สัมมนาวิชาการประจำปี 2553

อนาคตนโยบายการเงินไทย: ความท้ายทายจากเสถียรภาพทางการเงินและอัตราแลกเปลี่ยน

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22 กันยายน 2553

บทคัดย่อ

พลวัตทางเศรษฐกิจและการเงินของโลกที่จะเกิดขึ้นในระยะต่อไปมีนัยสำคัญต่อการดำเนินนโยบายการเงินของประเทศไทย บทวิจัยนี้นำเสนอ 2 ความท้าทายหลัก และแนวทางในการปรับปรุงกรอบเป้าหมายเงินเฟ้อ (Inflation targeting framework) ที่ใช้อยู่ในปัจจุบันเพื่อรับมือกับความท้าทายดังกล่าว ประการแรก กลไกทวีความผันผวน (Pro-cyclicality) ของภาคการเงินที่มีความซับซ้อนและรุนแรงขึ้นจะนำมาซึ่งความเสี่ยงที่มากขึ้นต่อเสถียรภาพทางการเงิน แบบจำลองทางทฤษฎีในบทวิจัยนี้แสดงให้เห็นว่า กลไกดังกล่าวไม่เพียงแต่ขยายผลกระทบของ shock ให้รุนแรงขึ้น แต่ยังสามารถก่อให้เกิดการก่อตัวของฟองสบู่ที่ตามมาด้วยการปรับลดลงอย่างรุนแรงของราคาสินทรัพย์ ในบริบทนี้ ผู้วิจัยเสนอว่า ผู้ดำเนินนโยบายควรพิจารณาใช้มาตรการด้าน Macro-prudential ในลักษณะ Rule-based ซึ่งเป็นการลดปัญหา Pro-cyclicality ได้ที่ต้นเหตุ ประการที่สอง ผู้วิจัยศึกษาว่า ภายใต้กระแสโลกาภิวัตน์ที่มีความรุนแรงขึ้น การบริหารจัดการอัตราแลกเปลี่ยนควรเป็นอย่างไร ผลการศึกษาจากแบบจำลองทางเศรษฐมิติบ่งชี้ว่า ภายใต้โครงสร้างเศรษฐกิจและการเงินที่มีความแข็งแกร่ง ตลอดจนการใช้นโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อ อัตราแลกเปลี่ยนที่มีความยืดหยุ่นจะเป็นผลดีต่อการเจริญเติบโตทางเศรษฐกิจในระยะยาว ทั้งนี้ ประเทศไทยจัดว่ามีปัจจัยพื้นฐานทั้งด้านโครงสร้างและนโยบายที่เหมาะสมที่จะได้รับประโยชน์จากอัตราแลกเปลี่ยนที่ยืดหยุ่นมากขึ้น ซึ่งจะกระตุ้นให้เกิดการปรับตัวของภาคเอกชนและเสริมสร้างเศรษฐกิจไทยให้มีความแข็งแกร่งมากขึ้นในท้ายที่สุด

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The Future of Monetary Policy: Roles of Financial Stability and Exchange Rate

September 16, 2010

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Abstract

The impending change in the global economic and financial landscape will have important implications for the making of monetary policy in Thailand. This paper highlights two key challenges and proposes steps that can help strengthen the existing inflation targeting (IT) framework. First, we anticipate a more powerful procyclicality mechanism, which will pose greater risk to financial stability. A theoretical model is constructed to illustrate how such mechanism, in addition to propagating shocks, can generate bubble-and-crash phenomena. In this context, we argue that there are strong justifications for augmenting the IT framework by rule-based macroprudential policy. Secondly, we study the role of exchange rate flexibility in determining long-run sustainable growth. Through cross-country panel regressions, we find evidence that conditional on some criteria being met, greater exchange rate flexibility is conducive to higher economic growth. We argue that Thailand is well-positioned to benefit from more flexibility going forward, which in turn will help spur private sector's adjustments and ultimately ensure a more resilient Thailand.

Keywords: monetary policy, financial stability, macroprudential, exchange rate flexibility, exchange rate and growth

JEL Classification: E44, E50, F31

*We are grateful to Roong Malikamas, Titanun Malikamas, Don Nakornthab and discussants at the Bank of Thailand for their helpful comments. Any errors are our own. The views expressed in this article are not necessary those of the Bank of Thailand.

1 Introduction

The recent global economic crisis marks a crucial turning point in modern economic history. Legacies from the crisis together with the continuation of globalization process will significantly reshape the global and regional economic and financial landscape going forward. This new landscape, the so-called "new globalization", will likely be characterized by (1) larger, more persistent, and more volatile capital flows, prompted by cyclical shifts in flows of funds in response to new risks and opportunities, (2) greater interconnectedness, between financial institutions as well as between the real and financial sectors, and (3) lower global potential growth, with the centre of economic gravity shifting towards emerging markets especially in Asia.

These impending structural changes pose a number of challenges to emerging markets in the post-crisis era. There are two especially pressing policy issues from the viewpoint of monetary authorities. First, more volatile capital flows combined with greater financial interconnectedness will translate into a growing risk to financial stability. The adequacy of the existing monetary policy framework in dealing with this risk must then be reassessed, and questions must be asked about what can be done to further strengthen the framework to enable it to withstand new risks. Second, the lower global growth will put pressure on the sustainability of the export-led growth model, the hallmark of emerging market economies' success over the past decade. This pressure is moreover further intensified by more persistent capital flows. The policy issue is then to determine the appropriate role of exchange rate policy, with a view to facilitating economic adjustments that promote long-run sustainable growth.

In Thailand, the existing flexible inflation targeting framework has served its purposes well since its inception over a decade ago. Inflation has been low and growth relatively stable throughout the adoption of the policy regime. However, as the recent crisis evidently illustrated, a low inflation environment alone is not a sufficient condition for a stable economy. Undercurrent of risks and financial imbalances can certainly develop in spite of moderate economic conditions. To be sure, the flexible inflation targeting framework does acknowledge the importance of financial imbalances, and policy response

can certainly be justified within this framework to the extent that they pose threat to the overall economic outlook. Indeed the Bank of Thailand has continually been monitoring various measures of risks in the financial sector and incorporate the assessments into the making of monetary policy. The Federal Reserve itself was perfectly aware of the many indicators in the housing market throughout the build-up of the bubble, and took them into account as reported in their FOMC minutes. Therefore the issue was never a lack of attention, but rather a lack of clarity about the precise manner in which the risks should be addressed. Should interest rate be used to lean against financial excesses? Or should central banks supplement the existing policy toolbox with additional instruments, such as the regulatory policy? What purpose does this new instrument serve? The first part of this paper will be devoted to these issues.

Economic growth in Thailand over the past decade to a large degree has been driven by the export sector, partly owing to weak domestic demand. As a consequence, the policy makers have been giving significant consideration to keeping exchange rate volatility moderate through active exchange rate interventions, with an aim to allow the real sector to adjust to short-term changes in the exchange rate in an orderly fashion. Such policy, while somewhat justifiable from the short-run concerns, leads to a number of long-term costs that must eventually be settled: (1) the inconsistency with monetary policy independence and financial openness ("the policy trilemma"), implying increasing costs of reserve accumulation, (2) more distortions brought about by external shocks, as the exchange rate cannot play a stabilizing role by absorbing them, and (3) a delay in private sector's adjustments that otherwise would bring about greater efficiency improvement and more rapid financial development. Going forward, the exchange rate policy should aim to rebalance between these short- and long-term concerns. In addition, in order to maximize the economic gain from such transition, it will be important to identify the conditions under which greater exchange rate flexibility would bring greater benefit. These issues will be addressed in the second part of the paper.

Our research approach is as follows. In the first part which addresses the issue of financial stability and its implications for monetary policy, a theoretical model of a

banking sector will be constructed to help shed light on critical issues at the conceptual level. We will use this model to show how a "procyclicality" mechanism can generate cycles that resemble the build-up and crash of an asset price bubble. By doing so, we hope to highlight the precise nature of difficulties facing a central bank in using a counter-cyclical tool such as the policy interest rate. The model is then used to evaluate the merits of implementing a regulatory policy with an aim to foster financial stability. The second part of the paper will present a series of empirical evidence, through cross-country panel regressions, that attempt to measure the long-run impact of exchange rate volatility on economic growth. We condition for a variety of economic and financial fundamentals that may have bearing on the strength and direction of this linkage. We interpret our results and offer an exchange rate policy recommendation, in light of anecdotal and formal empirical evidence elsewhere.

2 Financial Stability and Monetary Policy

History shows time and again that a sound and stable financial system is an imperative pre-condition for economic stability. In the recent subprime crisis episode, those economies that were able to weather the crisis better and emerged relatively unscathed were precisely those with healthier financial sector. Ensuring a robust financial system will certainly continue to be among the top economic policy agenda. Unfortunately, the path ahead is likely to be increasingly hazardous for policy makers.

The ongoing trend of financial market development, especially in the emerging markets, most likely will continue. This will bring about deeper debt, capital and derivatives markets, greater financial access of households and corporations, and more access to foreign sources of funding. While continuation of this progress is vital for the long-run growth prospect, it also brings new risks. Closer and more intricate financial integration means shocks can be transmitted more quickly in a more pronounced and complex way. A small disruption can therefore have far-reaching implications for the stability of the entire financial system. Markets are not self-correcting, as risk management at individual institution level inherently falls short of dealing with risk of systemic nature. No matter how much the public has learned from the past crises, the threat to financial stability will continue to exist and will take an ever more complex form.

In a long-standing series of recommendations, the Bank for International Settlements (BIS) has proposed that the regulators of financial system should go beyond the "micro-prudential" approach to regulation and explicitly take into account the positive feedback between the financial sector and the real economy.[1] This feedback relationship is sometimes referred to as "procyclicality", a phenomenon whereby financial developments work to reinforce the economic cycles. In this riskier environment, the BIS proposes that regulatory policy should be designed with "macroprudential" goals in mind. This recommendation has been embraced by practitioners, imparting an influence on monetary policy making in many countries as well as influencing the new design of global financial

[1]See for example Borio and Shim (2007), Borio (2009), Borio (2010) and Bank for International Settlements (2010).

architecture culminating in the Basel III.

Meanwhile the academic progress on the rationales for macroprudential policy, albeit ongoing, is trailing behind. Formal works on macroprudential policy remain few, with the existing ones largely focusing on the transmission properties within some arbitrary macroeconomic model.[2] In this paper, we take a step back and ask more fundamental questions: Why is macroprudential policy needed in the first place? What can macroprudential policy do that the traditional policy interest rate (itself a countercyclical tool) cannot? Is the issue simply that the interest rate is too blunt to be used for counteracting financial shocks?

Answering these questions will require an articulation of how procyclicality mechanism emerges, and how it may lead to financial instability. Therefore, in what follows, our first task is to construct a model that is capable of explaining financial instability. We adopt the ideas of balance sheet mechanism discussed in Adrian and Shin (2010) and Shleifer and Vishny (2010) as our workhorse to explore the dynamic implications of procyclicality. The appropriate roles of monetary policy, via policy interest rate and regulatory requirements, can then be assessed within this stylized context. We distinguish between rule-based and discretionary policies, as well as between types of policy makers who can react to shocks with varying speed. In doing so, we hope to clarify more formally the central benefits of adopting macroprudential regulatory policy, and shed light on what form it should take to maximize its benefits.

2.1 The Model

There is a single asset in the economy, in fixed supply of size N. The asset is the securitized loans extended to the real sector, and the banks' loan supply is modeled as the demand for this asset[3]. Banks finance their asset holdings from either equity

[2]Angelini et al. (2010), Angeloni and Faia (2009) and N'Diaye (2009) study the interactions between regulatory policy and interest rate within a DSGE framework, while Cecchetti and Li (2005) uses a backward-looking small-scale model. Brunnermeier and Sannikov (2010) constructs a macro model with more realistic nonlinearity properties due to financial frictions, but does not pursue the role of prudential policy in details. Ashcraft et al. (2010) investigate roles of interest rate and haircut policies in the context of an OLG production economy.

[3]See Bernanke and Blinder (1988) for a similar approach. This assumption is made purely for convenience, to bypass explicit modeling of borrowers. For a predominantly non-securitized banking

or short-term debt. The asset can also be bought by *passive investors*, whose asset demand function slopes downward with asset price. Time is discrete and divided into three periods, $t \in \{1, 2, 3\}$. At time t, denote asset's price by p_t, banks' total holding of asset by n_t, banks' equity by e_t, and banks' liability by d_t. The asset market equilibrium condition requires that the sum of demand for assets from banks and passive investors equals the total supply N in each period. In period 1, the equilibrium asset price and banks' asset holdings are exogenously given (which is consistent with a steady state, to be defined later).

In the beginning of periods 2, the central bank designs policy configuration before observing shocks. The permissible class of policy instruments includes (1) the policy interest rate i_t and (2) regulatory requirements that set limits on banks' total asset or leverage. In period 2, the asset market is then subject to a temporary shock, modeled as a shift in passive demand, causing the asset market to re-equilibrate. In the final period, the passive demand returns to its original position, and the asset market is allowed to go through final adjustment. We will distinguish between a *nimble* policy maker who can reset its policy in period 3, and a *clumsy* who cannot do so as it is constrained by the long lag with which the policy instrument works.

