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Corrigendum

Corrigendum to “The effects of inequality in the 1997–98 Asian crisis and the 2008–09 global tsunami: The case of five Asian economies” [J. Int. Money Fin. 110 (2021) 102306]



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The authors regret that the author list of the article was incorrect. It should be updated as above.
The authors would like to apologise for any inconvenience caused.

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The effects of inequality in the 1997–98 Asian crisis and the 2008–09 global tsunami: The case of five Asian economies

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ABSTRACT

This paper discusses why the Asian banking sector was so vulnerable to financial crisis in 1997–98 but so resilient to global turmoil in 2008–09. While current account imbalances and short-term capital flows are widely perceived to be responsible for banking crises, rising income inequality is found in our study to exert an indirect yet ultimate impact on financial instability. The change or level of inequality may affect an economy's growth strategy, which has a fundamental implication for external vulnerability and crisis risk. We also show that economic growth is financially less risky if led by export with stable trade surpluses than by overinvestment funded with volatile capital flows. Our results are derived from economic modeling based on uncovered interest parity and confirmed by empirical evidence found from Asian data.

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1. Introduction

The Great Recession triggered by the recent financial meltdown in advanced countries has been the worst economic event since the Great Depression. While this recession is attributed to the malfunction of financial systems in the literature (Krugman, 2009; Atkinson and Morelli, 2010; Bordo and Meissner, 2012; Schularick and Taylor, 2012; Jorda et al., 2013 & 2015; Lang and Schmidt, 2016), the problem is also linked to rising income inequality (Stiglitz, 2009; Rajan, 2010; Roy and Kemme, 2012; Gu and Huang, 2014; Kumhof et al., 2015; Perugini et al., 2015; Kirschenmann et al., 2016). Although there is no doubt that banking crises are due directly to various defects in financial sectors, discussions would yield incomplete results if neglecting weak economic fundamentals such as income inequality that could be a potential destabilizing factor (Malinen, 2016). It is observed that inequality has risen with trade and growth in many countries since the 1980s (Alvaredo et al., 2013; Karabarbounis and Neiman, 2014) while financial crises occurred with greater severity and higher frequency in the same period (van Treeck, 2012). In advanced economies, domestic demand depressed by rising inequality was kept artificially high through consumer credit and foreign financing (Fitoussi and Saraceno, 2010; Tridico, 2012; Wisman, 2013). Such consumption-led economic growth could not be sustained forever, but rather eventually led to external imbalances, debt explosions, and financial crises (Caballero, 2014; Stockhammer, 2015; Davis et al., 2016).

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The investigation of the recent financial crises in advanced economies makes it interesting to examine why emerging Asia that was previously vulnerable to crises became financially stable later during the 2008–09 global crisis. The Asian financial crisis erupted in 1997–98 as one of the worst events in the world economy. This regional event led to a global financial tsunami as Russia experienced a crisis in 1998, Brazil in 1999, and Argentina and Turkey in 2001. The voluminous literature is devoted to the analysis for the causes of the Asian crisis (Goldstein, 1998; Radelet and Sachs, 1998a; Burnside et al., 1999; Bordo et al., 2001). Yet there has been no consensus reached so far (Chang and Velasco, 2001; Chan and Dang, 2012), and no study pays attention, either, to rising inequality as a causal factor for this crisis. Although the distributional effect of the Asian crisis for a post-crisis period was examined in the literature (Hagen, 2007), the reverse link running from inequality to the crisis has not been tackled by any authors. An increasing number of economists argue that rising inequality can be a contributing factor leading up to the 2007–09 crisis in advanced countries. It is then natural to ask whether the rise in inequality experienced by Asia in the 1990s also played an important role in the build-up of its financial crisis. Our paper addresses this issue from the theoretical and empirical perspectives, and also sheds light on Asian financial stability in the midst of the recent global crisis. It seems that inequality now becoming fashionable is used to explain all kinds of problems. Our work, while exploring the potential role of inequality, also attaches great importance to the impacts of financial and other economic factors.

Considering the role of inequality provides an alternative explanation for the 1990s Asian crisis. Many authors recognize economic as well as financial imbalances as fundamental roots of the crisis, but this recognition does not include distributional imbalances. While the blame is put on capital flows (especially short-term ones) for instigating the crisis due to their nature of pro-cyclical movements (especially their danger of sudden reversals) (Rodrik and Velasco, 2000; Summers, 2000; Calvo, 2005; Weisbrot, 2007), a related question that remains unaddressed is why Asian crisis countries were subject to those flows or susceptible to their volatility. A markedly different account of the problem appears in the literature to turn the causality from capital flows to financial crises on its head. According to the latest studies, a heavy reliance on foreign financing for consumption-led growth as a stopgap means of dealing with rising inequality can only worsen current account imbalances, with which financial crises may be intimately connected (Obstfeld and Rogoff, 2009; Kumhof et al., 2012; Gu et al., 2015). In other words, a crisis occurs in the financial sector, but its root lies deeply in adverse changes in income distribution (Kirschenmann et al., 2016). Seeking capital inflows is therefore more of a passive response to weak macroeconomic conditions rather than an ultimate cause of the crisis (Benmelech and Dvir, 2013). Such weaknesses lie with distributional as well as external imbalances. This view accounts well for experiences of advanced economies; our paper is the first to explore whether such new view is also applicable to Asia. We address this question by looking at interactions of rising income inequality with current account imbalances and international finance factors.

Our work also contributes to the related discussion about why the Asian financial system has successfully resisted contagion effects from the 2007–09 global crises (Bernanke, 2009; Goldstein and Xie, 2009). Although Asian trade-dependent economies were not immune to the contracting influence of the global slump on their export and growth, their financial systems largely escaped the worst impacts of credit problems that erupted in the U.S. and Europe. Unlike other parts of the world, Asian economies have recovered swiftly from the global recession by relying on domestic and regional demand within Asia. These developments lead some people to speculate that the Asian economies have decoupled from their advanced counterparts in the West; for example, asset securitization prevailing in the West is not popular in Asia. Many believe that the reason for Asia to be well positioned to handle the 2007–09 global crises is that the lessons learned from its own 1990s crisis have served its banking sector well in resisting the large external shock. These lessons require the fundamentals to be sound, including an improvement of external debt position, a build-up of forex reserves, and a reform of financial systems (Muchhala, 2007). Stronger fundamentals have made the policy response to the global crisis more effective in Asia than in other regions. Something also fundamental yet still overlooked is the Asian income distribution that has become less unequal since 1998 (Lee, 2010). The Asian current account has changed from deficit to surplus since 2000, and this favorable development is attributable to falling inequality as well as undervalued exchange rates. Our paper provides a formal investigation for the implication of this change in inequality on current account improvement and recent financial stability in Asia.

Given that the existing literature did not fully explain the causes of the 1997–98 Asian crisis or the impacts on Asia of the 2007–09 global crisis, we are motivated to present a more complete account of these issues. Both our economic modeling and econometric estimation are based on several overlooked features of key fundamentals in Asia. First, income inequality in Asia was more serious in the previous than in the recent period. Higher inequality implies lower consumption or demand (Fitoussi and Saraceno, 2010) and hence heavier reliance on investment or trade for output growth. Second, developed countries can resort to *consumption-led* growth (Tridico, 2012) due to their strong ability to finance consumer credit with foreign savings, but Asia cannot. Instead, Asia has to rely on its own high savings for *export-led* growth (Aizenman and Sengupta, 2011) or on capital inflows for *investment-led* growth (Lim and Khor, 2010). Third, in Asia, the change or level of inequality affects the risk of financial crisis through the investment-to-saving ratio or the current account channel. Finally, crisis-hit Asian economies are characterized as a risky model of investment-led growth in 1985–1998 but a relatively safe model of export-led growth in 1999–2018. Clearly, such a change in growth model after 1999 hinges on the lessons learned from the 1997–98 crises. The theoretical prediction from our modeling based on those economic fundamentals is consistent with empirical evidence found from Asia.

Our empirical study finds that rising inequality had a significant impact on Asian financial instability previously while at the same time trade deficits contributed greatly to crisis risk. The opposite was true recently when inequality experienced a

decline or trade reaped a surplus. Our findings confirm Stiglitz-Rajan's general view on rising inequality as a causal factor behind financial crises for the particular case of Asia. Specifically, in 1985–98, rising income inequality and persistent trade deficits eventually led to the occurrence of currency, banking, and economic crises in Asia. It was indeed unsustainable for the Asian economy to grow through over-investment that was financed by volatile capital flows (Corsetti et al., 1999). In contrast, trade surpluses and falling inequality in the post-crisis period (after 1999) allowed Asia to weather the global financial storm through ample foreign exchange reserves and comfortable domestic liquidity cushions (Kawai, 2009). Yet over-trade growth cannot be sustained, either, given the contracting foreign demand when trade partners from the OECD region are troubled by deficit problems and debt crises (Lim, 2014) and when trade wars are intensified and prolonged (Munoz, 2019). Our empirical results support the view that using capital inflows for economic growth with financial risk was an equilibrium response to worsening inequality in Asia before 1998, whereas its financial stability regardless of the 2008–09 global shock had much to do with its improved situation of inequality. Our work also generates some policy implications for economic growth and financial stability.

The rest of the paper proceeds as follows. Section 2 documents stylized facts. Section 3 provides economic modeling. Section 4 presents empirical strategies. Section 5 supplies estimation results. Section 6 concludes.

