reduce permanently the market value and consequently the debt level of firms. Nevertheless, output recovers to its pre-crisis optimal level (in de-trended terms) after a short-lived yet large drop, which is due to financial frictions. Firms' leverage play a central role in generating output drops. In the data, firms with very low leverage barely show any reduction in their output despite the large drop in their market value. The model generates a similar pattern since the drop in the market value is due to the trend shock, but the transmission of the shock to output hinges on a sizable leverage, even when borrowing constraints are binding. Another novelty in the paper is the modeling of firms of different size which is based on the assumption that small firms are growth firms, to which there is support in the data as well as in the literature. This assumption alone will lead to a larger response to trend shocks from small firms' market value. The data show that Tobin's Q and size are correlated and that the first capture some of the size effect that is seen in the regressions, despite the fact that Tobins' Q is usually strongly and positively associated with an increase in future sales.

One major shortcoming of this paper is that it models trend shocks as an exogenous factor, and remains silent about the factors that could lead to this sudden downward shift in the trend. Despite the recent literature on the role of these shocks in emerging markets' business cycle, they remain largely unexplained and therefore an avenue for future research. The results in this paper also call for further research into whether a combination of trend shocks and financial frictions could improve the explanatory powers of Sudden Stop models.

V. APPENDIX

A. Solution

First order conditions Let λ and μ be the Lagrange multipliers on the budget constraint and the borrowing constraint respectively. Taking the derivatives we get:

$$\hat{d} : 1 - \lambda \varphi_{\hat{d}}(\hat{d}) = 0 \quad (12)$$

$$\hat{b}' : -\mu \phi + \frac{\lambda}{1+r} + (\beta + \mu) EV_{\hat{b}'}(\hat{k}', \hat{b}', a', g') = 0 \quad (13)$$

$$\hat{k}' : (\beta + \mu) EV_{\hat{k}'}(\hat{k}', \hat{b}', a', g') - \mu = 0 \quad (14)$$

$$(15)$$

The envelope conditions are:

$$V_{\hat{k}}(\hat{k}, \hat{b}, a, g) = \lambda(f_{\hat{k}}(\hat{k}, \hat{b}, a, g) + (1 - \delta)) \quad (16)$$

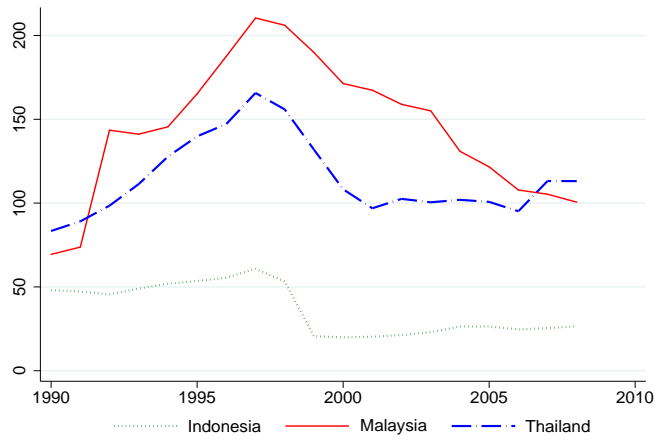
$$V_{\hat{b}}(\hat{k}, \hat{b}, a, g) = -\lambda \quad (17)$$

$$(18)$$

Numerical Procedure The numerical procedure solves the model nonlinearly to allow for the possibility that the borrowing constraint does not bind under certain parameterizations and during the transition following the shock. The approach consists of approximating the conditional expectations in (13) and (14) and in the objective function as functions of the state variables through a finite element representation that interpolates linearly between the grid points of the state space. For the case of homogeneous firms, we first solve for the steady states for each value of g and set accordingly the space of the grids. We then make a guess about the value function and its derivatives with respect to the state variables. For these guesses one can solve for all the variables assuming the borrowing constraint binds. If μ , the Lagrange multiplier on the borrowing constraint, is positive, this means the borrowing constraint is indeed binding. Otherwise, we solve the problem again setting $\mu = 0$ since this means that the constraint does not bind. This is done at every grid. The grid points are joined with bilinear functions so that the approximate functions are continuous. We update the initial guesses until convergence. Note that the problem with heterogeneous firms is solved in a similar way, however the steady state values are computing simultaneously during iteration procedure taking the homogeneous steady state results for each firm's parametrization as an initial guess.