At the end of the final period, the asset yields a return randomly drawn from a distribution with known expected value. Passive investors are risk-averse and therefore scale down their asset demand as price rises, in line with lower risk-adjusted expected return. A higher interest rate raises return on a competing risk-free asset, and lowers passive demand for assets. Passive demand, denoted by $t(i_t, p_t) \in [0, N]$, is therefore a decreasing function of both price and policy interest rate.

Banks only invest in one type of asset, therefore their asset demand is effectively their balance sheet size. Banks are risk-neutral and aim to maximize the net present value of investment. The asset's expected return is assumed to be sufficiently large such that the net present value is always positive, so that banks would always want to raise more debt to increase their asset holding. Their ability to issue debt is however constrained by their

system, such as Thailand, the assumption should be interpreted as saying banks have an exposure to the asset that their borrowers invest in for instance through the collateral value.

capital endowment. Specifically, in period t banks need to maintain a capital-to-asset ratio of $h_t(i_t)$, an increasing function of interest rate i_t, namely

$$\frac{e_t}{e_t + d_t} = h_t(i_t) \tag{2.1}$$

Clearly, the inverse $1/h_t(i_t)$ is simply *leverage* ratio.

The micro-foundation for $h_t(i_t)$ can be motivated in a number of ways. In the presence of asymmetric information and agency costs, $h_t(i_t)$ can be interpreted as the creditors' demand that banks hold a sufficient level of capital in order to retain enough 'skin in the game' for effort to be credible (in the spirit of Holmstrom and Tirole (1997)). Higher interest rate lowers returns to asset in present value terms, making agency cost more binding and hence forcing banks to hold more capital. In this sense, the ratio $h_t(i_t)$ is a *haircut* required by banks' creditors. Shleifer and Vishny (2010) adopt this interpretation and consider the special case of constant $h_t(i_t) = h$. An alternative interpretation is that $h_t(i_t)$ is chosen voluntarily by banks to meet some objective; for instance in Adrian and Shin (2010), banks aim to stay afloat in each period by holding enough capital to cushion against the worst-case loss. In their model, $h_t(i_t)$ is then derived from the value-at-risk constraint that banks strive to meet in each period. Higher interest rate lowers the present value of asset return, raising the worst case loss and making the value-at-risk constraint more binding. More generally, the dependence of $h_t(i_t)$ on i_t can also be interpreted as a representation of the 'risk-taking' channel of monetary policy transmission (Borio and Zhu (2008)). In any interpretation, $\partial h_t(i_t)/\partial i_t > 0$, for any t.

Because we remain agnostic about the exact source and functional form of $h_t(i_t)$, the terms *leverage* and *haircut* will be used interchangeably in what follows. Our attention is focussed on the role that leverage plays in transmitting the effect of monetary policy to asset market equilibrium. We let h_t depend on time t solely to allow for the possibility of discretionary regulatory policy effecting change on banks' leverage so that, for fixed $i_t = i$, $h_1(i) \neq h_2(i) \neq h_3(i)$. Absent this regulatory policy action, we assume that $h_1(i) = h_2(i) = h_3(i)$ for any given i so that there is no inherent 'leverage cycle' in our model (unlike the mechanism in Geanakoplos (2009), for example, where leverage is

time-varying indicating shifts in risk-taking behavior).

The asset price p_t and the amount of net asset buying/selling by banks are determined by the market equilibrium condition, which in turn defines the state variables' dynamics. The net asset buying in equilibrium, denoted by B_t, is financed by more borrowing, hence:

$$d_t = d_{t-1} + p_t B_t \tag{2.2}$$

At the beginning of each period, banks' assets are marked to market and any price appreciation increases the equity value of the banks:

$$e_t = n_{t-1} p_t - d_{t-1} \tag{2.3}$$

2.2 Genesis of Financial Instability

Let us begin by formulating the asset market equilibrium condition. Substituting equations 2.2 and 2.3 into 2.1, we get

$$h_t(i_t) = \frac{n_{t-1} p_t - d_{t-1}}{p_t \left(n_{t-1} + B_t\right)} \tag{2.4}$$

Invert this, using the balance sheet identity $d_{t-1} \equiv (1 - h_{t-1}(i_{t-1}))n_{t-1}p_{t-1}$ and the asset size identity $n_t \equiv n_{t-1} + B_t$, we obtain banks' asset demand function

$$n_t(i_t, p_t) = \frac{n_{t-1}}{h_t(i_t)} \left[1 - \frac{p_{t-1}}{p_t}(1 - h_{t-1}(i_{t-1}))\right] \tag{2.5}$$

for $0 \leq n_t \leq N$.

Banks' and passive investors' demand together make up the total asset demand. The asset market clears when the total asset demand equals asset supply, i.e.

$$N = t(i_t, p_t) + n_t(i_t, p_t) \tag{2.6}$$

We now consider the implications of the model within period (static) and across periods (dynamic), respectively. To focus attention on the inherent properties of the asset market

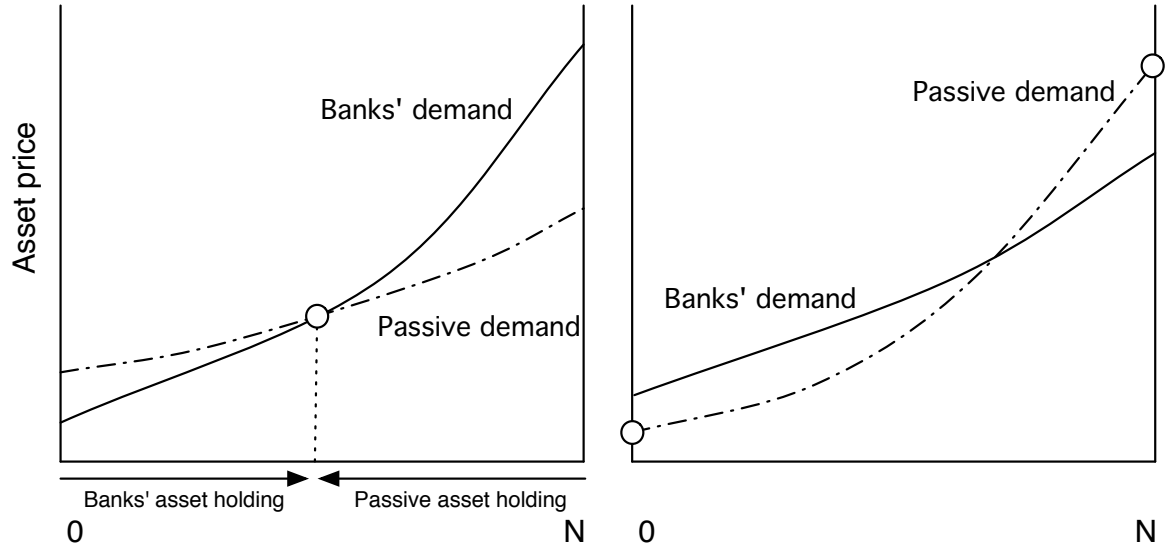

Figure 1: Procyclicality and Static Implications

equilibrium, we will assume fixed policy, i.e. $h_t(i_t) = h$ for all t, throughout the rest of this section before relaxing this assumption in section 2.3.

2.2.1 Propagation and indeterminacy

It is evident from equation 2.5 that banks' demand function is upward sloping in asset price. This unorthodox shape of the demand curve stems from the marking-to-market originating in equation 2.3, whereby a rise in asset price induces a capital gain accrued to banks, strengthening their balance sheets and allowing them to increase asset holdings while still respecting the haircut constraint. The upward-sloping demand is the procyclicality engine in our model. Any shock that induces price appreciation is amplified by the expansion of banks' balance sheets and debt accumulation. In this subsection, we show that when procyclicality is sufficiently strong, self-fulfilling expectations may take over fundamentals.

The determination of asset market equilibrium can be schematically illustrated in Figure 1. In both panels, the asset demand by banks should be read from left to right, while passive demand from right to left. The intersection point of the two demand curves defines the market equilibrium. Consider first the left panel, in which there is a unique interior stable equilibrium. Because of banks' upward-sloping demand function,

a shock that induces an upward shift in the passive demand curve, say by Δ, would lead to a larger-than-Δ increase in the equilibrium asset price. In contrast, if both demand functions were downward sloping, the increase in asset price would have been less than one-for-one. Moreover, the passive investors end up holding less assets in the new equilibrium despite the initial demand shift. This is because they are priced out of the market by banks, who, in response to the initial price rise, manage to raise asset demand via stronger balance sheets.

A unique stable equilibrium is not the only possibility. In the right panel of Figure 1, the interior equilibrium becomes unstable, and a small rise in price would lead to positive excess demand, putting further upward pressure on price. In this case, there are two stable equilibria, both of which are corner solutions where banks either price all passive investors out totally, or exit the market altogether. Which equilibrium will be borne out is indeterminate. The indeterminacy can be interpreted as an extreme form of uncertainty, as the procyclicality from marking-to-market becomes so strong that the asset price and banks' investment can swing from self-fulfilling expectations without any change in fundamentals.

The uniqueness of a stable equilibrium can be guaranteed provided this procyclicality is not too strong, i.e. if banks' asset demand does not rise too quickly with price. This in turn ensures that the excess demand function, $t(i, p_t) + n_t(i, p_t) - N$, is monotone decreasing in price and hence cuts zero from above at most once. A precise sufficient condition for a unique stable equilibrium is that banks' demand function be a "contraction" of passive demand. That is, there exists $k < 1$ such that, for any $p^1, p^0 \geq 0$,

$$\left|n_t(i, p^1) - n_t(i, p^0)\right| \leq k \left|t(i, p^1) - t(i, p^0)\right| \tag{2.7}$$

Under this condition, uniqueness of a stable equilibrium can be established using arguments akin to contraction mapping theorem (a proof is given in the appendix). Intuitively, this condition requires that, as asset price rises, banks' demand for asset climbs more slowly than passive demand falls. In other words, banks' demand function is flatter (and inverse demand function steeper) than that of passive investors, as depicted on the left

panel of Figure 1.

Leverage is an integral determinant of the strength of procyclicality, as the next result establishes.

Proposition 1. *The slope along any two points of banks' demand is decreasing in h.*

Proof. See the appendix. □

An immediate implication is that, the uniqueness condition 2.7 is more likely to fail with higher leverage. Intuitively, higher leverage (lower h) raises the strength of balance sheet valuation mechanism, enabling banks to expand debt-financed asset purchase following any price increase. Underlying this mechanism is a spillover effect, as one bank's increased asset demand pushes price up, which in turn allows other banks to purchase more asset and so on. This results in higher sensitivity of market equilibrium to fundamental shocks such as changes in passive demand. It is in this sense that higher leverage is associated with more procyclicality. As leverage grows sufficiently high, the spillover effect between banks becomes so strong that coordination problem emerges: each bank will purchase more asset if it believes other banks will also do so, but will sell otherwise. The association between strong *strategic complementarities* and multiple equilibria is well-documented in the literature, see for example Cooper and John (1988).

Procyclicality in this form presents a challenge to the policy maker. If adjustments in monetary policy, either via policy interest rate or through regulatory haircut requirement, are not large enough to raise h above the range that can support multiple equilibria, monetary policy can be completely ineffective. The market equilibrium in this case will solely be a function of self-fulfilling expectations rather than h that the policy maker is influencing to no avail.[4] For monetary policy to have an effect, the policy adjustment must be large enough to ensure that the contraction condition 2.7 holds. The upshot is, with procyclicality, the transmission of monetary policy can be highly nonlinear.

[4]In a more elaborate model, e.g. one equipped with an equilibrium selection mechanism, it may be argued that monetary policy works by changing the relative sizes of the basins of attractions, which makes one equilibrium more likely than the other. The market equilibrium in that model, while unique, will still be insensitive to monetary policy for small policy adjustments.

The potential ineffectiveness of policy interest rate in the presence of strong procyclicality provides a powerful rationale for adopting an alternative and more coercive measure such as regulatory policy. Indeed this is one of the oft-cited reasons when central banks decide to take steps beyond adjusting interest rate in order to control financial excesses. But, perhaps less obviously, even without equilibrium multiplicity, the balance sheet mechanism remains a potent source of complex procyclicality, posing threat to financial stability in a more complicated way than simply magnifying shocks. To pursue this issue at greater length, henceforth it will be assumed that the condition for equilibrium uniqueness is always satisfied throughout and multiplicity never arises.

2.2.2 Path dependence and dynamic implications

Equation 2.5 shows that banks' demand function exhibits *path dependence* property, since the current demand n_t depends on p_{t-1} and n_{t-1} in addition to the current price p_t. Past equilibrium therefore has bearing on the current demand. As an illustration, consider the following two limiting cases. As $p_t \to \infty$, the asset demand asymptotes to n_{t-1}/h, so a larger asset holding in the last period would boost the current demand. On the other hand, the intercept of the inverse demand function (the price p_t at which $n_t = 0$) is given by $p_{t-1}(1-h)$, so that a higher equilibrium price in the last period would raise inverse demand function (i.e. a drop in demand). These limiting cases suggest that the past equilibrium affects the current asset demand by 'rotating' the demand schedule and changing its slope. In the following, we will characterize these rotational adjustments in demand curve more precisely using the idea of contraction, and show how they give rise to non-trivial dynamic implications.