2. Observed facts

This section provides an illustrative analysis for economic and financial fundamentals through key stylized facts observed in Asia over the past three decades. We focus on five countries badly hit by the 1997–98 crises: Indonesia, Malaysia, South Korea, Thailand, and the Philippines. Investment-led growth before 1997 was pursued by these countries as a reaction to falling consumption demand under rising income inequality. Their savings, albeit high, still fell short of investment that was then financed by capital inflows through high interest rates, and their current accounts were thus in deficit. Much of such over-investment was made in non-tradable sectors and illiquid assets that became less profitable later and contributed little to export earnings or forex reserves. Banks unable to obtain long-term financing for domestic investment (as their assets) had to borrow short-term external debt (as their liabilities). This aggressive practice in Asia with double mismatches (term and currency) created serious vulnerability to exchange-rate risk as well as rollover risk. Banking crises erupted drastically due to a sharp rise in the cost of liabilities and a drastic fall in the value of assets following the currency collapse during 1997–98 after forex reserves had been exhausted due to massive capital outflows. The lesson learned by the crisis-hit countries later enabled them to weather the contagion effects of the global financial storm during 2008–09 (Goldstein and Xie, 2009; Kawai, 2009).

Fig. 1 shows that income inequality either increased sharply for years up to the 1990s crisis in Indonesia, Malaysia, and the Philippines or stood at a high level in Thailand. Korea seems an odd man out because there was a trend fall in inequality before the crisis but a sharp surge after it; this transient surge was followed by an even sharp drop so that the Gini index has stayed low ever since. The situation in most countries sampled is similar to the U.S. case, where the top 5% income share increased from 27.5% in 1920 to 34.8% in 1927 before the Great Depression and from 21.8% in 1983 to 33.8% in 2007 before the Great Recession (Kumhof and Ranciere, 2010). The economic implications of rising inequality are a drop in aggregate demand and an action needed to make up for such demand insufficiency. The actions taken were the credit-based expansion of consumption in the U.S. before 2007 (Tridico, 2012) and the capital flows-financed growth of investment in Asia before 1997 (Corsetti et al., 1999). The resultant lending frenzies must end up with major financial crises, as did erupt in 1997 in Asia and 2007 in the U.S. (Bordo and Meissner, 2012; Schularick and Taylor, 2012). It is fortunate that most of the Asian countries have witnessed a significant decline in income inequality after their 1990s crisis. Formal research in the literature establishes a turning point for this change in Asian inequality, finding that the role of development level in the Kuznets curve is replaced by that of globalization in reversing the inequality trend in Asia (Lee, 2010). Such turning point has so fundamental an impact as to shield the Asian banking sector from the global financial crisis; this phenomenon is further unfolded below.

Fig. 2 displays the change in domestic investment I relative to national saving S over the whole sample period in the five Asian countries. This change in the I/S ratio seemingly has no bearing on variations in income inequality, but actually can be rooted in them. Before the 1990s Asian crisis, rising inequality that depressed consumption forced those economies to grow through overinvestment, as evidenced by their rising or high levels of I/S (exceeding 1.0 prior to the crisis). While investment was well above 30% of GDP and even above 40% sometimes, much of it was financed by capital inflows and concentrated in non-traded sectors with low profitability, leading to trade deficits and external vulnerability. Such over-investment necessitated credit expansion, greatly increasing crisis risk (Guest and McDonald, 1999). Since 1999, however, the Asian economic strategy has been altered from investment-led to export-based growth (with investment dropping below saving), as implied by falling or low levels of the I/S ratio (Soedarmono et al., 2011). The recent growth model in Asia has become healthier than before, and, in the meanwhile, its inequality is generally declining, albeit still at high levels. High inequality is supposed to correspond to high saving and trade surplus if not resorting to credit growth to deal with insufficient demand (Gu et al., 2015). More balanced interactions between economic and credit growth would make the banking sector more resilient to financial crisis, as experienced by Asia during the 2007–08 global turmoil.

Fig. 3 portrays a clear picture that current accounts of the five Asian countries were mostly in deficit before the 1990s crisis but in surplus after the crisis. According to the national income account, this picture is inherently associated with

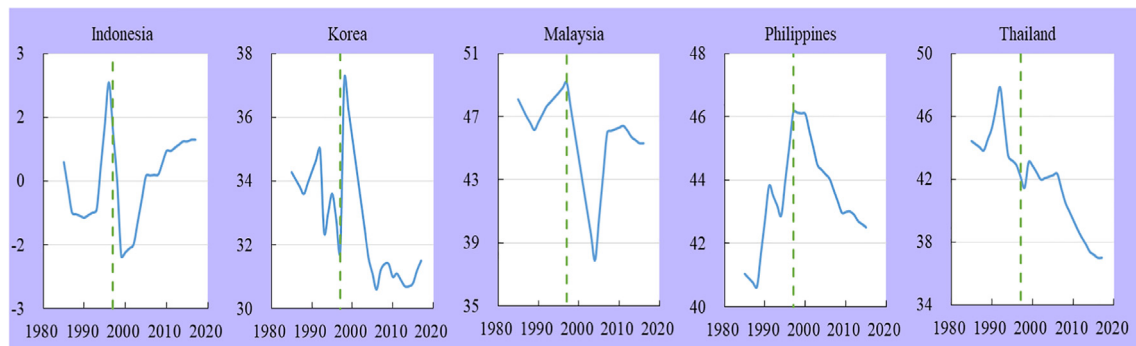


Fig. 1. Change in income inequality. *Note:* Raw data on the Gini index (in %) are used for Korea, Malaysia, Thailand, and the Philippines. Standardized data are used for Indonesia through dividing the difference between actual observations and their mean by the sample standard deviation for the pre- and post-crisis periods. Such standardized data for Indonesia reveal a sharp increase in its inequality prior to the crisis and a dramatic drop afterwards.

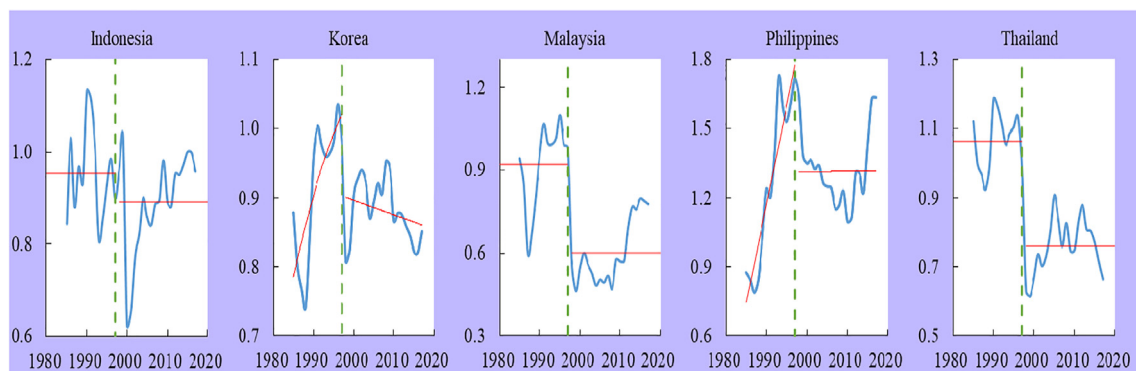


Fig. 2. Ratio of investment to saving. *Note:* The red lines indicate average levels of I/S before and after the crisis in Indonesia, Malaysia, and Thailand. The red lines for Korea and the Philippines are the time trends in the two periods.

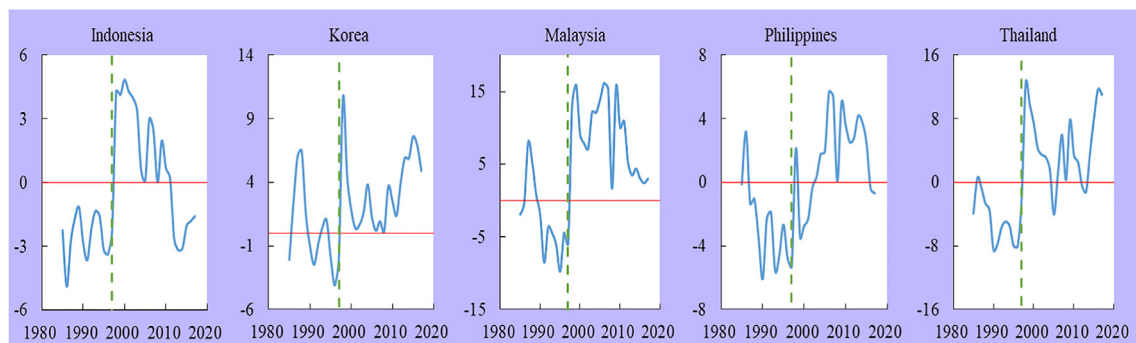


Fig. 3. Ratio of current account balance to GDP. *Note:* The red horizontal line represents the position of balanced current account. This account is in deficit if below the line or in surplus if above the line.

the evolution of the investment-to-saving ratio across periods. A current account deficit exceeding 5% of GDP is viewed as dangerous for market stability if financed by capital flows, since they could rapidly reverse themselves (Summers, 2000). The five countries as a group that came under speculative attack in 1997 appear to have been troubled by large or persistent current account deficits throughout 1985–97. Malaysia and Thailand had suffered current account deficits between 6 and 10% of GDP for many years before 1997, and Indonesia experienced a large deficit for longer than a decade. While the previous financial crisis in Asia is attributed to its worsening current account imbalances (Feridun, 2006), its financial stability during the recent global crisis is believed to hinge on its falling distributional imbalances (Lim, 2014). The fundamental link between crisis risk and rising inequality via external imbalances has been established for advanced economies in the literature (Kumhof et al., 2012), and will also be taken seriously for Asian economies in our study.