B. Figures and Tables

Figure 1. The ratio of credit to GDP.



Data source: World Development Indicators, World Bank.

Figure 2. MSCI market indices

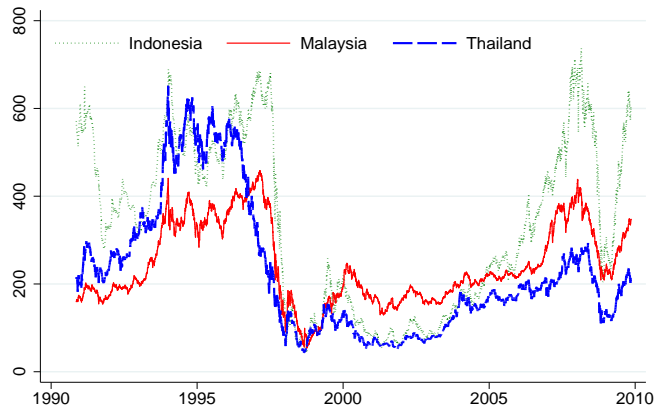
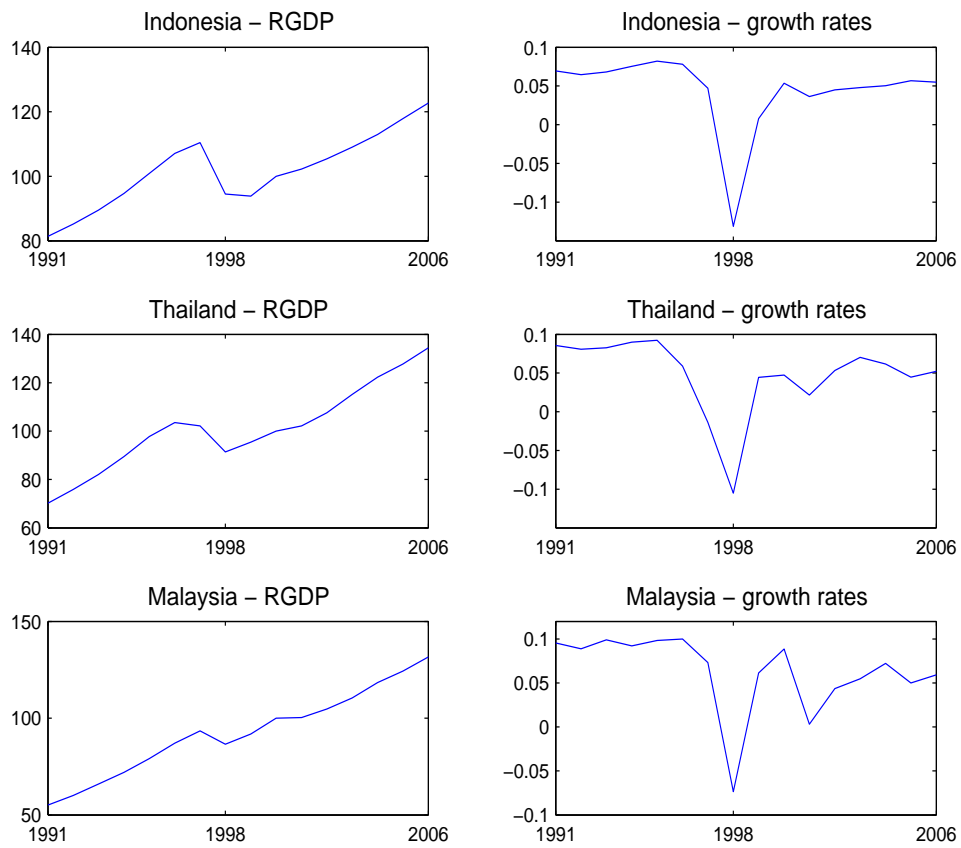


Figure 3. Real GDP and its growth rate.