The key result of this section can be understood intuitively. Asset price and asset holding jointly determine banks' initial balance sheet size, which in turn dictates the strength of balance sheet mechanism and resulting degree of procyclicality. Stronger procyclicality is associated with a flatter of banks' demand schedule, indicating higher demand elasticity with banks increasing their demand by more in response to a price rise. While higher elasticity implies stronger propagation of any positive shock to asset price,

it also implies more vulnerability to any negative price shock. With this mechanism at work, financial instability can simply be induced by a positive transitory shock to price. A positive shock leads to the expansion of banks' balance sheet, which raises procyclicality and leaves the asset market highly vulnerable. A reversal in shock, due to its transitory nature, is therefore sufficient to result in an outsized downward adjustment in asset price as banks scramble to sell asset in a falling market. The evolution of asset market adjustments therefore closely mimics the build-up of bubbles and the subsequent crash. This is our basic story of how financial instability emerges.

We begin our formal discussion of the model's dynamics and implications by first establishing the existence of steady states and characterize their properties.

Steady states

A steady state is defined as a sequence of equilibrium outcomes in which the pair $\{n_t, p_t\}$ is fixed over time, and equal to some constant $\{n^*, p^*\}$. In other words, in a steady state equilibrium, both passive and banks' demand schedules must be time invariant. But it is evident from equation 2.5 that, for a given history of past equilibrium $\{n_{t-1}, p_{t-1}\}$, there is a unique pair on the banks' demand schedule that can be upheld as a steady state equilibrium, namely $\{n_t, p_t\} = \{n_{t-1}, p_{t-1}\} = \{n^*, p^*\}$. This steady state can then be attained under some passive demand schedule $t(i, p)$ that leads to the equilibrium pair $\{n^*, p^*\}$. This establishes the existence of a steady state. An alternative way to characterize a steady state equilibrium, is to take passive demand function as given. Any pair $\{n_t, p_t\}$ on the passive demand schedule is consistent with a steady state corresponding to the history $\{n_{t-1}, p_{t-1}\} = \{n_t, p_t\} = \{n^*, p^*\}$.

There are clearly an infinite number of possible steady states. A formal welfare evaluation between different steady states is beyond our scope, and instead focus will be on short-run equilibrium dynamics after a steady state is perturbed by shocks. We assume that the initial steady state is already welfare-maximizing, and that the policy maker's problem is to stabilize the economy around this initial steady state.[5]

[5]In a fuller model, the welfare-maximizing steady state may be one in which the market correctly prices risks associated with the asset's return. In this case, the risk-return profile of the asset as well as the social welfare function must be spelled out. Alternatively, the society may wish to maximize the asset price in equilibrium (thereby minimizing the real sector's borrowing cost) while maintaining the

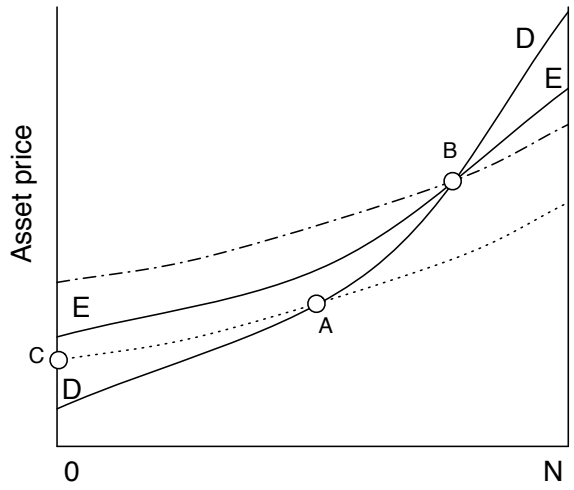

Figure 2: The lasting impact of temporary shock

Shocks and instability

Figure 2 depicts the asset market equilibrium. All variables are predetermined in period 1, and we are interested in the evolution of asset market equilibrium in periods 2 and 3. The initial equilibrium at point A, $\{n_1^*, p_1^*\}$, coincides with a steady state which, in the absence of any further shock, would imply $n_1^* = n_2 = n_3$ and $p_1^* = p_2 = p_3$. The corresponding banks' demand schedule is represented by the curve D-D. Assume that in period 2 the passive demand schedule is subject to a positive temporary shock that causes it to shift upwards, before falling back to its original position in period 3. That is

$$\text{Passive demand in period } t = t(i, p_t) + c_t \tag{2.8}$$

where $c_1 = c_3 = 0$ and $c_2 > 0$. How would this period-2 temporary shock affect the dynamics of asset market equilibrium?

Given that the initial equilibrium at point A is a steady state, banks' demand function remains unchanged in periods 1 and 2, before endogenously adjusting in period 3. In period 2, the upward shift in passive demand bids up the asset price, which in turn leads to banks' capital gain and higher demand for asset that pushes asset price up further. The equilibrium in period 2 is at point B, in which both asset price p_2^* and banks' asset holding n_2^* are now higher than at the initial steady state A.

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banks' zero profit condition.

In period 3, banks' demand adjusts and takes the form:

$$n_3 = \frac{n_2^*}{h(i)} - \left(\frac{1-h(i)}{h(i)}\right)\left(\frac{n_2^* p_2^*}{p_3}\right) \tag{2.9}$$

The first observation is that $\{n_3, p_3\} = \{n_2^*, p_2^*\}$ is a solution to equation 2.9, hence the period-3 demand schedule goes through period-2 equilibrium $\{n_2^*, p_2^*\}$ at point B. Secondly, we can establish the following:

Proposition 2. *If $n_2^* p_2^* > n_1^* p_1^*$, then n_2 is a contraction mapping of n_3, namely there exists $k < 0$ such that for any p^1 and p^0*

$$\left|n_2(i, p^1) - n_2(i, p^0)\right| \leq k \left|n_3(i, p^1) - n_3(i, p^0)\right| \tag{2.10}$$

Proof. See the appendix. □

By the same arguments used in the proof of proposition 1, proposition 2 implies that the inverse demand function in period 3, depicted by E-E curve in Figure 2, cuts the D-D curve from the left and only once at point B. Banks are now responding more aggressively to asset price movements, raising demand more rapidly if price rises and selling more heavily should price fall.

If the upward shift in passive demand was permanent, point B would have been a new steady state. But as passive demand schedule shifts back to its original position in period 3, there will be an excess supply of asset at the old equilibrium price p_2^*. The initial downward pressure on price is then amplified by the balance sheet adjustment mechanism, as banks sell assets in a falling market in an attempt to retain the old leverage ratio. Since the selling is now more pronounced given a new demand function that is more sensitive to price, the new equilibrium price will undershoot p_1^*. In Figure 2, the equilibrium is restored only at point C, which illustrates an extreme case where banks exit the market altogether.

The transition from point B to point C is the "Wiley Coyote" moment, as the expansion of banks' balance sheet leaves the asset market highly vulnerable to any price

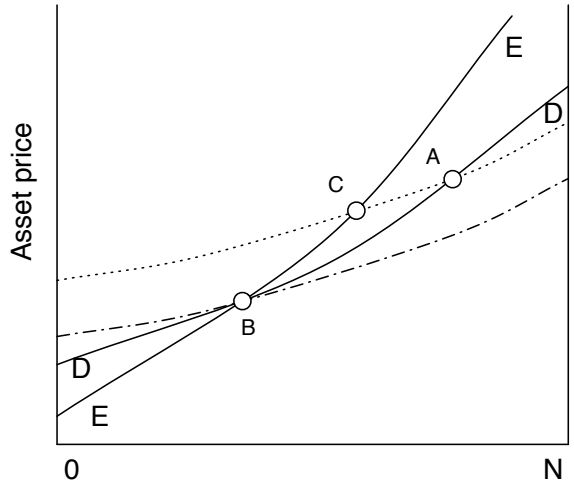


Figure 3: Effect of a temporary fall in passive demand

fall. Thus, a temporary positive shock will only induce a short-term price appreciation, but will lead to an undershooting of asset price following the initial boom. As apparent from Figure 2 this undershooting is a generic property.

On the other hand, the impact of a negative shock to passive demand, i.e. when $c_2 < 0$ is qualitatively different. This case is illustrated in Figure 3, where we make the converse assumption that the passive demand shifts down temporarily in period 2. The asset market equilibria in periods 1, 2 and 3 are represented by points A, B and C respectively. There is still a net decrease in the asset price, so the temporary shock does have a permanent effect, however there will be no overshooting. This property, too, is generic.

Short-term aberrations in passive demand, albeit temporary, can therefore have a permanent effect on the asset market equilibrium. The response of equilibrium asset price and banks' demand to shocks is asymmetric: an upward shock will result in an amplified upward movement, followed by a large crash that undershoots the initial steady state. In the case of a negative temporary shock, there will be an amplified effect on price initially, which is then attenuated in the subsequent period. Thus, in our model, the absence of large and persistent shocks does not preclude asset prices from being volatile and susceptible to periods of booms followed by busts.

Financial instability in our model emerges through a procyclicality mechanism that

simply relies on marking-to-market and balance sheet adjustment. The instability does not stem from "irrational exuberance" or endogenous "leverage cycle" that have often been cited as key features of financial crises. Our analysis suggests that one needs not see a pick-up in leverage in the run-up to a crisis, as instability can emerge even if banks never change their targeted leverage throughout the adjustments. To be sure, the level of leverage does indicate the financial system's vulnerability to shock at any given point in time, but in terms of monitoring the development of financial instability over time, the more appropriate indicators may simply be changes in the asset price and banks' balance sheet size themselves.

Our analysis also has broader methodological implications. It proposes a new way in which crises and financial instability can be theoretically modeled. Our approach distinguishes between the basic procyclicality mechanism, which propagates shocks in the standard way, versus the second mechanism that makes the strength of procyclicality itself procyclical. In the present model, the positive response to a price increase is the basic procyclicality mechanism. The feedback effect of banks' balance sheet expansion on asset demand makes the basic mechanism itself procyclical. The two mechanisms combined ensure that a boom automatically sows its own seed of destruction, so that unless it is supported by persistent shock, an eventual outsized crash is inevitable.[6]

2.3 Scope of Stabilization Policy

Uncertainty is a key constraint facing the policy maker in our model, as policy choices must be committed before shocks are observed. If shocks occur very rapidly, the policy makers may not be able to retract the policy they prescribe before they can observe whether the shock has already receded or not. A clumsy policy maker is therefore not necessarily inept in terms of skills, but simply operates under extreme uncertainty. Generally the interpretation is that policy works with a long lag, so that it cannot be re-calibrated to respond to shocks in real time. The policy maker faces the same scenario considered in the previous section, where passive demand curve is subject to a random

[6]Theories of endogenous business cycles are relatively scarce, and there is still a lack of workhorse model. For a recent much-needed contribution, see Suarez and Sussman (1999).

temporary shock in period 2 potentially posing threat to financial stability. The policy objective is to safeguard financial stability by *ex ante* minimizing the variances of asset price as well as banks' lending around the initial steady state over these last two periods. Conditional on a random period-2 shock c_2 to passive demand, the loss function is given by

$$L(c_2) = \sum_{j=2}^{3} \left[(n_j(c_2) - n_1^*)^2 + (p_j(c_2) - p_1^*)^2 \right] \tag{2.11}$$

where $n_j(c_2)$ and $p_j(c_2)$ are market equilibrium values corresponding to shock c_2. For simplicity, we assume

$$c_2 = \begin{cases} c & \text{with probability 0.5} \\ -c & \text{with probability 0.5} \end{cases} \tag{2.12}$$

where $c > 0$. Given this symmetric and discrete shock distribution, the policy objective for a risk-neutral policy maker is to minimize the expected loss

$$Min \frac{1}{2} \left[L(c) + L(-c) \right] \tag{2.13}$$

Two broad classes of policy instruments are examined, namely the conventional policy interest rate and regulatory policy that limits the extent to which banks can expand/contract their asset investment. Policy interest rate affects the asset market equilibrium via both passive and banks' demand functions. Two different variants of regulatory policy are considered: (1) a haircut requirement h^* that banks must meet, and (2) a cap and a floor on the number of assets held, $\bar{n}$ and $\underline{n}$, that n_t must obey.

It is important to distinguish between two distinct policy dimensions. The first pertains the adequacy of using the policy interest rate as the sole instrument for counter-cyclical *discretionary* monetary policy, and whether there are grounds for expanding the standard counter-cyclical toolbox to include regulatory policy. The second issue concerns the design of monetary policy *framework* that will enable the economy to better withstand shocks, and how deployment of *rule-based* prudential regulatory measures may constitute an important ingredient for achieving such desirable outcome. The objective of this section is to elucidate the role of regulatory policy in each of these two contexts and shed

light on what a coherent implementation of prudential measures should entail.