Fig. 4 depicts the evolution of external vulnerability over the past three decades in the five Asian economies. This vulnerability is characterized by the ratio of M2 or short-term external debt to forex reserves, with a higher ratio indicating greater vulnerability. Such financial vulnerability has much to do with a large or prolonged current account deficit that entails borrowing from abroad. Yet external liabilities used to finance this deficit tend to reach excessive proportions, ultimately triggering devaluation expectations, speculative outflows, and financial crises. In fact, the 1985–97 deficits in Asia could not be sustained any longer since its rapid domestic growth funded with short-term external debt did not lead to enough export receipts. Its foreign-financed investment should have been made in the exporting sector to yield business profits and trade surpluses to repay external debt obligations, but all this did not take place in Asia before 1997. It is then no wonder that the end result was capital-flow reversals and banking-sector collapses. There exists controversy over whether the buildup of short-term debt before 1997 was a cause or an effect of the incipient crisis. While some authors believe that short-term liabilities together with self-fulfilling elements resulted in vulnerability to liquidity/rollover risk (Summers, 2000; Eichengreen, 2004; Calvo, 2005), others think of these factors merely as a passive response to the weakness of underlying economies. More recent studies identify the currency mismatch and the liquidity mismatch as a derived problem with secondary importance (Diamond and Rajan, 2001; Benmelech and Dvir, 2013). Our study attempts to clarify which view is closer to the reality. The data plot in Fig. 4 displays the noticeable regularities that external vulnerability reached its peak at the onset of the 1990s crisis but fell sharply in the wake of the crisis in most of the affected economies. Such statistical regularities are suggestive of the direct impact on the financial risk of capital flows that, however, can be indirectly traced back to the change of income inequality as identified in our theoretical discussion.

3. Theoretical analysis

This section proposes a simple economic model as the theoretical base for the subsequent empirical analysis. We keep this model at a minimal level of complexity since the emphasis of this paper is on estimation rather than on theorization. Our theoretical formulation, hinging on the above-observed facts, introduces the role of income inequality, among other things, for crisis risk, with the resultant model solved through analytic geometry for intuitive clarity.

3.1. Model setup

Our model goes beyond uncovered interest parity (UIP) since forex reserves as well as interest rates and exchange rates are related to the risk of financial crisis as observed in many events of currency crises. UIP holds if investors know relatively well about future exchange rates (Romer, 2001). However, the exchange rate is affected by unexpected shocks, so the UIP condition needs to be modified to consider exchange risk. We introduce this risk explicitly in the model but will not address risk premia since investors are assumed to be risk-neutral (Caves et al., 2007).

Our model is composed of two equations that jointly determine the risk π of financial crisis and the rate r of interest on domestic assets. Let the exchange rate e be the price of a foreign currency in terms of the domestic currency. This rate is either fixed by the central bank or determined by forex markets. However, the peg is not completely credible in the former case, and governments may occasionally intervene in forex markets in the latter case. Each period that the fix is in effect, there is a likelihood that the central bank will abandon the peg and devalue the currency to $e' (> e)$; this tends to arise when a crisis is about to break out. By contrast, under a floating regime, the exchange rate varies much more easily and frequently, with a large depreciation to e' occurring if a crisis is impending. Denote by s the rate of devaluation or depreciation: $s = (e' - e)/e (> 0)$. Domestic assets may pay r with probability $(1 - \pi)$ of no crisis, or $(r - s)$ with probability π of a crisis erupting.

Under risk neutrality the expected payoff from holding domestic assets is required to equal the risk-free rate r^* of return on foreign assets, as specified below

$$\pi(r - s) + (1 - \pi)r = r^* \text{ or } \pi = \frac{r - r^*}{s}. \quad (1)$$

This is the first equation in our model and can be rewritten as $\pi s = r - r^*$ (i.e., the excess return). This equation looks like UIP, $r - r^* = s^e$, since the expected depreciation s^e is similar to the expected value of exchange loss $\pi s + (1 - \pi)0 = \pi s$. Yet the crisis probability or exchange risk is now explicitly expressed in Eq. (1) as π (that will be further specified shortly). Domestic interest rates must vary within the interval of $r \in [r^*, r^* + s]$ in order for the probability to fall in the range of $\pi \in [0, 1]$.

Eq. (1) reduces to $r = r^*$ in the tranquil case with $\pi = 0$, which is equivalent to applying UIP to the case of fixed exchange rates. Eq. (1) may reduce to $r = r^* + s$ in the volatile or turmoil case with $\pi = 1$, in which investors are compensated for the exchange loss of $s > 0$ through higher domestic rates r than foreign ones r^* . Since π is defined as a continuous variable, a compensation equal to $\pi s (< s)$ can be imputed to the risk π of depreciation under the floating exchange rate. It is widely observed that the central bank, if faced with such a risk, will increase the interest rate to protect the value of its currency. The line of Eq. (1) is depicted in Fig. 5. Eq. (1) can also be used to analyze a favorable situation with $s < 0$, where π is re-defined as the probability that fundamentals are improved. In this situation, the Eq. (1) line is downward sloped and defined on $r \in [r^* + s, r^*]$.

In reality, crisis risk has to do with the actual stock Z of forex reserves relative to a certain minimum amount z of reserves required. Each country has a different such amount given their differing fundamentals. A crisis may erupt when reserves fall

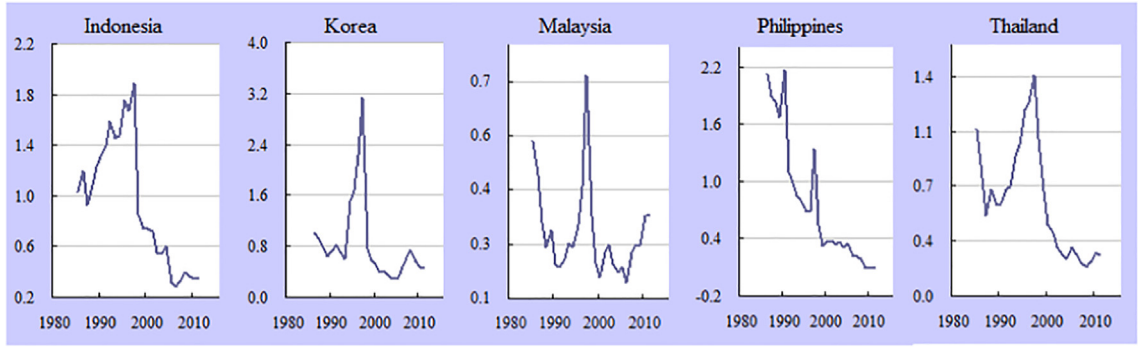


Fig. 4. Ratio of short-term external debt to foreign exchange reserves. Note: The situation of debt was much more serious in Korea than in the other nations for several years up to the crisis.

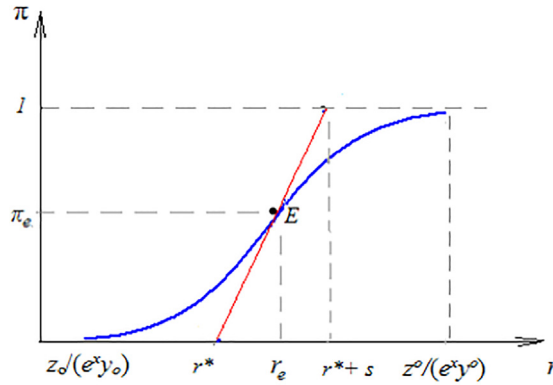


Fig. 5. Determination of the interest rate and crisis risk in equilibrium. Note: The end points of the (c.p.d.) interval for r will be specified shortly via further parameterization.

below this threshold. The risk of crisis is therefore the probability that Z is less than z . This random variable $Z \in [z_o, z^o]$ follows a cumulative probability distribution (c.p.d.)

$$\pi = \Pr(Z < z|\theta) = F(z|\theta) \quad \text{or} \quad \pi = F(z(r)|\theta) \quad \text{if } z = z(r), \quad (2)$$

where θ is a vector of shifting parameters both for objective economic conditions and for investors' subjective beliefs that, albeit fickle sometimes, often move in line with altering fundamentals. A more pessimistic belief shifts the entire $F(\cdot)$ curve to the left, with the resulting c.p.d. first-order stochastically dominated by the original one. The required amount z of reserves has an intrinsic bearing on domestic interest rates r , as parameterized to be $z = z(r)$. The link of z with r hinges on the extent of capital mobility, the degree of monetary autonomy, and the regime of exchange rate according to the impossibility trinity.

The equilibrium stipulated by the two equations emerges as a point like E in Fig. 5, where the curve intersects the line. Both Eqs. (1) and (2) are simultaneously satisfied at point E . In this equilibrium, the interest rate r_e on external debt makes investors willing to hold the debt given the probability π_e of crisis. This risk is the likelihood that forex reserves may be insufficient to pay off the debt given the interest rate.

3.2. Model re-parameterization

To analyze Asian finance issues with our model, re-parameterization is needed for its second equation in Eq. (2). A rule of thumb followed by central banks is to hold at least an amount of forex reserves equivalent to three months of imports to eschew trade interruption. Hence, a greater volume of imports or a larger deficit x of the current account pushes up the level of z ; that is, we need $\partial z/\partial x > 0$. Another rule of thumb adopted in practice is to hold liquid reserves at least equal to external debt coming due within one year to smooth financial flows (known as the Guidotti-Greenspan rule). Thus, a larger such debt y necessitates a higher level of z ; that is, we should have $\partial z/\partial y > 0$. Furthermore, the debt level y relates positively to interest rates r since a higher domestic rate attracts more capital inflows; that is, one sees $y'(r) > 0$. It then follows that z is a function of x as well as y or r : $z = z(x, y)$ and $y = y(r)$. For clarity, we simply use $y = y_o r$ and $z = y_o r / e^{\text{CAB}}$, where CAB refers to the current account balance that may be either a deficit x ($= -\text{CAB} > 0$) or a surplus v ($= \text{CAB} > 0$). Thus the c.p.d. in Eq. (2) is defined on $r \in [r_o, r^o]$, with this interval being $[z_o/(y_o e^x), z^o/(y_o e^x)]$ in the deficit case or $[z_o e^v/y_o, z^o e^v/y_o]$ in the surplus case. The c.p.d. shifts

to the left with a worsening current account (either a larger deficit or a smaller surplus). The probability π of crisis is equal to 0 for $r \leq r_o$ and 1 for $r \geq r^o$. If the density function $f(z)$ is bell-shaped, the *c.p.d.* exhibits an S shape as depicted in Fig. 5.