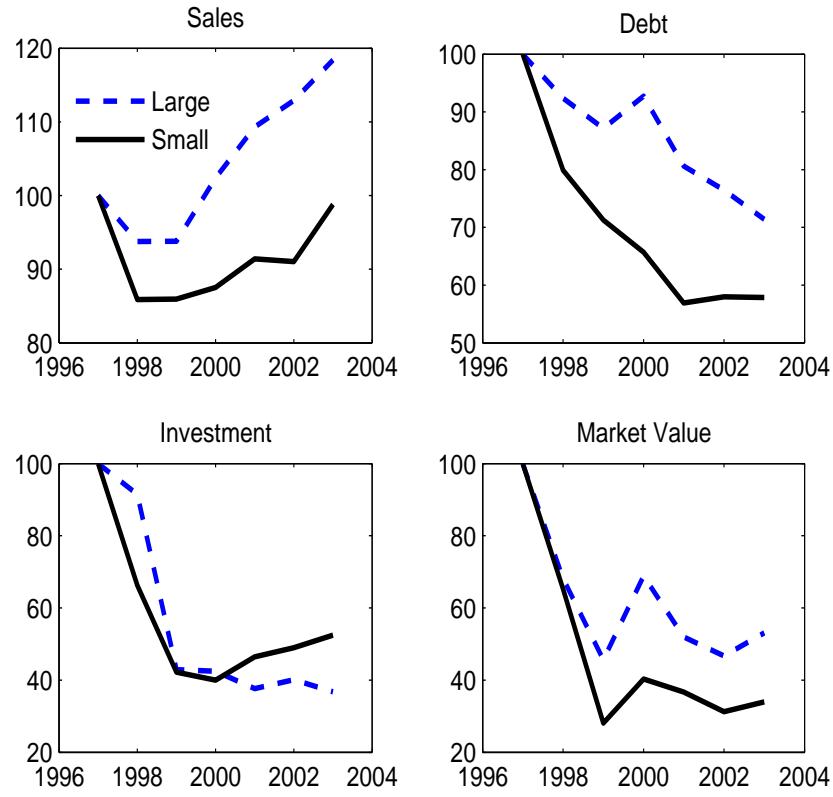
The left panels in this figure plot an index of the real GDP in Indonesia, Malaysia and Thailand between 1991 and 2006. The right panels plot the growth rates in the real GDP during this period. The three countries experienced their largest losses in output in the year 1998. Data source: IFS.

Figure 4. Indices of firms' average sales, debt, investment and market value.



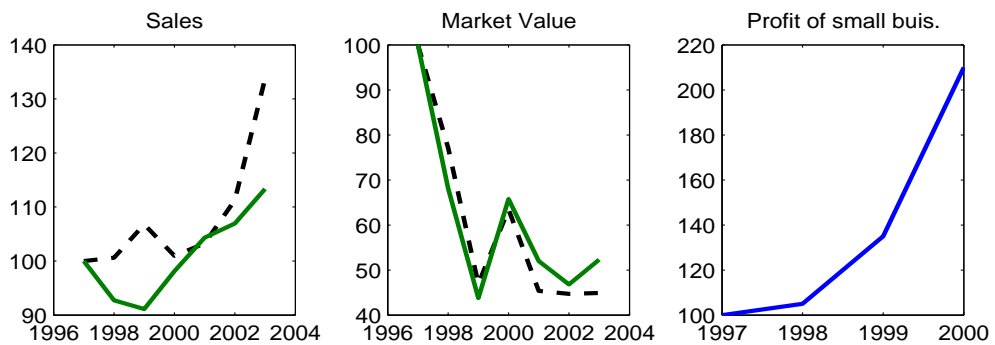
Notes: * Except for *Value* which is a beginning-of-year index since it precedes the drop in other variables, other indices are end-of-year values. Data source: Worldscope, Thomson Financial.