2.3.1 Optimal discretionary policy

The use of interest rate tool is always discretionary in our analysis. The nimble policy maker is free to choose any i_2 and i_3, while the clumsy policy maker can pick any $i_2 = i_3$. On the other hand, by retaining discretionary power, the policy maker can also impose a binding haircut requirement onto banks by setting $h_2(i)$ and $h_3(i)$ or impose requirement on n_2 and n_3. The policy is first prescribed at the beginning of period 2 after the first-period equilibrium is determined but before the period-2 shock is drawn. The nimble policy maker gets another chance to adjust the policy just before the final period commences.

Let us briefly foreshadow the main results of this section. In solving the policy optimization problem 2.13, the clumsy policy maker must anticipate and take into account the direct impact of its policy not only on period-2 but also on period-3 equilibrium. The policy is therefore optimized only once. Given the temporary nature of the period-2 shock, the inability to retract policy will dissuade the clumsy policy maker from over-stabilizing period-2 equilibrium, as a big adjustment will itself introduce shock to the market in the final period.

The nimble policy maker, on the other hand, can readjust the policy in the final period, and hence has no reason to hold back in the second period. Results from section 2.2 show that smaller balance sheet adjustment in period 2 implies a milder impact on the final-period equilibrium. Solving backwards, this implies that the nimble policy will simply aim to stabilize the period-2 equilibrium, provided it knows the direction of the shock. Under uncertainty, it will react relatively more aggressively to a positive shock in period 2 than it would if the shock was negative, as the impact from shock on period 3 is asymmetric.

Transmission mechanism of interest rate

An interest rate change affects the market equilibrium through both passive and banks' demand. Suppose that the period-1 steady state is underpinned by an initial

interest rate of i_1, and the interest rate is lifted by $\Delta > 0$ to $i_1 + \Delta$, with no binding regulatory policy in place. The first impact is to lower passive demand since $\partial t(i,p)/\partial i < 0$. Secondly, banks' demand is also decreased, represented by a leftward shift of demand schedule in the diagram, since:

$$\begin{aligned} n_2(i_1, p) &= \frac{n_1}{h_1(i_1)}\left[1 - \frac{p_1}{p}(1 - h_1(i_1))\right] \\ &> \frac{n_1}{h_1(i_1 + \Delta)}\left[1 - \frac{p_1}{p}(1 - h_1(i_1))\right] \\ &= \frac{n_1}{h_2(i_1 + \Delta)}\left[1 - \frac{p_1}{p}(1 - h_1(i_1))\right] \\ &\equiv n_2(i_1 + \Delta, p) \end{aligned}$$

A policy rate tightening therefore reduces the asset demand from both passive investors and banks. In the absence of any shock in period 2, the effect of such policy change on market equilibrium will be to unambiguously lower asset price. Moreover, given the upward-sloping shape of banks' demand, there will be an unambiguous decrease in banks' asset holding in the new period-2 equilibrium. The reason is that the interest rate rise has both a direct and indirect impact on banks' demand. Apart from affecting period-2 haircut directly, the negative shock to asset price also triggers the balance sheet mechanism that induces banks to scale down asset holding further. The net impact of policy tightening is therefore to lower asset price and curb banks' lending in the second period.

Faced with the prospect of temporary shock in period 2, what is the optimal interest rate policy? It is instructive to first consider the perfect information case, in which the policy maker knows in advance the realization of c_2. Suppose it is foreseen that $c_2 = c$. When choosing interest rate i, the policy maker knows that the market clearing condition in period 2 is given by

$$N = t(i, p_2) + c + \frac{n_1^*}{h_1(i)}\left[1 - \frac{p_1^*}{p_2}(1 - h_1(i_1))\right] \tag{2.14}$$

If the policy maker wishes to stabilize the period-2 equilibrium, it can set $i > i_1$ in order

to absorb the observed positive shock $c_2 = c > 0$. The policy maker can choose to stabilize the asset price completely by setting i such that $p_2 = p_1^*$, which requires the interest rate to be the solution to

$$N = t(i, p_1^*) + c + n_1^* \frac{h_1(i_1)}{h_1(i)}$$

Under this interest rate, banks' asset holding is $n_1^* h_1(i_1)/h_1(i) < n_1^*$, since $i > i_1$ and $h_1' > 0$. Therefore to totally stabilize the asset price, the policy maker will need to raise the policy rate by so much that it causes a contraction in banks' asset holding. The policy maker may instead seek to stabilize banks' asset holding and choose i such that

$$\frac{n_1^*}{h_1(i)} \left[1 - \frac{p_1^*}{p_2}(1 - h_1(i_1)) \right] = n_1^*$$

which implies

$$1 - h_1(i) = \frac{p_1^*}{p_2}(1 - h_1(i_1))$$

Since $i > i_1$, it follows that $p_2 > p_1^*$. The policy adjustment that exactly stabilizes banks' asset holding is not sufficient to stabilize the asset price. There is in fact a locus tracing all combinations between banks' asset holding and asset price attainable by adjusting policy interest rate, lying strictly above and to the left of $\{n_1^*, p_1^*\}$. Given the quadratic loss function, the policy maker would likely trade off some contraction in banks' asset holding for bringing the asset price closer to target. The key point here is that it is not possible to completely stabilize both asset price and banks' asset holding, since the interest rate tool is too blunt to fully absorb a passive demand (i.e. sector-specific) shock.

Claim 1. *Policy interest rate cannot simultaneously stabilize both the asset price and banks' asset holding in period 2, even with perfect information about shock. The interest rate as a tool is too blunt, and control is necessarily imperfect.*

This 'imperfect control' problem is faced by the nimble policy maker, but becomes even more severe for the clumsy policy maker. Given that policy cannot be removed in period 3 and that the period-2 shock is only temporary, an all-out attempt to absorb the

period-2 shock is likely to be suboptimal since it will result in passive and banks' demand over/undershoot in period 3. The optimal interest rate for the clumsy policy maker will therefore have to negotiate a trade-off between (1) responding more to stabilize period-2 market equilibrium and lessen the impact of procyclicality on period-3 outcome, versus (2) responding less to avoid disrupting period-3 equilibrium from policy over-adjustment. In other words, the interest rate is also too blunt along the time dimension, and cannot fully absorb short-term temporary shocks, so that only partial stabilization can be carried out. The fully optimal policy response for a clumsy policy maker, under certainty about period-2 shock, will therefore be characterized by partial absorption of the initial shock and partial stabilization of period-2 equilibrium.

Let us now describe the optimal policy under uncertainty. We rewrite the loss function as $L(c_2, i_2)$, allowing the loss function to depend explicitly on the policy choice variable. The dependence on period-3 interest rate is suppressed, as in the case of the nimble policy maker we take the optimal period-3 interest rate as given and interpret $-L(c_2, i_2)$ as the value function which is parameterized by i_2. For the clumsy policy maker, the omission is not an issue since $i_3 = i_2$. The first-order condition from 2.13 is then given by

$$-L_2(c, i_2^*) = L_2(-c, i_2^*) \tag{2.15}$$

In other words, the optimal policy under uncertainty should equalize the marginal loss under the two shock realizations.

Suppose that the policy maker keeps interest rate constant at i_1. It follows from the optimal policy under certainty that, irrespective of the policy maker's type, $L_2(c, i_1) < 0$ since raising rate in the event of positive shock is counter-cyclical, whereas $L_2(-c, i_1) > 0$ for opposite reasons. Meanwhile, results from Section 2.2.2 suggest that the effect of shocks on market equilibrium in period 3 is asymmetric, with a positive shock having a larger impact as it is propagated rather than absorbed by balance sheet mechanism. This implies that, for the nimble policy maker, a small upward adjustment of interest rate in period 2 increases the value function when there is a positive shock, by more than the

deduction in value when the shock is negative, namely

$$-L_2(c, i_1) > L_2(-c, i_1)$$

To satisfy the first-order condition 2.15, interest rate needs to be raise since $L_2(c, i_1) < 0$ and $L_{22}(c, i_1) > 0$ due to convexity. Thus it follows that $i^* > i_1$ for the nimble policy maker.

The clumsy policy maker faces a more binding constraint, since the policy choice cannot be withdrawn in the final period. In this case, any policy tightening is tantamount to a negative shock to the asset market in period 3. The clumsy policy maker will therefore be more averse to policy tightening under uncertainty relative to the nimble policy maker. Simulation shows that under symmetric shocks as assumed in 2.12, the optimal policy choice is to always lower interest rate.

Claim 2. *Despite the shock symmetry, the optimal discretionary policy prescribes preemptive interest rate adjustments. The nimble policy maker should raise interest rate, while the clumsy type should lower it.*

Our result offers one perspective on the 'lean versus clean' debate. On the one hand, the 'leaning against the wind' strategy, forwarded by the BIS amongst other proponents, suggests that an interest rate can and should be raised to preemptively rein in financial excesses (see White (2009) for example). Our model provides the conditions under which the 'leaning' strategy may be optimal: (1) the policy maker must be confident that there will be a positive shock, or (2) in the presence of a large degree of uncertainty, then the policy maker must be able to retract its policy sufficiently quickly. On the other hand, the 'clean' strategy, favoured by many practitioners especially before the subprime crisis, can be rationalized in our model if a large degree of uncertainty is coupled with more volatile shocks that work their way through more quickly than monetary policy can hope to offset in real time.

Transmission of regulatory policy

The discretionary use of regulatory tool is qualitatively very similar to the use of

interest rate. To see this, consider the case of perfect information about shock ($c_2 = c > 0$), and suppose that haircut policy is the sole instrument. To absorb the positive shock, haircut requirement can be raised so that $h_2(i_1) > h_1(i_1)$. This policy will produce the same directional effect on banks' demand schedule as an increase in interest rate, but will not affect passive demand. Therefore, the passive demand function is effectively the constraint that the policy maker must take as given in both periods 2 and 3 when choosing haircut requirement. It follows then that the use of discretionary haircut policy also suffers from the imperfect control problem. The extent of this problem relative to the use of interest rate policy is ambiguous for the clumsy policy maker, since the loss of control in period 2 due to inability to affect passive demand is compensated by the period-3 gain since haircut policy is not blunt along the time dimension.

Policy implications under uncertainty remain very much in the same spirit as in the case of interest rate. The optimal discretionary haircut policy h_2^* should satisfy the first-order condition given by (after rewriting the loss function in terms of haircut policy choice)

$$-L_2(c, h_2^*) = L_2(-c, h_2^*)$$

The merits of leaning against the wind versus cleaning are qualitatively identical to the line of arguments given above. Claims 1 and 2 therefore generalize to the use of discretionary regulatory policy.

It is clear that an optimal *combination* of interest rate and haircut requirement will raise welfare, since the policy maker can always mimic the one-instrument outcomes by choosing not to employ one of the tools. The exact optimal combination is likely to be complex however. For example, equipped with both policy instruments, the imperfect control problem disappears in period 2. Following a positive shock $c_2 = c$, the policy maker can implement the initial equilibrium $\{n_1^*, p_1^*\}$ exactly by (1) raising interest rate to completely neutralize the effect of shock, i.e. set i_2 such that $t(i_1, p_1^*) = t(i_2, p_1^*) + c$, and (2) lowering haircut to neutralize the effect of interest rate increase on haircut, i.e. set $h_2 = h_1(i_1) < h_1(i_2)$. In other words, haircut policy helps cushion the impact of higher rate on banks' demand, allowing the policy interest rate to directly absorb passive

shock more than otherwise.

Claim 3. *In the optimal combination of policy, the two instruments may need to work in opposite direction in order to fine-tune both banks' asset holding and the asset price.*

The stringent context in which perfect control can be achieved should be highlighted. The basic requirement is that the policy maker must be able to foresee shock with sufficiently high accuracy that it is willing to prescribe two policies that work by canceling each other out. Moreover, this complex policy mix is most likely suboptimal for the clumsy policy maker, whose tools remain too blunt along the time dimension.

2.3.2 Framework design and rule-based prudential policy

The preceding discussion illustrates that the discretionary use of regulatory policy in addition to interest rate, while welfare-enhancing for trivial reasons, is subject to a number of limitations. In addition to the problem of imperfect control if the policy tools remain blunt, the optimal combination of multiple instruments is likely to be complex and therefore highly susceptible to errors or inaccuracies on the part of policy maker. The idealized optimal monetary policy is in other words unlikely to be robust. In addition, there are other important considerations that have not been incorporated into the model, e.g. policy makers must ultimately aim to stabilize inflation and growth, or that the policy maker will find communicating conflicting policy moves very problematic. Taking these factors into account, the constraints facing the policy maker will become much more binding. Even if the policy maker eventually deems it worthwhile to pursue discretionary policy, the complexity of actions can compromise policy transparency, one of the key benefits of inflation targeting framework.