In Eq. (2) the vector θ of parameters reflects the impacts of fundamentals on z_o , z^o , x , and y_o ; however, not all of them are to be discussed here.¹ Instead, we only examine the impact of income inequality q on trade deficits x to conserve space. Our first approach to this impact is to look at the amount M of imports relative to aggregate income Y , where $x = M - E$ and E is the value of exports. The national income identity implies $S + x = I$, where C , $S (= Y - C)$, and I stand for consumption, saving, and investment, respectively. Part of imports are used for consumption M_C and all the rest of them go for investment M_I , where $M_C + M_I = M$. Let $\lambda_1 = M_C/C$ and $\lambda_2 = M_I/I [= M/(S + x)]$ be the shares of imported goods used for consumption and investment, respectively. Realistically, $\lambda_1 < \lambda_2 (< 1)$ since, unlike their developed counterparts, developing countries usually import foreign goods for capital construction rather than domestic consumption. Piecing together all these expressions yields

$$\frac{M}{Y} = \frac{1}{1 - \lambda_2} \left[\lambda_1 + (\lambda_2 - \lambda_1) \frac{S}{Y} - \lambda_2 \frac{E}{Y} \right]. \quad (3)$$

There was no export growth (in fact, E/Y went down) in most of the five Asian economies before 1997 because much of investment was made in non-tradable sectors. Furthermore, the saving rate $s = S/Y$ rises with higher inequality q [i.e., $s'(q) > 0$], as predicted by a Post-Keynesian model (Gu et al., 2015). It then follows from Eq. (3) that M/Y should increase with higher inequality q , thereby contributing to the trade deficit x relative to Y (note that $M \uparrow - E \downarrow = x \uparrow$ due to $q \uparrow$). We can thus specify $x'(q) > 0$.

The second approach is to look at investment I relative to saving S . Before the crisis in Asia, a large portion I_N of saving S was invested in non-tradable sectors, while only a small part I_T was used for export trade, where $I = I_T + I_N$. The investment propensity out of saving is defined to be $\tau_1 = I_T/S_1$ for tradable sectors and $\tau_2 = I_N/(S_2 + D_f)$ for non-tradable sectors, where D_f was foreign debt borrowed for flaunty investment by family business empires in Asia before 1997 while S_1 and S_2 were savings by the general public and those empires, respectively. The truth for Asia in that period was $\tau_1 < \tau_2$ since the family businesses had strong incentives to undertake “conspicuous investment”, that is, their debt ratio $\beta_f = D_f/S_2$ was high (Corsetti et al., 1999). Algebraic operation leads to

$$\frac{I}{S} = \tau_1 + [\tau_2(1 + \beta_f) - \tau_1] \frac{S_2}{S}. \quad (4)$$

The Post-Keynesian model implies that the saving share S_2/S of the family business empires hikes with rising inequality q . Since $\tau_2 > (\tau_1 >) \tau_1/(1 + \beta_f)$, it follows from Eq. (4) that I/S increases with higher q . Using the national income account again, we know from $x/S = I/S - 1$ that rising inequality q is conducive to investment I relative to S , that is, we have $x'(q) > 0$ again.

The current account deficit x can now be treated as a function of income inequality q (as an exogenous variable), with $x'(q) > 0$ confirmed also by empirical evidence found from many developed and developing countries (Katsimi and Moutos, 2011; Adam et al., 2012; Kumbhof et al., 2012). That is, rising inequality is bad for the current account if economic growth relies on some kinds of external factors (e.g., capital inflows). In addition, large and prolonged current account deficits can force domestic currencies to devalue or depreciate substantially (Mussa, 1982; Doukas and Lifland, 1994). Hence, s may be related positively to x , that is, $s'(x) > 0$, as often observed everywhere in trade transactions and forex markets (Neely and Dey, 2010). Other aspects of objective fundamentals or subjective beliefs are also captured by θ , and their weakening would shift the $F(\cdot | \theta)$ locus to the left. Obviously, the new *c.p.d.* following such a shift is first-order stochastically dominated by the original one.

3.3. Model analysis

The equilibrium E entails some analyses to generate useful predictions. First, there are multiple equilibria, not just point E in Fig. 5 or 6. Three equilibria (E_o , E , E^o) in Fig. 6 are worth attention. At E_o , crisis risk is very low and the domestic interest rate is only slightly above its foreign counterpart. At E in Fig. 6, there may be a substantial chance of crisis if the domestic rate is well above the foreign rate. At E^o , crises are certain and investors refuse to hold the debt at any domestic rate. Plausible dynamics, as depicted by (E, E', E'', \dots, E^o) in Fig. 6, are such that the equilibrium is unstable at E but stable at E_o and E^o . Once each investor conjectures that others believe that crisis risk will deviate from equilibrium π_e , the economy may actually deviate and this process can continue until a new equilibrium is reached at either E_o or E^o , depending on whether the initial belief is slightly below or above π_e . Such self-fulfilling effects lead the economy to converge to a stable state eventually (Obstfeld, 1986; Calvo, 1988; Morris and Shin, 1998).

Second, due to the role of differences in the initial belief just described, two countries may end up with different stable equilibria, even though they have similar economic fundamentals. In one country, crisis risk and the interest rate are both low; but, in the other, capital inflows reverse themselves, no matter how high the interest rate offered to investors is. A crisis, when it occurs, may be quite unexpected. Drastic capital outflows always follow this event, almost exhausting forex reserves of a central bank.

¹ Weaker (/stronger) fundamentals θ tend to lower (/raise) z_o , z^o , and y_o . For example, poorer economic conditions correspond to a smaller y_o in the function $y = y_o r$, under which only a lower debt y can be borrowed for any given interest rate r or a higher interest rate r must be offered in order to borrow the given amount y of debt. This sensitivity of capital movement to fundamentals and their effects on z_o and z^o are not included in this model.

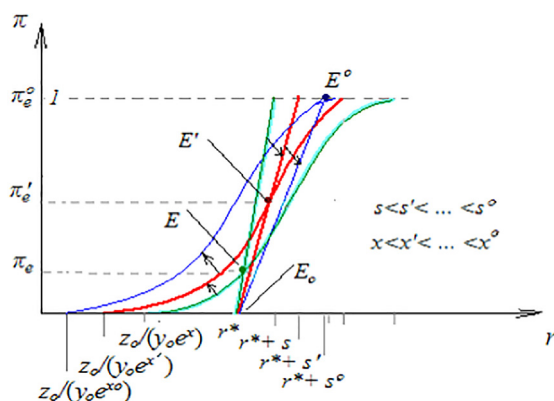


Fig. 6. Effects of rising inequality on the unstable equilibrium. Note: The end points of two r -intervals for Eq.'s (1) and (2) are affected by inequality q since $x'(q) > 0$ and $s'(q) > 0$.

Third, the emergence of financial crisis depends on self-fulfilling beliefs as well as on economic fundamentals. An equilibrium is affected by a parametric change of fundamentals in the (r, π) graph of Fig. 6. The line of $\pi = (r - r^*)/s$ and the curve of $\pi = F(xy_o r | \theta)$ will shift down and up, respectively, at the same time when there is a rise in foreign interest rates r^* , a deterioration in current accounts x , or a devaluation/depreciation $s (> 0)$ of the domestic currency. Each of these shifts increases π_e and affects other equilibria. It is thus clear that the 1997–98 Asian crisis had an intimate relation to the rising U.S. interest rate in the mid-1990s, to the five countries' persistent trade deficits over 1990–97, and to the unsustainability of their fixed exchange rates speculated by investors prior to the crisis. Under financial integration that amplifies contagion effects, a major crisis occurring in one country can quickly spread to others regardless of their fundamentals.

The above three points show that our model has great potential as a plausible explanation for the causes of financial vulnerability in Asia prior to its 1990s crisis. Such an explanation can be provided with the aid of our above re-parameterization according to specific situations in Asia before 1997. The five Asian countries experienced an increase in income inequality before 1999. We can explain the impacts of this factor on their financial systems through graphical analysis in Fig. 6. Rising inequality q worsens the current account x (as implied by $x'(q) > 0$) and heightens currency devaluation or depreciation s (as posited by $s'(x) > 0$), shifting the line to the right and the curve to the left (as derived from our model depicted in Fig. 6). The equilibrium thus derived is shifted from point E to point E' ; this shift is more serious for economies with weaker fundamentals θ . Clearly, there are a greater chance of crisis and a higher rate of interest at E' than at E . Worse fundamentals under rising q and swelling x , causing the E -to- E' shift, tend to unleash a self-fulfilling spiral. This strong effect can move the economy to go through points (E', E'', E''', \dots) until the point E° is finally reached as a steady-state equilibrium, where there is no interest rate, no matter how high (offered by the central bank), that can stop capital inflow reversals; a financial crisis will then become an inevitable end result (Hellwig et al., 2006).

We can also use a similar model to account for the episode of financial stability in Asia after 1999, especially during the 2008–09 global crisis that had no serious impact on its banking sector. We base our explanation on two new developments in Asia: a) income inequality has fallen since 1999 in most of the five countries, albeit still at somewhat high levels, and b) their current accounts have altered from deficits to surpluses with substantial accumulation of forex reserves. We interpret those developments as smaller pressure for depreciation (i.e., $s > 0$ falls) or alternatively as pressure for appreciation (i.e., $s < 0$, not shown in a figure). As a result, the line is shifted to the left (not shown) while the curve is shifted to the right (not shown), opposite to the shifts shown in Fig. 6. Naturally, a lower interest rate obtains along with smaller crisis risk in the unstable equilibrium due to healthier fundamentals. One can expect that this situation will then lead to a no-crisis outcome as a stable equilibrium under favorable self-fulfilling effects. It is thus far clear that our theoretical predictions for Asia are consistent with the stylized facts presented earlier. In what follows we will check whether these predictions accord well with empirical evidence found from Asia.