Figure 5. Comparing the performance of large and small firms.



Notes: Figure 5 plots an index of average sales, debt, investment and credit where the 1997 value is normalized to 100. The dotted line shows the figure for the larger companies while the solid line is for the smaller firms. Firms are ranked by their size in 1996 based on the dollar value of their fixed assets (upper and lower terciles). Data source: Worldscope, Thomson Financial.

Figure 6. The impact of the crisis on low leverage firms.



Notes: The left and center panel contrast the performance of low-leverage firms (dashed line), defined as firms with a leverage below the 10th centile which corresponds to 0.2, and that of the average firm in the sample. The panel on the right shows the median profits for household businesses in Thailand during the crisis (see Paulson and Townsend (2005) for a more detailed description of the sample).

Figure 7. The benchmark parametrization

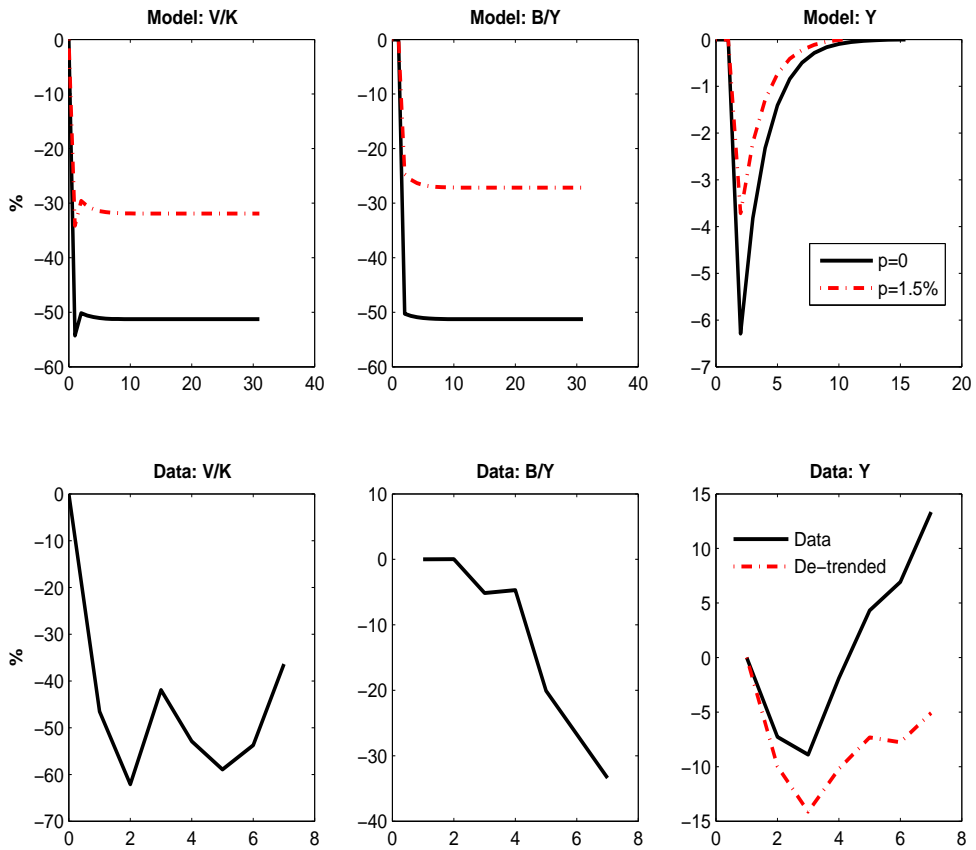


Figure 8. The leverage effect

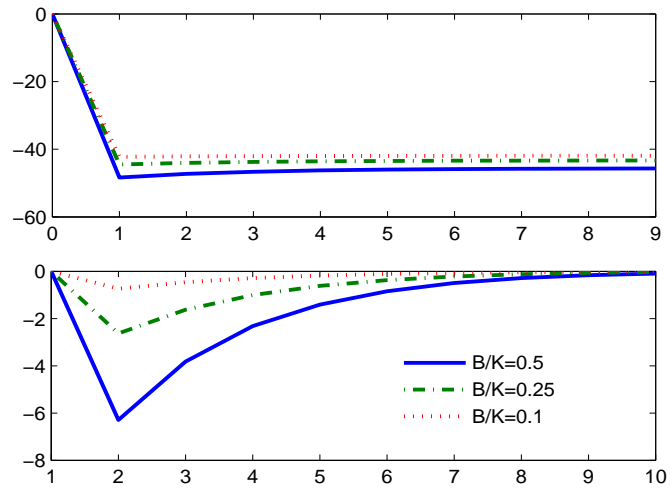


Figure 9. The size effect

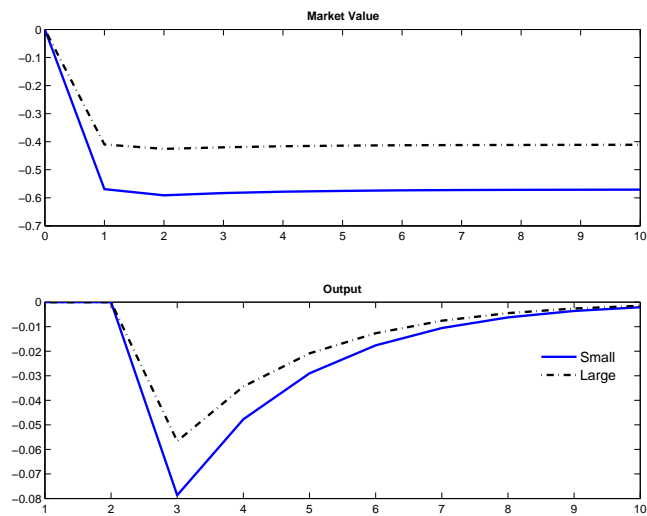
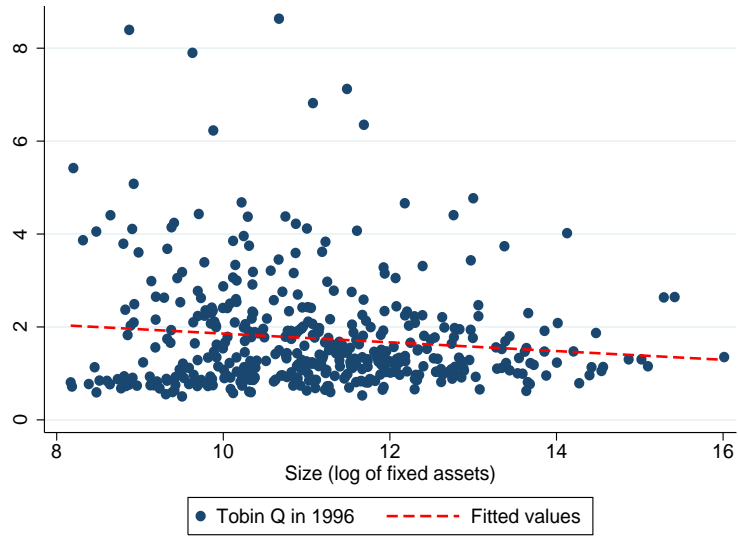


Figure 10. Size and Tobin's Q.



This figure shows a negative relationship between size and Tobin's Q both measured at end 1996. Size is proxied by the log of fixed assets and Tobin's Q is proxied by the ratio of a firm's market value to its total assets.

Figure 11. Changing the degree of financial frictions

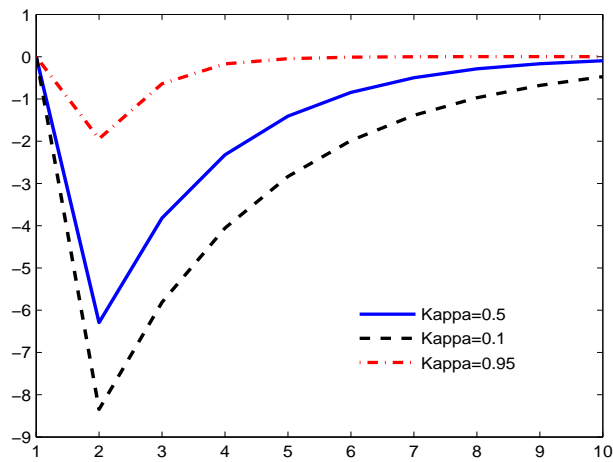


Table 1. Determinants of firms' performance during the crisis.