Perhaps most importantly, treating regulatory policy as an additional instrument for discretionary policy purposes may not give full justice to its potential role as a 'prudential measure'. Indeed, the underlying source of instability in our model is structural, as it lies in the procyclicality within the banking sector originating from balance sheet mechanism. Discretionary counter-cyclical policy only attempts to absorb shocks and smooth out their impact, but cannot fix the problem at its root. This section considers the problem of

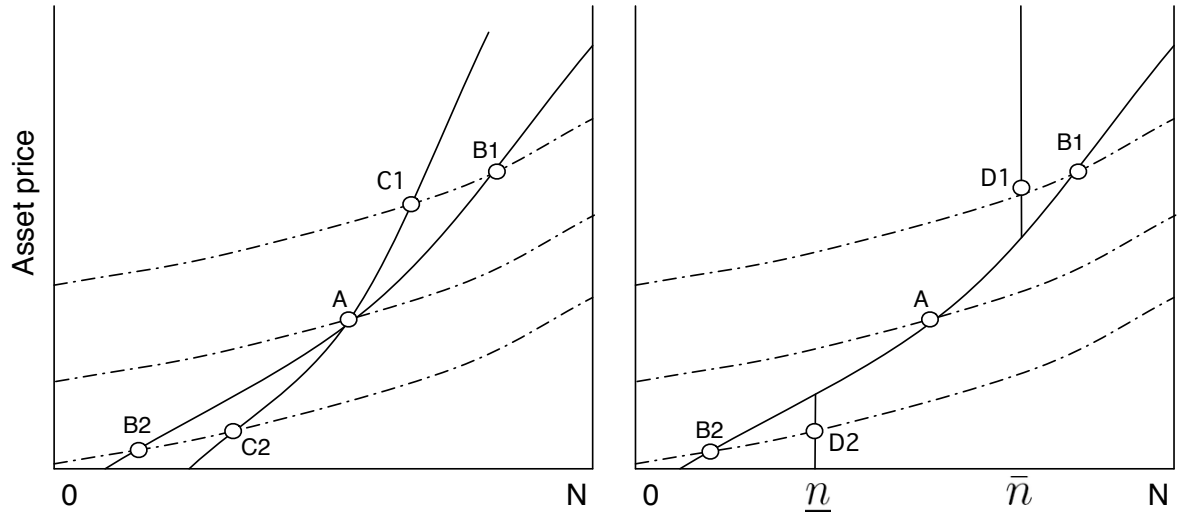


Figure 4: Rule-based regulatory policy as prudential measures

designing a 'framework' that helps alleviate procyclicality at the source, using rule-based regulatory policy.

A rule-based regulatory policy is defined to be a regulatory policy that is fixed permanently and structurally integrated *a priori* into the policy framework, and is not subject to change in response to shock assessment. We consider two related types of such rule-based policy: (1) a haircut requirement that the policy maker fixes throughout all periods, $h_1 = h_2 = h_3 = h^*$ (we hold interest rate fixed henceforth, and suppress i to ease notation), and (2) a cap and a floor on banks' asset holding, $\bar{n}$ and $\underline{\text{n}}$, that n_1, n_2 and n_3 must obey.

Figure 4 depicts the adjustments of market equilibrium in response to shocks, with the left panel showing the effect of a haircut policy whereas the right panel displays the effect of a cap and a floor on asset holding. In either case, the initial steady state equilibrium is given by point A. A random shock then perturbs the passive demand in period 2, represented by the dotted lines in both panels. Absent any rule-based policy, a positive shock will lead to a higher asset price and balance sheet expansion, marked by point B1. Conversely, a negative shock will result in B2 being the new equilibrium. The new equilibrium then provides a new basis on which the banks' demand will adjust in period 3, as described before.

Consider the case where the policy maker, by tightening rule-based regulatory

policy, enforces a structurally higher h^*. Proposition 1 implies that imposing a higher h^* requirement in this structural sense will rotate the banks' demand schedule anti-clockwise around the initial steady state, as shown in the left panel. Intuitively, a permanently higher haircut weakens the balance sheet mechanism and hence the underlying strength of procyclicality, making banks' demand less responsive to price changes. The effect of such policy is to increase the resiliency to shocks of either direction. A positive shock now results in smaller upward adjustments in both asset price and banks' asset holding, represented by point C1. Similarly, a negative shock only induces an equilibrium adjustment to point C2 relative to B2 without policy. These smaller period-2 adjustments, in turn, imply less pronounced adjustments in the final period since the path dependence of banks' demand becomes less severe.

Alternatively the policy maker may set a cap $\bar{n}$ and a floor $\underline{n}$ on the banks' asset holding as shown on the right panel. The result is to make banks' demand perfectly inelastic to asset price at $n_t = \underline{n}$ and $n_t = \bar{n}$. The new equilibrium under a positive and a negative shock is given by points D1 and D2 respectively. Analogous to the haircut policy, these limits on banks' asset holdings serve to curb procyclicality at its source, and as a consequence make the market more resilient to shocks.

Claim 4. *The rule-based implementation of regulatory tools, via haircut and balance sheet cap policies, can reduce the degree of procyclicality at the structural level, and hence help stabilize the asset market even if shocks cannot be foreseen in advance.*

The stabilizing benefit of rule-based regulatory policy holds even when there are multiple equilibria. Enforcing a sufficiently high haircut policy, by proposition 1, can help coordinate banks' expectations around a unique stable equilibrium. A prudent design of monetary framework should therefore ensure that, at the minimum, the leverage is never allowed to be too high to admit self-fulfilling prophesies to arise. On the other hand, a tighter gap between asset holding floor $n_t = \underline{n}$ and cap $n_t = \bar{n}$ will help limit the extent of equilibrium fluctuations that may arise from multiplicity. Indeed the equilibrium uniqueness is restored when the gap approaches zero in the limit.

It is in this sense that regulatory policy can be employed in pursuit of prudential

goals. The policy maker cannot foresee whether financial instability will occur, any more than it can forecast what type of shock will be realized. In the context of such uncertainty, there is very limited room for discretionary policy to also play the prudential role of guarding against instability. Instead, an appropriate design of policy framework that fosters resiliency of financial system against shocks can help contain the risk of instability directly. In this regard, the regulatory policy can play an active role, while other remaining discretionary tools can still be employed as usual. Prudential measures, as we envisage, therefore supplement and strengthen the existing inflation targeting framework, and regulatory tools should be seen as complementary to the traditional interest rate tool rather than a substitute for it.

2.4 Recommendations and discussions

Our simple model demonstrates that procyclicality plays a more complex role in the development of financial instability than simply magnifying shocks. Indeed, the narrative in section 2.2 is closer in spirit to a story of endogenous cycles than one of propagation. Such complexity, combined with the uncertainty about the nature of shock that may disrupt the system, lies well beyond the scope of discretionary policy tools including both interest rest and the regulatory variety. To effectively lean against potential threats to financial stability, even when the sources can be identified in advance with certainty, would require a comprehensive understanding of shock transmission process and meticulous effort to compute the optimal policy combination required.

Short of confidence that such precision can be achieved in practice, efforts should instead be invested in strengthening the financial system's resiliency against shocks at the structural level. This can be achieved by rule-based implementation of macroprudential tools, designed to subdue the procyclicality mechanism at source by introducing integrated 'speed limits'. The prudential policy in other words should be thought of as part and parcel of the monetary policy framework rather than an alternative counter-cyclical policy tool. Indeed, our analysis suggests that using regulatory measures as a counter-cyclical tool to absorb passive demand shock is likely to encounter the same set

of problems as when the use of interest rate is attempted. Even if the optimal use of discretionary regulatory policy for counter-cyclical purposes could be determined with perfect precision, it by no means precludes a rule-based macroprudential measure from fostering a more resilient financial system that is likely to have a first-order impact in terms of securing financial stability.

Several qualifications regarding our recommendation are in order. The model contains a single asset, hence it cannot address one important circumstance in which macroprudential tools have been actively used: when there appears to be sectoral imbalances. When instability threats emerge only in relatively small and specific sectors, the cost-benefit trade-off clearly stacks against the blunt use of interest rate. In these cases, it is often argued, the targeted nature of macroprudential policy offers a strong advantage. We view the rationales for employing macroprudential tools in this situation as self-evident, and do not consider them in our analysis which exclusively focuses on system-wide financial instability emanating from the banking sector.

The second qualification concerns the measurement issues in implementing a rule-based prudential framework in practice. How low should a leverage cap be set? How tight should caps on balance sheet size be set? How do policy makers ascertain that the regulatory grip is neither too tight that it chokes the smooth functioning of financial system, nor too loose that instability is allowed to develop? Determining the optimal trade-off between the dual goals of ensuring financial stability versus promoting the efficiency of the financial system is one important challenge that policy makers must overcome. This difficulty is one of intellectual nature which can certainly be resolved upon more empirical research.

Lastly, the standard criticisms of rule-based policies, such as the Goodhart's law or vulnerability to regulatory arbitrage, also qualify our recommendation. These problems are more difficult to address given the current state of knowledge, but can perhaps be mitigated by better policy design that explicitly takes into account the incentive effects and resulting endogenous adjustments of private agents.

On balance, our recommendation is for policy makers to place greater emphasis on

taming procyclicality mechanism at the structural level, with a view to forestalling the threat of financial imbalances at source. System-wide rule-based macroprudential can be deployed fruitfully towards this end. We also recommend limiting the use of discretionary policy, whether in terms of interest rate or regulatory tools, to only those cases where the source of shocks can be accurately anticipated, and whose complexity if terms of transmission is well understood. Failing these conditions, the prescribed discretionary policy may be counter-productive.

3 Role of Exchange Rate Under Flexible Inflation Targeting Framework

Another important challenge for emerging markets posed by the new global economic and financial environment is how to manage the exchange rate and macroeconomic implications in the face of increasingly large and volatile financial flows. Under a flexible exchange rate regime, large swings in capital flows can generate excessive exchange rate fluctuations which may in turn undermine macroeconomic stability. On the other hand, the rigidity of fixed exchange rates, while having the advantage of maintaining short-term external stability and reducing exchange rate risk, can delay needed adjustments in the face of large and persistent capital flows and may eventually lead to a currency crisis.

The issue of exchange rate management is even more challenging for emerging markets that adopts inflation targeting (IT) monetary policy. Under the orthodox IT framework practiced in advanced economies, the exchange rate does not appear explicitly in the policy reaction function, but implicitly only insofar as their developments and prospects affect the inflation forecasts and output away from the target. However, for emerging market economies the exchange rate has long been the center of macroeconomic and development policies. And, although they have moved towards more flexible exchange rate and adopted some variation of inflation targeting, policymakers' attention to it has not been moderated since the channels between the exchange rate and economic performance remain relatively strong due to structural characteristics of these economies. Leading advocates of inflation targeting in emerging market countries also advise against benign neglect of the exchange rate but have not provided specific guidance on what should be an appropriate role of exchange rate under this framework.

In this section, we attempt to address the issue of what is the best-designed strategy for the exchange rate that would be consistent under the inflation targeting framework and conducive to long-term sustainable growth particularly in the context of emerging markets.[7] In the following sub-section, we review existing literature that discusses the

[7]The role of exchange rate under the IT regime in achieving the monetary policy objective of price stability has already been addressed in a previous BOT discussion paper by Chai-anant et al. (2008)

relationship between the exchange rate flexibility and economic growth, both in theory and empirics. Then, the empirical investigation is conducted using a cross-country panel regression method, followed by a discussion of the results with implications for Thailand.

3.1 Theoretical framework and literature review

3.1.1 Exchange rate, inflation targeting and the trilemma

Under the "policy trilemma" principle, a country cannot maintain a fixed exchange rate, open capital market, and monetary policy independence at the same time. In the age of globalization in which the financial sector is more internationally integrated and the capital account is increasingly liberalized, the inflexibility of fixed exchange rates can place an enormous constraint on monetary policy. In such cases, the greater exchange rate flexibility is needed to allow a country to pursue an independent monetary policy, particularly in the face of shocks from open capital markets, rather than have its own monetary policy set by an anchor currency country.

In the context of IT framework under which monetary policy independence is pursued through the use of domestic inflation target as a nominal anchor, the policy trilemma entails that an financially open country needs to forgo exchange rate stability provided by the fixed exchange rate in order to maintain policy consistency. However, the reality is not entirely consistent with the trilemma predictions. This is because violation of the trilemma is plausible via the use of reserve accumulation and sterilized intervention which enable the countries to achieve some target combination of exchange rate stability, monetary policy autonomy, and financial integration. It is thus not surprising to observe open inflation-targeting economies to be able to pursue different exchange rate policies across the spectrum of exchange rate flexibility, including heavily managed ones to the extent that the cost of international reserves accumulation does not outweigh the net benefits of reducing exchange rate fluctuations perceived by the policymakers.

which investigates the roles of the exchange rate as a channel of monetary policy transmission, a shock absorber, and a role in alleviating inflationary pressure. To complement, in this present paper the focus is on the relationship between the exchange rate regime and a broader economic policy objective of long-term economic growth.

3.1.2 Exchange rate and long-term growth

The effects of the exchange rate regime and movements on long-term economic growth have been widely studied both theoretically and empirically. It is, however, difficult to draw clear conclusions from either ground regarding the direction and strength of the relationship. The main reasons may be that 1) the effect of the exchange rate regime on growth depends on a number of factors characterizing country- and time-specific circumstances, and that 2) the effect works through various channels in different directions, and magnitudes and it would be impossible for a theoretical model to pin down the net effect on growth. The inconclusiveness of the empirical results can also be attributable to the discrepancies across studies in exchange rate regime classification, exchange rate flexibility or volatility measures, estimation method, time period and country group coverage.[8] Nonetheless, to understand the issues better, it would be useful to first look at relevant arguments in the literature that relate the exchange rate to economic growth.