4. Empirical strategies

This section designs regression strategies to identify main determinants of financial risk for the five Asian economies, which were hit badly by one crisis from within in 1997–98 and affected slightly by another from outside in 2008–09. Our empirical study involves panel-data regressions, with chosen estimators suiting us to take into account both financial and economic fundamentals. While the regressand and regressors should be selected in accordance with stylized facts, theoretical predictions, and previous literatures, such choice of variables is inevitably subject to data availability and quality as in all other studies.

4.1. Dependent variables

Two variables are chosen as a proxy for financial vulnerability: one is the credit cycle and another is the *ERW* index to be defined shortly. When using credit as the regressand Y_{it} for estimation, a two-stage strategy needs to be implemented: A dummy variable (equal to 1 for a crisis or 0 if no crisis) is regressed on credit in stage 1, and credit is then regressed on its potential determinants in stage 2. If using the *ERW* index instead, it can be directly regressed on those determinants as only one-stage work. Our paper will examine these two alternatives for empirical robustness check. In what follows the estimation equation is referred to as the type 1 regression if Y_{it} is the *ERW* or the type 2 regression if Y_{it} is the credit cycle.

The *ERW* index is proposed by Eichengreen et al. (1996) and also termed the “exchange market pressure”. In fact, this index actually originates from Girton and Roper (1977) who observe that when facing pressure on its currency, a government may devalue the currency, raise the interest rate, and/or run down forex reserves. The *ERW* summarizes all changes in exchange rates, interest rates, and forex reserves. All the three variables were used in the preceding theoretical discussion, entering into our economic model. The index is widely used as an indicator of currency crisis risk in the literature, albeit having some critics. We believe that the *ERW* index can also serve as a proxy for the risk of financial crisis since a banking crisis usually follows the currency crisis in emerging-market economies with the limited flexibility of currency exchange rates prior to their crises. Indeed, this was the case for Asia in 1997–98. In this paper, both these crises combined are referred to as the financial crisis for expository convenience as in other papers.

The *ERW* index is denoted by K_t and constructed as

$$K_t = w_1 \Delta e_t + w_2 \Delta i_t - w_3 \Delta fr_t, \quad (3)$$

where Δe_t , Δi_t , and Δfr_t are percentage changes in exchange rates, interest rates (relative to the U.S. level), and forex reserves, respectively, and their weights (w_1 , w_2 , w_3) are the inverse of their standard deviations over the period in question. A higher value of the *ERW* indicates a greater risk of financial distress. Hence, this index reaches an extreme level with the advent of a crisis, but stays low and stable under no crisis. Denote by σ_k and K_μ the standard deviation and mean value of K_t , respectively. The *ERW* is used in the literature to construct a dummy variable Y_t to identify speculative attacks on a currency. This Y_t is set equal to one in period t if $K_t > K_\mu + 2\sigma_k$ or to zero otherwise. In our paper, however, K_t itself is treated as the dependent variable Y_t as depicted for Asia in Fig. 7.

The *ERW* plotted in Fig. 7 provides a clear picture of financial pressure over time in both tranquil and crisis periods for three reasons (Zhang, 2001). First, high interest rates were used in Asia to attract capital inflows to fund its overinvestment for many years up to the crisis, hence sowing the seeds for crisis outbreak later in 1997–98. Second, inadequate forex reserves with a problematic composition due to current account deficits and inappropriate investment projects were hemorrhaging fast after mid-1997 when the authorities tried to defend their currencies from freefall. Third, even if interest rates were increased further in order to stop capital inflow reversals, these currencies that originally had pegged to the U.S. dollar eventually collapsed due to the outflow of short-term capital and the exhaustion of forex reserves, with their exchange rates forced into some types of floating regimes.

Fig. 7 exhibits an identifiable pattern for financial risk over time in the five Asian countries most troubled by the 1990s crisis. The *ERW* is observed to be roughly stable at low levels before this crisis and after it, signaling a relatively lower financial risk. In 1997–98, a sharp upward jump in the *ERW* indicated the eruption of the Asian crisis as a disastrous economic event. In 2007–09, however, the *ERW* fluctuation was insignificant and small in Asia whose banking sector was almost immune to the global financial crisis. Clearly, the *ERW* best serves our purposes to measure the exposure of the five Asian economies to the risk of financial crisis. In what follows we explore on the empirical front whether there is a significant link between income inequality and financial risk in Asia.

4.2. Independent variables

The independent variables in our work include economic as well as financial imbalances as fundamental factors to explain crisis risks, with economic fundamentals embracing distributional as well as external imbalances. The selection of these variables is based on stylized facts and theoretical predictions presented earlier in this paper, with previous studies in the literature also invoked to facilitate our regressor selection. The same set of explanatory variables is employed for model specification in both type-1 and type-2 regressions to facilitate the comparison between their estimation results, with the sample period of 1985–2011 covering both the previous Asian crisis and recent global one. Our regressors selected for emerging Asia aim to identify the root causes of its devastating financial vulnerability in 1997–98 and of its remarkable financial stability in 2007–09 despite the adverse shocks from the global crisis.

The sample period for type-1 estimation is divided into two sub-periods, 1985–1998 and 1999–2011, to look at different performances of the five Asian economies. Different combinations of regressors are invoked for estimation as usual as done

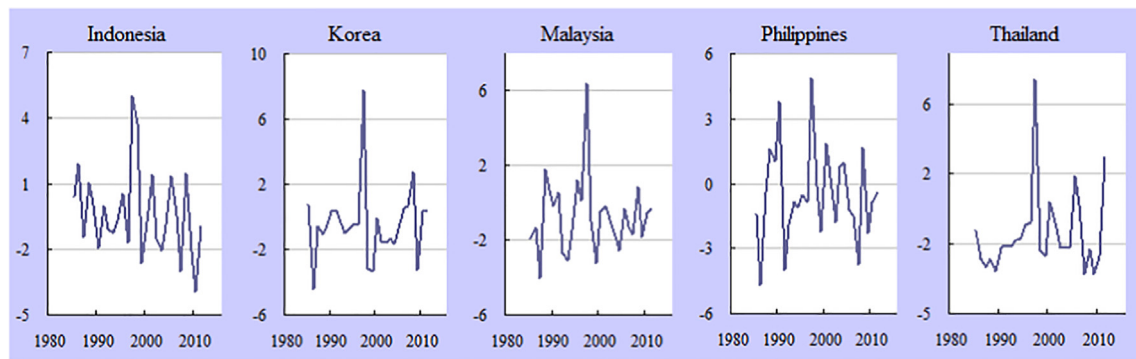


Fig. 7. Risk of financial crisis captured by the ERW index.

by all other studies in the literature. More than one measure for a variable may also be used to examine the stability of coefficient estimates. Our data for all variables are collected from several official sources. We find that there is no 100% consistency between different databases for the same variable or even between the old and updated versions of a dataset. This situation would have a certain distorting impact on estimation results. Necessary adjustments therefore need to be made to ensure the precision of estimation.

Our difficulty lies with inconsistent data on income inequality for the five Asian countries.² Interpersonal inequality is usually measured by the Gini index that, however, has plenty of limitations (Alvaredo et al., 2018). Alternatively, such inequality is measured by top (1%, 5%, 10%) income shares. Our problem is that data on top income shares are either unavailable or incomplete in Asia, according to the World Inequality Database. For instance, the top 1% income share data are only available from Malaysia for 6 years in 2002–2014 (no data for the 1990s or earlier as we need), Thailand for 16 years in 2001–2016, Indonesia for 28 years in 1921–2004, and Korea for 42 years in 1933–2016. Such data are even not available at all in the Philippines. Thus, we have to use Gini data. As suggested by Leigh (2007), there is a strong and significant relationship between top shares and Gini coefficients in some economies, so that the two measures may be useful substitutes for each other. Even the Gini data themselves are not consistent between their old and updated versions supplied by the same database. It is therefore necessary to conduct certain statistical procedures such as interpolation, standardization, and consolidation to minimize structural distortions in data sampling.

Table 1 supplies the definition of all our variables and the source of their databases.

4.3. Estimation methodologies

The probit or logit estimator is not used in our regression since we do not attempt to identify a currency crisis but rather to find out key determinants of Asian financial (in)stability. Unlike other studies using massive bank-level data (actually, either unavailable or incomplete), this paper has to rely on low-frequency data because economic fundamentals only have small samples. We employ usual panel-data models as suitable methodologies for our purposes. The fixed-effects (FE), random-effects (RE), and the panel corrected standard error (PCSE) models are chosen to have the ERW index in Eq. (3) regressed on its potential determinants.

Various statistical tests are employed to ensure the precision and robustness of our estimation. The Wald test is used to assess the overall significance of our regression models. The Breusch-Pagan (B-P) and Pesaran tests are performed for the PCSE models under the null hypothesis of cross-sectional independence. The Hausman test is conducted for estimator selection between the FE and RE models under the null that both estimators are consistent against the alternative hypothesis that only the FE estimator is consistent. The Hausman test, if not rejecting the null, implies that the RE model should be chosen and that endogeneity is not an issue.³ Two arguments are provided for this assertion (Wooldridge, 2001; Greene, 2018). First, the individual effects are uncorrelated with the regressors in RE models. Second, the property of consistency stated in the null hypothesis of the Hausman test implies that the regressors are uncorrelated with the residuals. The two arguments suggest that regressors should be exogenous in the model selected. More than one estimator and more than one measure of a variable together with different model specifications are adopted to check for the robustness of estimation results.

² There are three types of income inequality: factor income inequality (between labor and capital), sectoral inequality (between households, firms, and governments), and interpersonal inequality (between different percentiles of the population). These three inequalities are not consistent with each other due to many interfering factors such as taxes, transfers, etc. For example, Germany maintained a stable level of interpersonal inequality but experienced a large drop in the labor income share in 1980–2000; by contrast, the U.K. recorded a stable labor share but witnessed a dramatic rise in interpersonal inequality (Giovannoni, 2010).