Notes: The sample is formed by merging data from Indonesia, Malaysia and Thailand after converting all values to the U.S. dollar of 2000. The dependent variables are the changes in the log of sales and market value between end-1996 and end-1998. The last four columns exclude the non-tradable (NT) sector and the tradable (T) sector, respectively. The table shows the output of simple OLS regressions. The explanatory variables are from end-1996. *Size* is a measure of firms' fixed assets. *Export* is a dummy that takes the value one for exporters. *Leverage* is the ratio of total liabilities to total assets. *Interest* is the ratio of the total interest payments to total liabilities. *Profitability* is the ratio of net income to total assets. *Dividends* is a dummy that takes the value one for firms that paid dividends in 1996. *Investment* is the ratio of investment to total assets on end-1996. The regression also includes a dummy for Thailand, a dummy for Indonesia and dummies based on the SIC codes to capture the industry effects. Data source: Worldscope, Thomson Financial.

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Sales	Δ Value	Δ Sales	Δ Value	Δ Sales	Δ Value
Size	0.0468** (2.15)	0.0760** (2.46)	0.0697*** (3.06)	0.113*** (2.90)	0.0483** (2.49)	0.0183 (0.48)
Export	0.193*** (2.93)	0.222** (2.38)			0.129** (2.18)	0.102 (0.89)
Leverage	-0.309* (-1.82)	-0.818*** (-3.39)	-0.339* (-1.90)	-1.096*** (-3.49)	0.110 (0.68)	-0.604* (-1.92)
Profit.	0.583* (1.78)	0.603 (1.30)	-0.900* (-1.94)	2.192*** (2.68)	-0.767** (-2.09)	0.820 (1.59)
Interest	-0.431 (-0.37)	-1.128 (-0.69)	-1.510 (-1.28)	1.002 (0.49)	-2.389** (-1.99)	-3.956* (-1.72)
Dividends	-0.109 (-1.13)	0.0179 (0.13)	-0.0543 (-0.52)	0.0127 (0.07)	0.0859 (0.90)	0.213 (1.08)
W. Capital	-0.215 (-1.19)	-0.172 (-0.66)	-0.387** (-2.18)	-0.745** (-2.39)	-0.00257 (-0.01)	-0.655* (-1.94)
Investment	0.659** (2.09)	-1.002** (-2.26)	0.856** (2.59)	-1.079* (-1.90)	-0.0400 (-0.12)	-0.899 (-1.45)
Thailand	-0.107 (-1.37)	0.254** (2.28)	0.00795 (0.10)	0.317** (2.31)	0.00969 (0.13)	0.458*** (3.25)
Indonesia	0.0182 (0.17)	0.0470 (0.31)	-0.0406 (-0.43)	-0.114 (-0.70)	0.205** (2.44)	0.0639 (0.38)
Indust.	YES	YES	YES	YES	YES	YES
Constant	-0.455* (-1.68)	-1.629*** (-4.24)	-0.570* (-1.97)	-2.101*** (-4.20)	-0.609** (-2.48)	-1.236** (-2.57)
R2	0.186	0.206	0.164	0.208	0.164	0.150

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2. Average growth rates before and after the crisis.

Notes: The data are taken from the IFS. The table shows the simple average of growth rates before and after the crisis. The standard errors are shown in italic. A t-test rejects the equality of the means between the two samples.