Arguments for and against exchange rate flexibility

The theoretical arguments regarding the degree of flexibility of the exchange rate that is optimal for growth are two-sided. On the arguments supporting the flexible exchange rates as conducive for long-term growth, three potential explanations are drawn here. The major advantage of allowing the exchange rate to move freely, as mentioned above, is for the policy makers to pursue monetary policy independently in response to any random shocks, without being constrained by the mandate of exchange rate stabilization. The independent monetary policy would help stabilize short-run economic cycle and enable smooth long-term path of economic growth.

Second, in achieving economic stability, flexibility in the exchange rate can complement by working as shock absorber. Indeed, this role has been one of the classical theories for choosing exchange rate regimes since 1950s (Rodriguez (2009)). Friedman

[8]Examples of empirical findings on the issue include Levy-Yeyati and Sturzenegger (2003) who find that, for non-industrialized countries, fixed exchange rates are connected with slower growth rates and higher output volatility; Rogoff et al. (2003) find positive influence of exchange rate flexibility on growth in advanced countries. In contrast, Ghosh et al. (2003) find slightly superiority of pegs but show that this result is not very robust.

(1953) argues that, in the presence of nominal rigidities, floating rates would provide better insulation from foreign shocks by allowing relative prices to adjust faster. A number of empirical literature has also confirmed such virtue. For example, Edwards and Levy-Yeyati (2002) underscores the shock-absorbing role in case of term-of-trade shock.[9] Asymmetry in economic shocks across countries lends support to the importance of the shock-absorbing role of flexible exchange rates.[10]

Third, in the longer run, flexible exchange rates induce economic adjustments in the way that strengthen the economic institutions and structure and make the economy more robust and resilient to shocks. In a market economy where price is determined by market force, firms are frequently forced to adjust themselves to price changes. Similarly, the market-determined flexible exchange rate could persuade firms to improve their economic efficiency of which better cost management, productivity improvement, and process of *creative destruction* could be a result. Exchange rate risk implied by the flexibility of floating exchange rate also reduces implicit guarantee by the central bank and provides the incentives for business and financial sector to reduce unhedged foreign exchange exposure to minimize an impact of exchange rate shock, leaving national balance sheet less vulnerable to exchange rate changes. In addition, financial institutions will have an incentive to develop hedging products and financial instruments.

Nevertheless, when considered as an asset price, the exchange rate can sometimes be viewed as a source of shocks itself (Farrant and Peersman (2006), Artis and Ehrmann (2006)), and hence allowing it to be fully flexible may be detrimental to economic growth, particularly for countries characterized by several structural and institutional weaknesses that make the countries' macroeconomic performance highly sensitive to exchange rate fluctuations. These countries may be divided into two groups according to two strands of modern exchange rate literature. First, the "fear of floating" literature (Calvo and Reinhart (2002)) predicts that for countries with high liability dollarization and high

[9]To verify such role in Thailand, Chai-anant et al. (2008) provided empirical test using small model and discover that the exchange rate can help absorb real shock.

[10]For Thailand, Goo and Siregar (2009) find that relinquishing the role of exchange rate as a shock absorber would be costly as economic shocks in Thailand have predominantly been asymmetric relative to important trading partners' economies.

exchange rate pass-through, depreciation or devaluation of the exchange rate could pose adverse impact on macroeconomic performance through their prevailing effects on the risk of balance sheet losses and domestic inflation. Thus, in many cases especially for Latin American countries in the past, the currencies that were *de jure* float were *de facto* heavily managed with a fear that even slight exchange rate changes could potentially result in a financial crisis and worsen the credibility of the central bank in fighting against the inflation.

The other strand of literature emerged along with the recent trend of large reserve accumulation in many emerging countries including the South-East Asian economies during the past decade. This so-called the "fear of appreciation" hypothesis attributes the tendency to intervene to postpone the appreciation of the local currency to the motive to promote the export sector and protect infant industries as a development strategy according to the neo-mercantilist view (Levy-Yeyati and Sturzenegger (2007)). Countries that rely heavily on exports as a main engine of growth thus tend to establish the fear of appreciation as an appreciating exchange rate could be extremely harmful to their short-run economic growth.

Existence of facilitating conditions: Advanced vs. Emerging markets

The discussion above implies that country-specific conditions matter in determining whether a certain exchange rate regime is conducive to growth. This can be illustrated by distinguishing between financially-robust advanced and financially-vulnerable emerging countries.[11] There exist general structural characteristics that tend to differentiate between advanced and emerging market economies in their exposure to exchange rate movements and the capacity of their economies to absorb the adverse effects of sharp exchange rate fluctuations. In particular, emerging markets often possesses the following economic and financial weaknesses that make them vulnerable to the exchange rate variability:

(1) External reliance From the above discussion regarding "fear of appreciation", most emerging economies rely on exports as a main engine for economic growth, and thus

[11]See also Calvo and Reinhart (2000) and Ho and McCauley (2003) that distinguish between advanced and emerging countries.

require stability in the exchange rate to create certainty in trading transaction as well as to promote price competitiveness.

(2) Less-developed financial market Findings by Aghion et al. (2009) and Serven (2003) suggest that the development of financial market, especially derivatives market, are crucial in determining the impact of the exchange rate shock. In this regard, the adverse impact of exchange rate volatility would be small in advanced countries where markets are more developed. In those markets, there are available tools for market participants to hedge against exchange-rate risk. Assets and liabilities are more diversified. Furthermore, lower cost of hedging additionally induces them to engage in this activity.

(3) High liability dollarization As a result of financial liberalization and integration, economies are exposed with high external debt, especially in the emerging ones that often have insufficient saving. Due to what is dubbed "original sin"[12], a bulk of corporate and household financial liabilities in most emerging markets is typically denominated in foreign currency, creating a direct exposure of balance sheets to exchange rate movements. The high level of foreign-currency denominated external debt used to be one of the causes of many financial crises in the past when capital flow reversal occurred and led to weakening of domestic currency.[13]

(4) High exchange rate pass-through Emerging markets usually have higher trade openness and larger portion of traded goods in consumption than industrial counterparts (Calvo and Reinhart (2002)), intensifying linkages between exchange rate and price. Though most literatures indicate that the pass-through has been lower partly as a result of more credible monetary policy, this is rather a case of developed countries while high pass-through still prevails in some developing countries. In any case, exchange rate movements that are large and abrupt may still have an implication on price.

[12]The *original sin hypothesis* was coined by Eichengreen et al. (2002) to refer to a situation in which most countries are not able to borrow abroad in their domestic currency.

[13]Support in a more general case is provided by Arturo Galindo and Montero (2007), who study an effect on industrial employment and show that real exchange rate depreciation can negatively impact employment growth in industries with high liability dollarization.

3.2 Empirical investigation: exchange rate and growth

The inclusiveness of the theoretical and previous empirical results on the relationship between the exchange rate and growth does not make the issue irrelevant, especially for emerging markets where these two variables tend to have stronger linkages than advanced economies. As discussed above, exchange rate flexibility can be either beneficial or harmful to growth. Accepting this as a fact, in this section we do not aim at drawing an absolute conclusion on the relationship between the exchange rate and growth. Rather, we attempt to understand why an exchange rate regime may have different influences on growth. In particular, we are interested to explore the conditions under which an economy can best reap the benefits of greater exchange rate flexibility.

To investigate the issue at hand, below we perform cross-country panel data regressions, which allows for both regime and structural shifts across times and heterogeneity across countries.

3.2.1 Data and variables

The study spans the 1980-2008 period on a yearly basis and covers 74 countries, both advanced and emerging economies from all major regions (Appendix C presents a list of countries included in the sample). Data used to construct growth measures and determinants are taken from the World Bank's World Development Indicators, the IMF's International Financial Statistics, and central bank websites. The data set is an unbalanced panel due to missing observations for some countries especially in the earlier sample years.

To construct a measure for exchange rate flexibility, we calculate annual average of the absolute monthly log-change in the exchange rates. The exchange rate used here is the bilateral nominal exchange rate of home currency against the US dollar or other explicit base currency as indicated in the *de facto* exchange rate classification schemes constructed by Levy-Yeyati and Sturzenegger (2005) and Reinhart and Rogoff (2004). The US dollar is used as the denominating currency in case of unspecified base currency. To avoid an upward bias in the index, i.e., exaggerating the "flexibility" of the exchange

rate especially when the rate usually follows a narrow band or a soft peg, but is de- or revalued infrequently, we apply a threshold to the exchange rate movements by dropping monthly changes that are greater than 10 percent before calculating the annual average change. Observations during the known currency crises and announced regime changes are also removed with an attempt to filter out exchange rate fluctuations during the transition periods.[14] Alternative measures of exchange rate flexibility are also used as described in the robustness check section.

3.2.2 Econometric methodology

We consider standard cross-country growth regressions to which we later add a measure of exchange rate flexibility, as well as interaction terms between the exchange rate measure and each of the relevant financial and structural conditions to capture any possible differential effects depending on these conditioning variables. Following the modern empirical growth model literature, a dynamic panel data model is used. This model is based on the convergence hypothesis, namely, in the long run countries converge to parallel balanced growth paths. Thus, as appears in our benchmark growth regression 3.1 below, the first difference of log output contains some dynamics in lagged output.

$$\log y_{i,t} = (1+\beta)\log y_{i,t-1} + X_{i,t}\Psi + \alpha_i + \mu_t + \varepsilon_{i,t} \tag{3.1}$$

The following notation is used: our dependent variable, $y_{i,t}$, is the long-run rate of real per capita GDP in country i and period t; $X_{i,t}$ is a vector of structural, institutional and policy variables that determine long-run growth, these include investment rate, level of education, political stability, and trade openness; α_i denotes country-specific effects or so-called growth residuals; μ_t is a vector of time dummies to capture global shocks or technological change at the world level; and $\varepsilon_{i,t}$ is an error term assumed to be heteroskedastic. As is now standard in the empirical growth literature, five-year periods are used, since that interval is thought to be long enough to eliminate business cycle

[14]Currency crisis dating are taken from Laeven and Valencia (2008) which covers the universe of systemic banking crises, currency crises, and debt crisis during 1970-2007.

effects but short enough to capture important structural changes that occur over time for a particular country. Thus, all time-varying variables are constructed as five-year averages.

The growth residuals from equation 3.1, captured by α_i, can be regressed on the exchange rate measure to test whether greater exchange rate flexibility is associated with higher growth after taking into account all standard growth determinants. However, since this second stage regression would have to be a cross-section regression due to the time-invariant α_i, this approach would yield ambiguous result if there has been a regime shift or a structural change that influenced a change in the exchange rate behavior in a particular country over the whole sample period, which is very much likely to have occurred over this more than two-decade time window. Nonetheless, these growth residuals extracted from equation 3.1 will be used in the following subsection to examine whether there exists any relationship between the exchange rate movement pattern and growth residuals which cannot be explained by standard growth determinants.

To allow for regime changes in the exchange rate over the sample period, as well as to examine the differential effects of the exchange rate on growth conditional on other country-specific factors, we modify equation 3.1 by directly including the measure of exchange rate flexibility and the interaction terms as follows:

$$\log y_{i,t} = (1+\beta)\log y_{i,t-1} + X_{i,t}\Psi + \gamma \mathrm{FX}_{i,t} + \tau \mathrm{FX}_{i,t}\mathrm{Cond}_{i,t} + \alpha_i + \mu_t + \varepsilon_{i,t} \qquad (3.2)$$

where $\mathrm{FX}_{i,t}$ is the measure of exchange rate flexibility described above and $\mathrm{Cond}_{i,t}$ is a country- and time-specific financial or structural condition including a dummy for an adoption of the IT regime, a new millennium dummy (2000-2008 period), a dummy to capture threshold effects of FX flexibility, the level of financial development (proxied by the sum of private credit and stock market capitalization to GDP), external balance sheet exposure (proxied by short-term external debt to GDP), export reliance (export to GDP), and financial openness (capital account openness index due to Chinn and Ito (2008)). We are particularly interested in the effect of the interaction terms since we suspect that the differential effects on growth might depend on the existence of facilitating conditions as

previously discussed.