³ As a cautious check against endogeneity that might arise between financial instability and income inequality, we have used the lagged value of income inequality as an internal instrumental variable for estimation, finding that our results remain qualitatively unchanged with only small variations in the size of coefficient estimate for each regressor. The results are omitted here but will be available upon request.

Table 1

The definition of variables and the source of data.

Variable	Definition	Data source
ERW index	Defined by Eichengreen et al. (1996) on the basis of interest rates, exchange rates, and international reserves.	World Bank (WB): World Development Indicators (WDI, 2014)
Real credit growth; Credit/GDP	Growth of credit in constant 2010 prices; Domestic credit to private sector as % of GDP	WDI (2014)
Income inequality	The Gini index used in percentage points between 0 and 100, with a larger number implying higher inequality.	WDI (2014) and UNU-WIDER (2014): World Income Inequality Database (WIID3.0b)
Current account	Equal to the sum of net exports of goods and services, net primary income, and net secondary income.	WDI (2014)
Capital flow mix	The ratio of portfolio to direct investment or of portfolio to total investment, where "total" means "direct" plus "portfolio".	Asia Development Bank (ADB): Key Indicators for Asia and the Pacific (KIAP) and International Monetary Fund (IMF): International Financial Statistics
External vulnerability	The ratio of short-term external debt to total international reserves or of M2 to reserves.	KIAP and WDI
Capital account openness	The Chinn-Ito index; Capital inflows and outflows	Chinn and Ito (2006, online update); United Nations Conference on Trade and Development: World Investment Report
Stock market	The share price times the number of shares outstanding in the yearend, the stock price measured by its yearly average value, or growth in market capitalization.	WDI (2014) and CEIC
Macroeconomic variables	Gross fixed capital formation; Gross domestic savings; Gross domestic product (GDP)	WDI (2014)
China dummy	Equal to zero before 1994 and one in 1994 and after it.	
Global crisis dummy	Equal to one for 2007–09 and zero for the other years, or equal to one for 2008–09 and zero otherwise.	
Asian crisis dummy	Equal to one for 1997–99 and zero for the other years.	

Note: Three versions of the Gini index can be found from publicly accessible websites: The first one is related to pre-tax/transfer household *market* income, the second is based on post-tax/transfer household *disposable* income, and the third is a set of Gini data collected by the WB & WIID from various sources. Those versions are by no means identical for all time but can be quite different in some periods. Which version is used depends on whether it can produce statistically significant estimates, as done in previous studies. However, only the third version is used in our work since more information on inequality can be extracted from more than one source of data.

5. Estimation results

This section presents the estimated results of risk determinants from massive regressions for the five Asian economies over a special period of time, which saw major financial crises in both Asian and advanced countries. The type-1 regressions are based on the *ERW* index for two sub-periods (1985–98 and 1999–2011) to reflect structural shifts and also for the entire sample period (1985–2011) to look at estimates' stability. The type-2 regressions that are run only for the full sample (1985–2011) use credit cycles as an alternative proxy for crisis risk. The credit cycle is characterized by real GDP growth and the credit-to-GDP ratio. Such alternative regressions are performed to check for the statistical robustness of estimation results. Both types of regressions corroborate our earlier theoretical predictions with strong empirical evidence found from the five Asian economies.

5.1. Type-1 (one-stage) estimation results

Table 2 presents estimation results from different models for the first sub-period that saw the outbreak of the Asian financial crisis. Two estimators (RE and PCSE) are chosen in our regression for the *ERW* index of financial risk. Two versions of capital flow mix are utilized to check for estimation stability. The rate of change in *I/S* is included in regression either alone or interacting with inequality to estimate the financial effect of the growth pattern. The ratio of M2 to forex reserves popular in the crisis literature is used in our estimation as a proxy for external vulnerability to crisis risk.

The Table 2 results are summarized below. First, income inequality is found, as expected, to be a statistically significant determinant of the risk exposure of the Asian financial system in all models. High or rising inequality in Asia seems a strong driver for its 1990s crisis. Second, the coefficient estimate for the current account is significantly negative across all regressions. Its sign shows that a larger deficit (i.e., a negative balance) in 1985–97 exposed Asia to a greater risk of financial crisis. Third, the ratio of M2 to forex reserves is estimated to be a highly significant contributor to financial volatility in all models. This finding suggests that it is financially risky to adopt easy money policy with inadequate forex reserves. Fourth, the expansion of investment given the saving carries a significant and positive coefficient estimate by interacting with inequality. This result implies that the 1990s financial crisis in Asia was somewhat related to its typical pattern of growth resting on overinvestment. Fifth, a highly significant and robustly negative estimate is obtained for the coefficient on stock markets in all models. Such evidence is in line with the common wisdom that stock markets often send clear signals about economic conditions with risk implications. Sixth, the China dummy is associated with a positive estimate, which is significant in some

Table 2

Estimation results for the ERW in sub-period 1: 1985–1998.

Variable	RE model			PCSE model		
	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6
Income inequality	0.096** (2.02)	0.095** (2.48)	0.106*** (2.97)	0.113** (2.20)	0.115** (2.12)	0.120** (2.19)
External Imbalances	−0.119** (−2.45)	−0.080* (−1.93)	−0.072*** (−2.63)	−0.092** (−2.15)	−0.095** (−2.10)	−0.083* (−1.75)
External vulnerability	0.025*** (4.03)	0.022*** (4.26)	0.021*** (3.24)	0.014*** (3.87)	0.014*** (3.82)	0.022*** (3.41)
Growth pattern		0.001*** (2.65)	0.001** (2.15)			0.037 (1.16)
Capital flow mix	0.002** (2.00)	0.001** (2.27)	0.001 (1.33)	0.002 (0.96)	0.002 (1.01)	0.001 (1.14)
Stock markets	−0.037*** (−4.48)	−0.039*** (−7.27)	−0.040*** (−5.77)	−0.034*** (−3.02)	−0.034*** (−2.92)	−0.041*** (−4.08)
Financial openness	0.314 (1.54)	0.277 (1.22)	0.300 (1.40)	0.396* (1.65)	0.409 (1.61)	0.338 (1.38)
China dummy	1.133 (1.26)		1.193 (1.06)	1.644*** (3.43)	1.347 (1.64)	1.303** (2.48)
Time trend	0.051 (0.32)	0.264*** (2.94)	0.109 (0.58)		0.056 (0.40)	0.086 (0.88)
Constant	−4.139*** (−3.79)	−5.380*** (−4.20)	−4.853*** (−3.28)	−4.539** (−2.42)	−4.990* (−1.94)	−5.216** (−2.21)
R ²	0.291	0.301	0.305	0.265	0.266	0.318
Wald test	27.76 [0.000]	697.54 [0.000]	136.43 [0.000]	42.30 [0.000]	39.25 [0.000]	61.55 [0.000]
Hausman test in Reg's 1–3	6.99	7.17	6.58	2.385	2.692	2.517
Pesaran test in Reg's 4–6	[0.136]	[0.127]	[0.160]	[0.017]	[0.007]	[0.012]

Note: The sample size is below 70 observations due to missing data in some Asian countries for earlier years. The ERW index is calculated for sub-period 1. *Income inequality* is measured by the Gini index in all Reg's. *External imbalances* are the current account balance relative to GDP in all Reg's. *External vulnerability* is the ratio of M2 to forex reserves in all Reg's. *Growth pattern* is the rate of change in *I/S* in Reg6 and this rate times the Gini index in Reg's 2 and 3. *Capital flow mix* is the ratio of portfolio to direct investment in Reg's 1–3 and 6, and the ratio of portfolio to total investment in Reg's 4 and 5. *Stock markets* are market capitalization divided by GDP in all Reg's. *Financial openness* is the Chinn-Ito index in all Reg's. *China dummy* is set equal to zero before 1994 and one in and after 1994. The Hausman statistic is employed in Reg's 1–3 to test the null hypothesis that the RE estimator is consistent and efficient against the FE estimator. The Pesaran test is conducted in Reg's 4–6 under the null hypothesis of cross-sectional independence. *t*-statistics are in parentheses. *p*-values are in square brackets. ****p* < 0.01, ***p* < 0.05, and **p* < 0.10.

regressions but not in others. This result seems to confirm, albeit weakly, the speculation that China's forex policy reform in 1994 might have contributed to the Asian financial crisis to some extent. Finally, our estimation yields positive yet mostly insignificant coefficients for capital account openness. The estimate for the mix of capital inflows is positive in all models but significant only in some models. The two results indicate that capital flows contributed weakly to Asian financial risk in the 1990s.

Table 3 records estimation results from different model specifications for the second sub-period that witnessed the global financial crisis. The two estimators (RE and PCSE) are also used in regressions for the ERW risk index. Unlike Table 2, however, Table 3 adopts the ratio of short-term external debt to forex reserves as an indicator for external vulnerability. A new dummy variable with two versions is included in Table 3 to detect the potential effect of the global crisis on Asia finance. The deviation of *I/S* from its mean is made to interact with the current account in some regressions. The signs of all coefficient estimates in Table 3 are in line with those in Table 2 regardless of structural shifts between the two sub-periods. Yet those same signs in the two tables have different implications for financial risk exposure due to dramatic changes in the values and signs of associated regressors.

The Table 3 results are briefly interpreted below. First, declining inequality over the recent period in this part of Asia has contributed significantly to its lower exposure to financial risk, a result very robust in all models. Second, Asian current account surpluses since 1999 have significantly reduced financial instability, an observation established firmly from our estimation. Third, the current account has been improved significantly by financing investment with saving in Asia. Its structural shift to trade-led growth exerts a depressing impact on financial vulnerability, an effect implied by the reported regressions. Fourth, the recent fall in external vulnerability in Asia is made possible by its lower short-term foreign debt and its larger forex reserves. This change has significantly decreased its financial fragility, as confirmed strongly by all regressions. Fifth, the trend rise in stock prices of Asia (except for a short setback due to the global crisis) signals lower risk exposure of the Asian financial system, as significantly estimated in some, not all, models. Sixth, capital flows, especially their short-term portions, inherently have certain impacts on financial volatility, as also found in our regressions; but this problem is no longer serious recently in Asia, given both the small inflows it has received and the large reserves it has accumulated. Finally, the dummy for the global crisis is found to have a positive but insignificant effect on Asia finance, an expected result that reflects the reality. Recent trade-based growth in Asia, though financially less risky than other growth strategies, can only

Table 3Estimation results for the *ERW* in sub-period 2: 1999–2011.