	Indonesia	Malaysia	Thailand
Annual: 1985 – 1996	0.068	0.084	0.092
<i>Standard errors</i>	<i>0.009</i>	<i>0.027</i>	<i>0.023</i>
Annual: 1990 – 1996	0.072	0.095	0.086
<i>Standard errors</i>	<i>0.006</i>	<i>0.004</i>	<i>0.015</i>
Annual: 2000 – 2006	0.049	0.055	0.051
<i>Standard errors</i>	<i>0.0067</i>	<i>0.025</i>	<i>0.015</i>
Annual: 2000 – 2008	0.052	0.055	0.048
<i>Standard errors</i>	<i>0.008</i>	<i>0.022</i>	<i>0.015</i>

Table 3. Benchmark Calibration

Description	Parameter Values
Discount factor	$\beta = 0.94$
Growth factor	$\bar{g} = 1.05$
Interest rate	$r = 0.041$
Depreciation rate	$\delta = 0.062$
Share of capital	$\alpha = 0.71$
Borrowing constraint parameter	$\phi = 9.85$
Cost of equities parameter	$\kappa = 0.5$

Table 4. Calibration for the small and the large firms.

Description	Parameter Values
Discount factor	$\beta = 0.94$
Growth factor	$\bar{g} = 1.05$
Interest rate	$r = 0.041$
Depreciation rate	$\delta = 0.062$
Share of capital	$\alpha = 0.71$
Borrowing constraint parameter	$\phi_L = 7.9$ $\phi_S = 12.4$
Probability of switching	$p = 0.021$
Cost of equities parameter	$\kappa = 0.5$

Table 5. The “*growth effect*”.

Notes: The dependent variables are: the change in the log of sales between end-1996 and end 1998, and the change in the log of the market value over the same period. *Q* is the ratio of the market value of a firm to its total assets at end-1996, which is direct counterpart of the model’s Tobin’s *Q*. It is a proxy, for the market value of the growth opportunities of a firm. Data source: Worldscope, Thomson Financial.

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Sales	Δ Value	Δ Sales	Δ Value	Δ Sales	Δ Value
Size	0.0468** (2.15)	0.0760** (2.46)	0.0395* (1.71)	0.0671** (2.12)		
Export	0.193*** (2.93)	0.222** (2.38)	0.170** (2.48)	0.207** (2.21)	0.180*** (2.63)	0.225** (2.39)
Leverage	-0.309* (-1.82)	-0.818*** (-3.39)	-0.353** (-2.01)	-0.825*** (-3.42)	-0.346* (-1.97)	-0.813*** (-3.35)
Profit.	0.583* (1.78)	0.603 (1.30)	0.709** (2.05)	0.746 (1.57)	0.741** (2.14)	0.796* (1.67)
Interest	-0.431 (-0.37)	-1.128 (-0.69)	-0.384 (-0.32)	-1.317 (-0.80)	-0.478 (-0.40)	-1.511 (-0.92)
Dividends	-0.109 (-1.13)	0.0179 (0.13)	-0.103 (-0.98)	0.00338 (0.02)	-0.0835 (-0.80)	0.0331 (0.23)
W. Capital	-0.215 (-1.19)	-0.172 (-0.66)	-0.248 (-1.32)	-0.160 (-0.62)	-0.299 (-1.60)	-0.246 (-0.96)
Investment	0.659** (2.09)	-1.002** (-2.26)	0.691** (2.13)	-0.938** (-2.11)	0.757** (2.34)	-0.820* (-1.85)
Thailand	-0.107 (-1.37)	0.254** (2.28)	-0.157* (-1.88)	0.218* (1.91)	-0.171** (-2.04)	0.197* (1.72)
Indonesia	0.0182 (0.17)	0.0470 (0.31)	0.00850 (0.08)	0.0320 (0.21)	0.00687 (0.06)	0.0279 (0.18)
Indust.	YES	YES	YES	YES	YES	YES
<i>Q</i>			-0.0317* (-1.76)	-0.0331 (-1.34)	-0.0381** (-2.16)	-0.0441* (-1.82)
Constant	-0.455* (-1.68)	-1.629*** (-4.24)	-0.294 (-0.99)	-1.445*** (-3.55)	0.139 (0.89)	-0.705*** (-3.32)
R2	0.186	0.206	0.192	0.210	0.184	0.199

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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