3.2.3 The results

Basic relationships

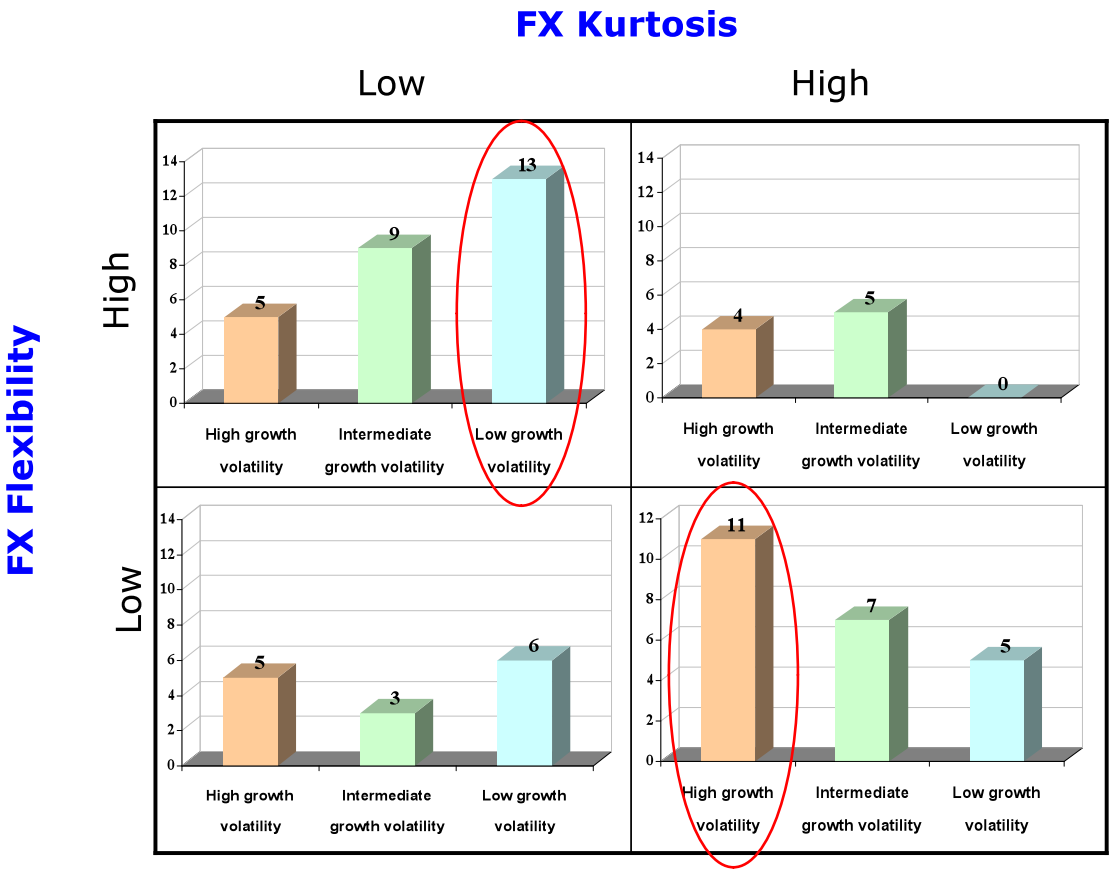
Before turning into the estimation results, let us first explore basic relationships between the exchange rate behavior and growth residuals and volatility. It would be interesting to see what kind of growth outcome is generally observed with a particular pattern of the exchange rate movements. To classify the exchange rate movement pattern we calculate, in addition to the measure of exchange rate flexibility[15], the "kurtosis" of the exchange rate to capture the jump process, i.e. infrequent extreme deviations, possibly caused by a currency crisis or a de- or revaluation.[16]

We then divide the exchange rates of the sample countries into four groups according to their relative flexibility and kurtosis: 1) high flexibility, high kurtosis; 2) high flexibility, low kurtosis; 3) low flexibility, high kurtosis; and 4) low flexibility, low kurtosis. Our prior is that the exchange rates described with *low* flexibility and *high* kurtosis are the one associated with a peg regime with a significant adjustment of the band or a collapse of the peg, while *high* flexibility and *low* kurtosis type of exchange rate movements can be used to characterize a free float regime with no large exchange rate adjustment. Growth volatility is then calculated as a standard deviation of annual growth rates over the whole sample period. The sample countries are categorized into three equally-populated groups according to their volatility measure: (1) high growth volatility, (2) intermediate growth volatility, and (3) low growth volatility.

Figure 5 plots the exchange rate characteristics against the relative level of growth volatility. Countries associated with "a peg regime" (low flexibility, high kurtosis) are generally observed with high growth volatility, while most countries with a close to "a free float regime" (high flexibility, low kurtosis) seem to experience low growth volatility over the sample period. This result is of no surprise given that a rigid exchange rate regime

[15]Be reminded that the exchange rate flexibility here is the flexibility during the "normal times", with extreme changes in the rate being excluded from the calculation.

[16]Kurtosis is defined as the fourth moment divided by the squared variance of the variable, minus 3.



Note: The y-axis shows the number of countries in each group.

Figure 5: FX movements and growth volatility

may bring about serious exchange rate misalignment and unsustainable macroeconomic imbalances, leading to frequent or severe economic contractions. For the latter case, perhaps with the benefits of the shock absorbing capacity of the flexible exchange rate and no extreme currency movements, the economies characterized by high exchange rate flexibility and low kurtosis were relatively more successful in growth stabilization.

We next investigate the basic correlation between the exchange rate behavior and *growth residuals* or α_i estimated from equation 3.1 above. Similar to the categorization of growth volatility, the sample countries are grouped according to the relative size of their alpha: (1) high alpha, (2) intermediate alpha, and (3) low alpha. As shown in Figure 6, more flexible and smooth exchange rate is linked to higher growth performance once other standard growth determinants are controlled for, whereas a rigid exchange rate with abrupt adjustments is often observed with relatively lower growth residuals.

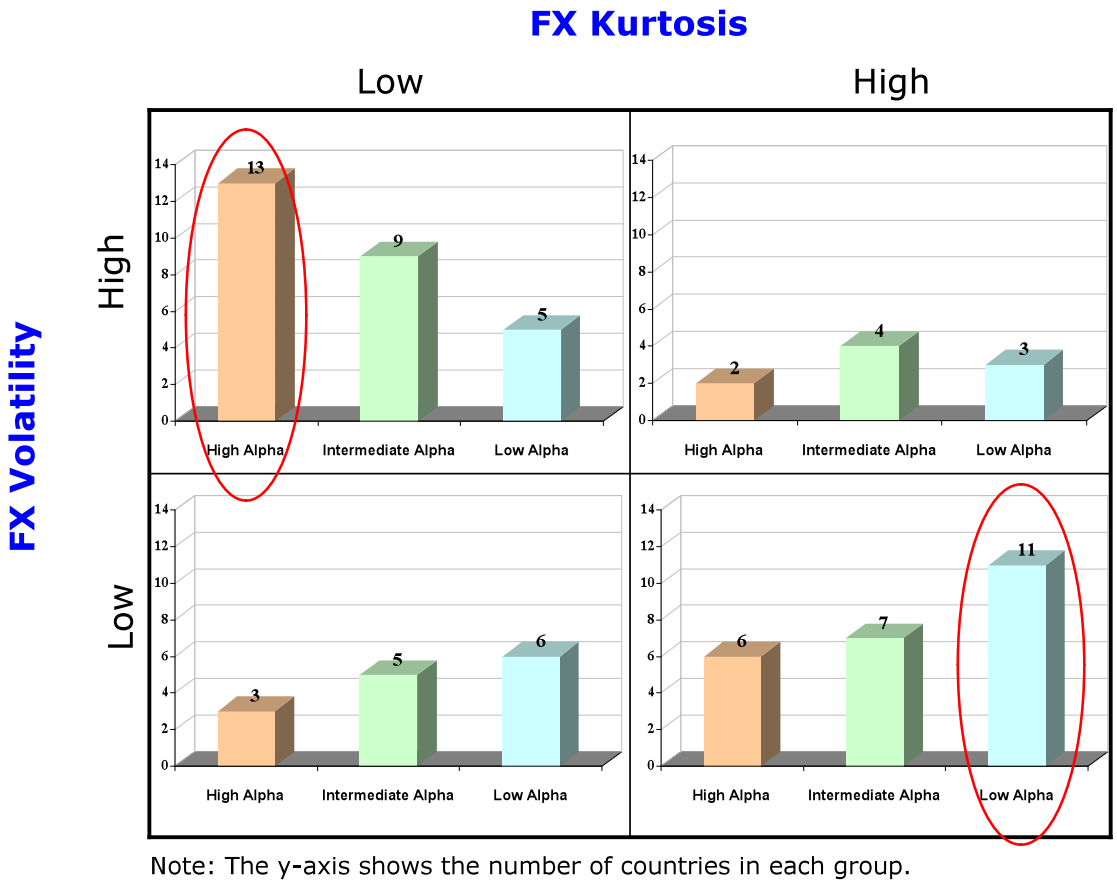


Figure 6: FX movements and growth residuals

This result may already lend support to the notion that flexible exchange rate, without extreme volatility, is conducive to long-term economic prosperity. However, a more rigorous econometric investigation is required to confirm and gain deeper insights into this preliminary finding. Let us now turn to the results from the regression analysis below.

Regression results

Table B1 in the appendix presents the estimations of the impact of the exchange rate flexibility on growth under the benchmark model specification in equation 3.2. Overall, the estimated coefficients of the standard determinants of long-run growth, namely, investment ratio, the level of education, trade openness, and political stability, are strongly significant with expected signs. In the full sample regression, **the coefficient of exchange rate flexibility is negative and significant**, indicating that exchange rate

volatility generally has a negative impact on growth. This is not surprising given that the majority of our sample countries are emerging markets which tend to be fundamentally vulnerable to large exchange rate fluctuations. Another plausible reason hinges on the possibility that the apparent negative impact on growth is driven by some extreme values of exchange rate volatility that would be certainly detrimental to growth.

To address this potential threshold effect of the degree of exchange rate flexibility, we divide the flexibility measure into halves with a cutoff at the middle of the range of the measure of flexibility and create a dummy called "high flex" for the upper half of the range.[17] As shown in Table B3, when the interaction for the "high flex" dummy is added to the main regression, the coefficient for exchange rate flexibility becomes insignificant, while the interaction term is significantly negative, implying that **the negative effect of exchange rate flexibility on growth found earlier is driven mainly by a few extreme values of flexibility**. This finding on non-linear effect provides an important guideline for policymakers that, when considering on the cost of exchange rate flexibility, the focus should be on those extreme volatilities.

More interestingly, **the negative impact is completely nullified when combined with the partial effect from the IT-regime interacting term**. This positive combined effect mean that, for countries that adopted the IT, greater exchange rate flexibility is beneficial for growth, and that IT economies may be able to tolerate exchange rate volatility to a greater extent than non-IT counterparts. Plausible explanations for this result are: 1) with the merits of greater transparency and ability to anchor inflation expectation, the IT regime gains greater policy credibility which results in the reduction of exchange rate pass-through, 2) with a flexible exchange rate acting as an absorber of external shocks, the policy rate under the IT framework can be more focused and more effective at accommodating domestic shocks.

Regarding the interaction with movements of the exchange rate, another interesting result has also been found, as presented in Column (3) of Table B1, the more flexible

[17]Note that there are much fewer observations that fall in the upper half (22% of observations) than the lower half (78%) of the flexibility range. We also try other threshold levels, including dividing the flexibility range into quartiles and carry out similar threshold tests. All specifications support the existence of the threshold effect.

exchange rate that is also on average appreciating, the higher is the long-run growth. The result seems contradictory to usual knowledge that appreciation of the currency can threaten export sector. However, as we will discuss later, it can potentially foster financial and economic adjustment that is crucial to growth in the longer run.

Next, we examine whether there is a time-varying effect of exchange rate flexibility on growth. We find that **the negative impact of exchange rate flexibility on growth has been moderated over time and such impact even turns positive since the turn of the new millennium**. The interaction term between exchange flexibility and the"new millennium" dummy, i.e. 2000-2008 period, yields a positive and significant coefficient, whereas the non-interacting exchange rate flexibility term which captures the effect during the pre-2000 sample period remains negative. The result is strongly confirmed when we divide the sample into two sub-periods: 1990-1999 and 2000-2008, and compare the results from a cross-section OLS regression for each sub-period (Table B2).[18] This result could reflect some changes in the world economic and financial landscape in the recent period—perhaps the growing importance of cross-border financial flows and intensified process of globalization, together with stronger economic fundamentals in a number of countries—that favor greater exchange rate flexibility.

Indeed, the rest of the regressions in Table B1, which add variables interacting between the exchange rate flexibility measure and some structural factors, have illustrated importance of economic and financial landscape in influencing exchange-rate effects. Except for the export reliance (export to GDP) variable, the other conditions all have statistically significant interactive effects with expected signs. **The more financially developed, the more financially opened, and the less exposed to external debt an economy is, the higher is the point estimate of the impact of exchange rate flexibility on growth**, supporting with our predictions regarding the growth benefits of exchange flexibility in financially robust economies. In our consideration, this finding, together with the time-varying effect above, may carry important implications

[18]The time-varying effects captured here could be one of the reasons why the literature survey that did not take into account time differences renders ambiguous result of the impact of the exchange rate on growth.

for policymakers going forward and hence requires a closer investigation (to be discussed in the next section).

Robustness checks

Several modifications of variable measurements and model specifications are performed to test the robustness of the main results.[19] First, instead of using the log of *level* of real GDP per capita as a dependent variable (with its lagged term on the right-hand side) as in the standard long-term growth model, we replace it with *growth* of real GDP per capita with initial level on the right-hand side. The two specifications yield almost the same results, both in terms of the magnitude and significance of the coefficients, except for the interaction term for financial openness that becomes insignificant in the latter specification.