Variable	RE model			PCSE model		
	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6
Income inequality	0.101*** (4.09)	0.104*** (5.52)	0.058*** (3.32)	0.104** (2.38)	0.116*** (2.64)	0.139*** (3.28)
External imbalances	−0.117*** (−3.00)	−0.384*** (−3.59)	−0.161* (−1.81)	−0.084** (−2.42)	−0.080*** (−2.89)	−0.134*** (−3.26)
External vulnerability	0.033*** (3.80)	0.043*** (5.39)	0.047*** (6.07)	0.041*** (2.29)	0.050*** (3.01)	0.043*** (2.43)
Growth variable 1		−1.276*** (−2.60)	−0.425 (−1.03)			
Growth variable 2				0.034* (1.70)	0.033* (1.66)	
Stock markets	−0.021 (−0.89)	−0.061** (−2.40)	−0.022*** (−8.86)	−0.011 (−0.38)		−0.059* (−1.95)
Capital flow mix	0.004 (1.53)	0.004* (1.93)	0.003* (1.73)	0.003** (2.06)	0.003** (2.10)	0.004** (2.24)
Financial openness	0.459 (1.43)	0.582** (2.30)	0.171 (1.20)	0.418 (1.54)	0.458* (1.67)	0.578* (1.91)
Global crisis dummy	0.123 (0.86)			0.085 (0.11)		0.105 (0.10)
Time trend		0.219*** (2.60)	0.083* (1.79)		0.064 (0.80)	0.158 (1.51)
Constant	−5.792*** (−4.42)	−10.11*** (−6.32)	−6.116*** (−4.88)	−6.424*** (−2.92)	−8.685*** (−2.84)	−10.36*** (−3.32)
R ²	0.182	0.317	0.559	0.274	0.275	0.277
Wald test	96.43 [0.000]	36.93 [0.000]	63.76 [0.000]	40.66 [0.000]	40.20 [0.000]	39.65 [0.000]
Hausman test in Reg's 1–3	5.64	4.18	1.50	25.736	25.523	28.752
B-P test in Reg's 4–6	[0.228]	[0.382]	[0.826]	[0.004]	[0.004]	[0.001]

Note: The *ERW* index is calculated for sub-period 2. *Income inequality* is the Gini index in all Reg's. *External imbalances* are the current account balance relative to GDP in all Reg's. *External vulnerability* is the ratio of short-term external debt to forex reserves in all Reg's. *Growth variable 1* is the deviation of *I/S* from its mean times *External imbalances* in Reg's 2 and 3. *Growth variable 2* is the rate of change in *I/S* in Reg's 4 and 5. *Stock markets* are the growth of market capitalization in Reg3 and the yearly average stock price in four other Reg's. *Capital flow mix* is the ratio of portfolio to total investment in all Reg's. *Financial openness* is the Chinn-Ito index in all Reg's. *Global crisis dummy* is set equal to one for 2007–09 and zero for the other years in Reg's 1 and 4, but to one for 2008–09 and zero otherwise in Reg6. The Hausman statistic is employed in Reg's 1–3 to test the null hypothesis that the RE estimator is consistent and efficient against the FE estimator. The Breusch-Pagan (B-P) test is performed in Reg's 4–6 under the null that residuals across panels are not correlated. *t*-statistics are in parentheses. *p*-values are in square brackets. ****p* < 0.01, ***p* < 0.05, and **p* < 0.10.

be sustained to the extent that foreign markets do not falter. In other words, such a strategy is still risky since it does not count on home markets to drive growth. An effective way out of this risk is to boost domestic demand by reducing income inequality further.

Table 4 provides a wide array of model specifications for the full sample period encompassing both the previous Asian crisis and the recent global crisis. Again, the two estimators (RE and PCSE) are used to yield comparable results. Another dummy variable is introduced to accommodate the impact of the Asian crisis on full-sample estimation. We keep combinations of regressors in Table 4 similar to those in Tables 2 and 3 to facilitate result comparison. The results in the present table actually serve as a robustness check for those in the preceding two tables. We find that all empirical results are consistent across different periods in the three tables. Also, note that estimation is supposed to fit the data better with greater precision in Table 4 than in Tables 2 and 3 since the sample size is now much larger with even more observations.

We do not directly explain estimation results of Table 4, but rather use them to derive the financial implications of economic imbalances in Asia. These results point to the indirect yet ultimate role of changes in income inequality in Asia for its financial vulnerability before 1997 and for its financial stability afterwards. It is interesting to iterate some key intermediate linkages between inceptive distributional imbalances and eventual financial imbalances. The 1990s Asian financial crisis appears to be associated with unfettered capital flows. A question going unanswered is why the Asian crisis countries with high saving rates relied so much on capital inflows, especially short-term debt, for economic growth. If such foreign debt was needed to finance their trade deficits, the next question that arises is why their external imbalances had increased by so much before 1997. Although the saving-investment framework was used by a few authors to address this issue (Guest and McDonald 1999), they did not unravel why those economies had to grow with overinvestment. Our results suggest that such inefficient growth was adopted as a passive response to shrinking consumption caused by rising inequality. Existing studies seem to have told part of the story, but our work presents a complete picture. One part of the picture is that: As an immediate or direct trigger for the Asian crisis, volatile capital flows hinged on underlying problems of trade deficits or overinvestment that in turn was deeply rooted in rising or high inequality. The other part of the picture is that: As an indirect yet fundamental factor, recent falling inequality made Asia less badly hit by the global crisis compared to the developed world. Such an outcome, manifesting in trade surpluses and mounting reserves, was attained through saving-financed

Table 4Estimation results for the *ERW* in the full sample period: 1985–2011.

Variable	RE model		PCSE model			
	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6
Income inequality	0.061* (1.76)	0.059* (1.80)	0.064*** (2.78)	0.056** (1.99)	0.062*** (2.85)	0.051** (2.25)
External imbalances	−0.102*** (−5.01)	−0.084*** (−4.67)	−0.108*** (−3.53)	−0.088** (−2.47)	−0.090*** (−3.09)	−0.105*** (−3.34)
Growth pattern		0.023* (1.83)			0.024* (1.88)	0.032** (2.30)
External vulnerability	0.019*** (3.58)	0.019*** (3.73)	0.019*** (5.51)	0.019*** (3.83)	0.019*** (5.68)	0.016*** (4.25)
Capital flow mix	0.003** (2.25)	0.003* (1.91)	0.003*** (2.82)	0.004*** (3.13)	0.003** (2.37)	0.003*** (2.80)
Financial openness	0.303 (1.35)	1.239 (1.29)	0.308** (2.36)	0.213 (1.28)	0.296** (2.42)	0.257** (2.06)
Stock markets	−0.043*** (−2.72)	−0.039** (−2.45)	−0.042* (−1.90)	−0.009 (−1.54)	−0.040* (−1.81)	−0.039* (−1.73)
Asian crisis dummy				1.300* (1.81)		1.680** (2.45)
Time trend	0.138*** (3.92)	0.132*** (3.85)	0.142*** (4.12)	0.121*** (2.78)	0.134*** (4.06)	0.124*** (3.39)
Constant	−5.968*** (−2.80)	−6.411*** (−2.67)	−6.095*** (−4.43)	−5.748*** (−3.22)	−5.948*** (−4.51)	−5.334*** (−3.73)
R ²	0.287	0.301	0.289	0.333	0.301	0.356
Wald test	67.90 [0.000]	48.47 [0.000]	55.72 [0.000]	47.88 [0.000]	63.08 [0.000]	59.88 [0.000]
Hausman test in Reg's 1 & 2; Pesaran test in Reg 4; B-P test in Reg's 3, 5 & 6	6.74 [0.150]	6.00 [0.200]	24.389 [0.007]	3.325 [0.001]	24.416 [0.007]	36.652 [0.000]

Note: The sample is slightly unbalanced with its size close to 135 observations. The *ERW* index is calculated for the full sample period. *Income inequality* is the Gini index in all Reg's. *External imbalances* are the current account balance relative to GDP in all Reg's. *Growth pattern* is the rate of change in I/S in Reg's 2, 5, and 6. *External vulnerability* is the ratio of short-term external debt to forex reserves in all Reg's. *Capital flow mix* is the ratio of portfolio to total investment in all Reg's. *Financial openness* is the sum of capital inflows and outflows divided by GDP in Reg2 and the Chinn-Ito index in all the other Reg's. *Stock markets* are the ratio of market capitalization to GDP in Reg4, and the yearly average stock price in all the other Reg's. *Asian crisis dummy* in Reg's 4 and 6 is set equal to one for 1997–99 and zero for all the other years. The Hausman statistic is used in Reg's 1 and 2 to test the null hypothesis that the RE estimator is consistent and efficient against the FE estimator. The Breusch-Pagan (B-P) and Pesaran statistics are used in Reg's 3–6 to test for cross-sectional dependence. *t*-statistics are in parentheses. *p*-values are in square brackets. ****p* < 0.01, ***p* < 0.05, and **p* < 0.10.

investment and export-led growth. While this outcome seems desirable, it is important not to take a wrong lesson or believe that export growth is always good for financial stability. Although export trade expansion can make up for low domestic demand given high income inequality, this effect may prove unsustainable as foreign markets are contracting and trade wars are spreading (Krugman, 2019). Striking a reasonable balance between promoting mass export and boosting domestic demand by lowering income inequality would be the best strategy to drive stable growth and minimize financial risk.

5.2. Type-2 (two-stage) estimation results

In the literature, the relationship between income inequality and financial crises is addressed through two-stage estimation involving credit booms. Regressions are specified for the possible link between crises and credit in stage 1 (Schularick and Taylor, 2012) and for a potential connection between credit and inequality in stage 2 (Bordo and Meissner, 2012). There seems no controversy in the literature over the positive association of crises with credit since this stage 1 result has been posited by theoretical modeling and confirmed by empirical studies. We are therefore concerned only with the stage 2 testing to see whether there is any effect of inequality on credit for Asia. Table 5 reports estimation results for real credit growth and the credit-to-GDP ratio as two new dependent variables. To facilitate result comparison, however, the explanatory variables included in Table-5 regressions are similar to those in the three preceding tables, with the sample period made identical to that for Table 4.

Estimation results in Table 5 (using credit cycles) are consistent with those in Table 4 (using the *ERW*). Four more points are worth making here. First, income inequality remains a significant factor for crisis risk through domestic credit, as implied by Table 5 and shown in Table 4. Rising inequality depressed aggregate demand, and the Asian economies reacted by resorting to over-investment to boost growth. Second, such investment went beyond national savings and much of it ended up producing non-tradables. These activities inevitably led to borrowing/lending frenzies and current-account deficits with consequential risk implications due to insufficient forex reserves and excessive domestic credit, as suggested by estimation results in Table 5 as well as in Table 4. Third, this credit boom was largely funded by volatile capital inflows, especially short-term external debt, thereby creating financial vulnerability and even sowing the seeds for crises. Such serious effect is found in our estimation for the five Asian economies, as shown in both Tables 4 and 5. This finding is consistent with

Table 5Estimation results for *credit cycles* in the full sample period: 1985–2011.

Variable	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6
Income inequality	0.725*** (5.45)	0.284*** (2.83)	0.759*** (5.18)	0.627*** (5.65)	0.789*** (8.42)	0.769*** (7.25)
External imbalances	−0.854** (−2.09)	−1.474*** (−3.71)	−1.176*** (−2.60)	−0.837* (−1.68)	−0.908* (−1.92)	−0.917* (−1.76)
External vulnerability				0.027*** (4.18)	0.025*** (3.80)	0.027*** (4.29)
Growth pattern	−5.954*** (−3.61)	−6.825*** (−4.29)	−7.485*** (−4.47)	−9.772*** (−2.73)	−11.049*** (−2.84)	−11.49*** (−2.87)
Capital flows & mix	0.666 (0.79)	0.001 (0.05)	0.000 (0.27)	1.250** (2.33)		
Stock markets	0.000 (−0.62)		0.000 (−0.72)			
Financial openness		0.286 (0.32)	0.036 (0.17)	0.201 (0.09)	0.516 (1.28)	0.478 (1.15)
Asian crisis dummy				13.08*** (2.95)	15.30*** (3.81)	
Time trend				1.592*** (8.49)	1.414*** (6.74)	1.494*** (6.57)
R ²	0.656	0.647	0.676	0.845	0.841	0.838
Wald test	207.3 [0.000]	15.546 [0.000]	234.9 [0.000]	5116 [0.000]	5989 [0.000]	3923 [0.000]
Breusch-Pagan test	20.37 [0.026]	22.88 [0.011]	19.43 [0.035]	31.36 [0.001]	29.70 [0.001]	69.43 [0.000]
Frees test	0.130 [< 0.1]	0.234 [< 0.05]	0.110 [> 0.1]	0.251 [< 0.01]	0.164 [< 0.05]	0.643 [< 0.01]
Hausman test (PCSE vs. FE)	0.00 [1.000]	1.77 [1.000]	0.03 [1.000]	−25.86 n.a.	−5.77 n.a.	−13.13 n.a.
Hausman test (PCSE vs. RE)	0.00 [1.000]	1.76 [1.000]	0.03 [1.000]	0.62 [0.999]	0.11 [1.000]	0.15 [1.000]

Note: The sample size for Asia is affected by its data availability in early years, getting close to 135 observations. *Credit cycles* are real credit growth in Reg's 1–3 and the credit-to-GDP ratio in Reg's 4–6. *Income inequality* is the Gini index. *External imbalances* are the current account balance divided by GDP. *External vulnerability* is M2 over forex reserves. *Growth pattern* is the deviation of I/S from its mean multiplied by external imbalances. *Capital flows & mix* are the ratio of total capital inflows to GDP in Reg1, the ratio of portfolio to total investments in Reg2, the ratio of portfolio to direct investment in Reg3, and the ratio of total capital inflows to gross fixed capital formation in Reg4. *Stock markets* are measured by market capitalization. *Financial openness* is the Chinn-Ito index in Reg4, the sum of inflows and outflows relative to GDP in Reg2, and this sum divided by gross fixed capital formation in Reg's 3, 5, and 6. *Asian crisis dummy* is equal to 1 in 1997–98 and 0 otherwise. All Reg's pass the two tests for cross-sectional dependence (except Reg3 for the Frees test). All Reg's pass the Hausman test for PCSE against both FE and RE estimators at high significance levels. *t*-statistics are in parentheses. *p*-values are in square brackets. ****p* < 0.01, ***p* < 0.05, and **p* < 0.10.

the widely held perception that financial risk is associated with capital flows, albeit at odds with what is claimed in Benmelech and Dvir (2013). Their work excludes the effect of short-term debt from regression, but concludes that such debt is unlikely to cause financial fragility. Our regression explicitly includes the impacts on credit boom and crisis risk of external vulnerability and capital flows along with their composition. Fourth, lessons learned from the 1997–78 crisis pushed the five Asian nations to lower distributional and external imbalances. Subsequently, these structural shifts made it possible for the five economies to isolate from the severe impacts of the 2008–09 global financial crisis even though they still kept merchandise trade with the West under no economic decoupling at all.

We are now in a position to clarify whether the link between income inequality and financial fragility is overblown in a study for Asia like ours. At least we can assert that inequality was a non-negligible factor behind the fragility in the 1990s in Asia, for this point has been proved in our theoretical model and also tested in our empirical estimation. The 1990s Asian crisis is similar to the 2008–09 global crisis in some aspects, albeit different in others. The similarity between them is the high inequality as one of their root causes. An economic slowdown under higher inequality was remedied by credit-based consumption in advanced nations but by credit-based investment in Asian economies. While Asian “investment” was just a “disguised” form of consumption (Corsetti et al., 1999), domestic credit for increased spending was financed by capital inflows in both Asia and the West. The only difference between the two regions is that credit-based consumption was designed for family business empires in Asia but for low- and middle-income households in the West, yet this makes no difference to the resultant risk of financial crises. Therefore, one may not feel that using inequality is a farfetched explanation for different experiences of the Asia financial system in the two major crises.

6. Conclusion

This paper tackles two controversial issues in the recent literature on financial crises. One issue is whether crisis risk bears any relation to income inequality. The other is why the Asian financial system was so vulnerable to the 1997–98 regio-

nal crisis but so resilient to the 2008–09 global crisis. Some authors claim that it is a mistake to draw a sharp distinction between the real and the monetary economy, because this dichotomy makes the analysis focus too often only on real variables and neglect the financial system that lubricates them (Cooper's comments included in Radelet and Sachs (1998b)). Yet other authors believe that a major crisis occurring in the financial sector may be deeply rooted in adverse changes in economic imbalances (Bernanke's remarks cited in Obstfeld and Rogoff (2009)). While financial crises have been attributed to external imbalances, the role of distributional imbalances in underlying crises is not seriously examined. Currently, some economists have started viewing the neglect of this role in the analysis as a serious problem that may give misleading results. We are concerned with whether sharply differing performances of the financial system in Asia across different periods (1997–98 versus 2008–09) have any bearing on changes in its income inequality. This seems to have become a fashionable issue, but we adopt a more balanced approach to crisis risk by simultaneously considering financial, external, and distributional imbalances. We also explore the potential role of interactions between rational self-fulfilling prophecies and underlying fundamental factors in affecting the Asian financial system.

This paper conducts the theoretical and the empirical analysis for Asian issues, producing consistent results. Our economic modeling along with data plots implies that rising inequality in Asia before 1997 caused economic growth to rely on over-investment, which was financed by capital inflows through high interest rates. This situation brought about a prolonged deterioration of the current account, an inevitable shrinking of forex reserves, and an increased use of short-term external debt. Such financial vulnerability triggering an undesirable self-fulfilling spiral led first to currency collapse as forex reserves dried up, and then to banking crisis as the liquidity and currency mismatches could not be sustained any longer. Fortunately, such bad outcome was reversed after 1999 in Asia due to its falling income inequality and its more balanced investment relative to savings. The resulting trade surplus and reserves accumulation greatly strengthened open positions of emerging Asia with lower external debts or even net capital outflows, thereby permitting its financial system to be shielded effectively from the worst impacts of the 2008–09 global crisis. The empirical part of this paper provides strong evidence for such theoretical assertion. Our econometric result clearly shows that crisis risk is still related significantly to financial factors such as short-term external debt relative to forex reserves, with this result being in line with the findings in most studies but at odds with the claim in Benmelech and Dvir (2013). Our estimation for Asia robustly finds that not only the current account but also income inequality can be responsible for the (in)stability of the banking sector; these two imbalances (external and distributional) are the most important economic factors relevant for the Asian financial system. Asia has altered its economic strategy from investment-led to export-led growth since 1999, and the resulting outcome seems to suggest that economic growth would be financially less risky by relying on trade expansion than on capital flows. However, the present growth pattern of Asia cannot be sustained forever, given the weakening foreign imports, resulting currency disputes, and spreading trade wars (Stiglitz, 2018). Income inequality still needs to be reduced further in order to grow with higher domestic demand, greater regional market (within Asia), and lower crisis risk (Kawai, 2009).

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