To address the issue of the relevant time frame for the "long-run" growth analysis, we alter the time interval in the regressions from a window of five-year averages to a five-year rolling window and a ten-year rolling window. Overall, the main results carry over with improvement on the significance of the control variables especially for the ten-year rolling regressions.

Next, we allow for some alternative measures of exchange rate flexibility. First, we calculate exchange rate volatility as an annualized exponentially weighted moving average of the daily bilateral exchange rate returns, which allows for a decayed effect as well as a closer trace of exchange rate volatility. Extreme daily returns are removed before calculating the "normal time" annualized moving averages. With this alternative flexibility measure, while the signs of the interactive effects are preserved, the negative impact of the exchange rate volatility becomes more pronounced, possibly reflecting the adverse effect of too vibrant (i.e. on a daily basis) exchange rate movements. Second, to address the issue of anchor currency to which we should consider the exchange rate movements against, we construct the annual average of absolute monthly changes in the nominal effective exchange rate (NEER) instead of the bilateral exchange rate. Interestingly, with the NEER flexibility measure only the interactive effects of the IT

[19] Some robustness checks results are not shown due to limited space.

regime, the new millennium and export/GDP variables are statistically significant with correct signs while the others become insignificant. The interaction term between the NEER volatility and export/GDP is especially large and strongly significant, whereas it was not significant before, implying that the NEER volatility, not the bilateral exchange rate, is what matters for countries that heavily rely on the export sector.[20]

3.3 Discussion of the results

The estimation results bear four important messages: 1) the negative effect of exchange rate flexibility on growth is largely driven by observations with extreme exchange rate volatility, 2) the overall negative impact seems to be moderated overtime and such impact even turns positive since the turn of the new millennium; 3) financially robust economies with stronger external balance sheet and higher level of financial development are in a better position than financially vulnerable economies to reap the benefits of the flexible exchange rates; and 4) financially open countries that adopted the IT regime tend to benefit more from exchange rate flexibility.

Why do we observe the changing effect of exchange rate flexibility on growth? More importantly, what do the empirical findings imply about appropriate exchange rate policy going forward? Considering the above conclusions from the empirical results together with observations about the changing economic and financial environment as well as country structure, we argue here that **greater exchange rate flexibility is likely a sensible and durable choice for emerging economies in maintain macroeconomic stability and prosperity in the foreseeable future**. The reasons are as follows:

1. The costs imposed by exchange rate fluctuations are falling

1.1 Declining external vulnerability

Many aspects of external and financial vulnerabilities in emerging markets have substantially reduced over time. Measures of size and liquidity of financial and capital

[20]Other minor robustness checks are performed by using different measures of the control and conditioning variables. For instance, public spending on education is used as a proxy for the level of education instead of average year of schooling; democracy index instead of political stability index; financial openness measured as the sum of gross capital inflows and outflows as a percentage of GDP instead of the capital account openness index. All of these modifications do not alter the main findings of our analysis.

Table 1: Comparison of external and financial vulnerability indicators, group median[a]

1990-1999 vs. 2000-2008

	IT emerging economies		Flexible FX, non-IT emerging		Pegged FX emerging	
	1990-99	2000-08	1990-99	2000-08	1990-99	2000-08
Financial development						
Stock mkt value (%GDP)	10.3	19.7	12.4	8.2	10.0	30.7
Stock mkt turnover ratio (%)	43.6	43.5	24.2	17.5	26.6	18.9
Private credit (% GDP)	36.7	44.4	20.0	36.9	37.9	45.8
Bond market (% GDP)[b]	19.0	42.7	5.0	11.1	2.3	6.0
M2 (%GDP)	34.7	44.8	26.0	28.0	50.6	48.2
Balance sheet vulnerability						
External debt (% GDP)	43.1	39.4	55.2	48.4	38.5	44.2
Short-term debt (% total external debt)	21.9	17.6	15.8	18.4	20.4	28.8
Policy credibility						
Avg CPI inflation (% annual)	17.6	5.7	48.9	11.2	7.8	5.6
Inflation volatility	8.4	2.3	32.4	4.5	5.9	4.8
Trade openness						
Exports (% GDP)	24.4	33.1	37.6	42.4	36.9	53.5
Trade (% GDP)	52.2	68.6	79.5	75.3	76.2	88.5
Energy imports, net (% energy use)	25.9	25.9	-14.6	-33.1	-114.5	-124.1
Financial openness						
Gross flows (% GDP)	8.1	9.6	8.4	13.4	8.5	13.0
Financial flow volatility[c]	1.0	2.2	1.1	1.9	1.2	3.4
Capital account openness[d]	-0.30	0.57	-0.43	-0.20	0.69	1.13

Source: Bank of Thailand, Stock Exchange of Thailand, World Bank, and BIS.
Notes: [a] Country groups are classified according to Stone, et al. (2009) which determines the exchange rate arrangements and country groupings based on the IMF's de facto classification system of mid-2007.
[b] Includes both international and domestic bond securities.
[c] Measured as coefficient of covariation (CV) which is a normalized measure of dispersion, calculated as the ratio of the standard deviation to the mean of net flows.
[d] Chinn and Ito (2008)

markets indicate considerable improvements in the degree of financial development (Table 1). The exposure to external debt and the share of short-term debt have been generally lowered, especially for inflation targeting emerging markets, partly due to the progress in domestic financial development that reduced reliance on external sources of finance and partly due to a costly lesson learned from the past financial crises. Policy credibility, proxied by the level and volatility of average inflation, has appeared to be strengthened over time, implying increased effectiveness of monetary policy in accommodating shocks

and a potentially lower exchange rate pass-through through the ability of the central bank to anchor expectations. It is indeed evident in the literature that the degree of pass-through has been moderated in the recent period, not only in advanced economies but also in emerging markets (Frankel et al. (2005)). All of these institutional and financial improvements make the economy progressively less vulnerable to exchange rate fluctuations and stand in a better position to reap the benefits of greater exchange rate flexibility. Increased exposure to financial flows due to continued capital account liberalization and the precarious nature of capital flows in the modern era puts forward the role of flexible exchange rate as an automatic stabilizer.

However, one feature that still prevails and more often than not causes short-term exchange rate fluctuations to entail significant impact on output performance is the increasing degree of trade openness in most emerging markets. This is potentially one of the main reasons for the reluctance of policymakers in many emerging markets to let the exchange rate freely float. We argue the use of competitive exchange rate to continue promoting export-led growth may not be sufficient to sustain growth dynamics, as discussed shortly below.

1.2 Problems with using competitive exchange rate to sustain growth

Under the export-led growth model commonly used in a number of emerging markets, exchange rate management is often aimed at delivering competitive or undervalued exchange rate to promote export sector, or an economic growth in general. Although this strategy has been evidently successful in many cases, such strategy is not without limitations, and there are potentially important downsides that could compromise long-term economic growth.

One essential limitation arises from the notion that effectiveness of such policy partly depends on how the global demand evolves. As the demand is an uncontrollable factor and often afflicted with various uncertainties, relying on price competitiveness to gain world market share cannot guarantee a success, especially since the world demand after the 2008 global crisis has become weaker than in the past (Haddad and Pancaro (2010)). Moreover, a worldwide competitive devaluation could result in externality that

hampers the effectiveness of this strategy.

Besides, there are also various trade-offs that adversely affect long-term growth potential and hence call into question the appropriateness of such strategy. First, resisting exchange rate appreciation forgoes the advantage of low imported costs, which in turn holds back new investments and the potential growth.[21] Investments abroad by domestic residents which would improve the balance of capital flows and enhance the benefits from diversification may also be discouraged when domestic currency remains weak.

Second, the trade-off could either come through in the form of under-developed non-tradable sector, i.e. the service sector. As undervaluation of the exchange rate is equivalent to a subsidy to tradable firms, resources could be disproportionally transferred to them, resulting in resource misallocation. In this regard, the economy additionally forgoes an opportunity to promote the service sector, which fundamentally offers a high value-added production and mainly utilizes local resources.[22] Furthermore, the subsidy would delay the efficiency-oriented adjustments of the subsidized firms. Sooner or later, excessive concentration on the tradable sector will translate into declining efficiency of investment[23] (Eichengreen (2007)).

After all, long-term economic growth is ultimately related to supply-side determinants.[24] By relying on competitive exchange rate, the benefit would be merely a demand boost in the short-run, while adjustment of the business sector which is crucial to the supply-side improvement is being put off. In this regard, such exchange rate policy may stand in the way to deter economic growth in the long run.

2. The benefits of flexibility has been enhanced

2.1 New globalization and more financial openness

The renewal of capital flows in the aftermath of the global crisis has been a much

[21]As a case in point, Harris (2001) illustrates that Canadian dollar undervaluation during 1990s has subdued the country's investment in machinery and equipment and imported technologies, which brought about lower Canada's productivity and growth with respect to the US during that period.

[22]The service sector constitutes large part in production of advanced countries. Thus, the transition to high-income economies may require development of this sector.

[23]China appears to be good illustration as its US dollar peg transferred excessive resources toward manufacturing sector and lowered marginal product. Moreover, the problem is more severe as inequality among regions is heightened due to large-scale migration to manufacturing sector.

[24]In their empirical investigation, Harris (2001) and Haddad and Pancaro (2010) find that the impact of undervaluation could turn negative in the long run.

concerned issue in the emerging markets. As apart from its implication on exchange rate volatility, it could also pose risks on economic instability in terms of economy overheating and financial imbalances. In this context, speculative flows are of particular concern, reminded by a number of past crisis episodes in East Asia and Latin America. Ensuring that these flows are well-managed would be desirable to prevent any unforeseeable negative consequences. We argue here that the exchange rate flexibility could be one tool in dealing with an influx of flows, especially when it arrives in the form of speculation.

The explanation involves decision-making of international investors. In one way, the flexibility introduces two-way movement of the exchange rate and creates return uncertainty which could discourage them from engaging in a speculative activity (Guillermo A Calvo and Reinhart (1994)). In the other way, as misalignment in the exchange rate could be a cause of speculation[25], preventing misaligned exchange rate in the first place would be forthright strategy, which could be well-served by allowing the exchange rate to move flexibly with changes in economic fundamentals, reducing the probability of an abrupt movement due to corrective actions forced by the market. The role of the exchange rate as a shock absorber would also help to mitigate the macroeconomic implications of capital flows.[26]

2.2 Policy consistency under the trilemma

As exchange rate is allowed to move more flexibly under the pre-condition of greater financial openness and monetary policy autonomy, the policy will become more consistent under the trilemma principle. For one thing, as stability of the exchange rate and the breakdown of the trilemma are mainly achieved by sterilized foreign exchange intervention, obvious benefit of letting the exchange rate freely adjusted is that the use of intervention would be moderated. This would especially the case for developing economies where reserves have been accumulated rapidly over the past decade and further intervention would be increasingly costly in terms of financial costs on the central bank balance sheet and economic costs falling on the economy as a whole.[27] Moreover, existing

[25]Undervaluation encourages speculations to long the currency to gain profit from future rate increase.

[26]Flexibility could, furthermore, induce financial development in terms of its size and players. The development would create two-way bets of the currency and make the market more resilient to shock.

[27]Financial costs of large reserve accumulation on the central bank balance sheet include the cost of

empirical studies have cast doubt over effectiveness of the intervention. Some report that it is by and large ineffective or effective merely in the short-run.[28]

One should note that policy consistency under the trilemma does not imply policy optimality for a particular country. But once the inflation targeting framework has been chosen for its own merits, it is then clear that monetary policy independence is called for to preserve its effectiveness. In face of increasing financial openness, this would require the exchange rate to be flexible for the following reasons. First, as domestic price has been explicitly targeted, the presence of nominal rigidities is further prevailing and the flexibility of the exchange rate would be needed as a price variable to absorb shocks. By keeping both prices stable, the adjustment may instead bear on the real economy. Second, under the interest parity condition, exchange rate is one of the channels of monetary policy transmission mechanism. Allowing it to move freely could help strengthen this role, subsequently improving policy effectiveness.

2.3 Opportunity to exploit FX flexibility in fostering structural improvement

Note that the results above suggest that the positive effect of exchange rate flexibility on economic growth relies partly on the presence of proper fundamentals, such as developed financial markets and lower external debt. However, given relatively weak economic and financial structures of a typical emerging-market economy, the vicious cycle often exists in a way that the central bank is reluctant to float its currency, unless the fundamentals are fully developed. With limited exchange rate risk, players in the economy then have no incentive to protect themselves or strengthen their resiliency against exchange rate movements. Accumulated vulnerabilities and underdeveloped financial markets then activate the fear of floating. The vicious cycle is thus completed.

Indeed, to break out of this vicious cycle, a gradual exit from active exchange rate management can play a vital role as the variability of the exchange rate encourages de-accumulation of balance sheet vulnerabilities, advances financial market development,

sterilization and capital loss on account of local currency appreciation against the dollar. Economic costs are in terms of opportunity costs of forgone consumption and investment as foreign reserves are financial resources set aside for precautionary needs or as a result of exchange rate intervention, which could be otherwise used for domestic consumption and investment that potentially yield greater benefits to the economy especially when the level of reserves has far exceeded the "optimal level.

[28]See Chai-anant et al. (2008) and Disyatat and Galati (2005) for empirical support.

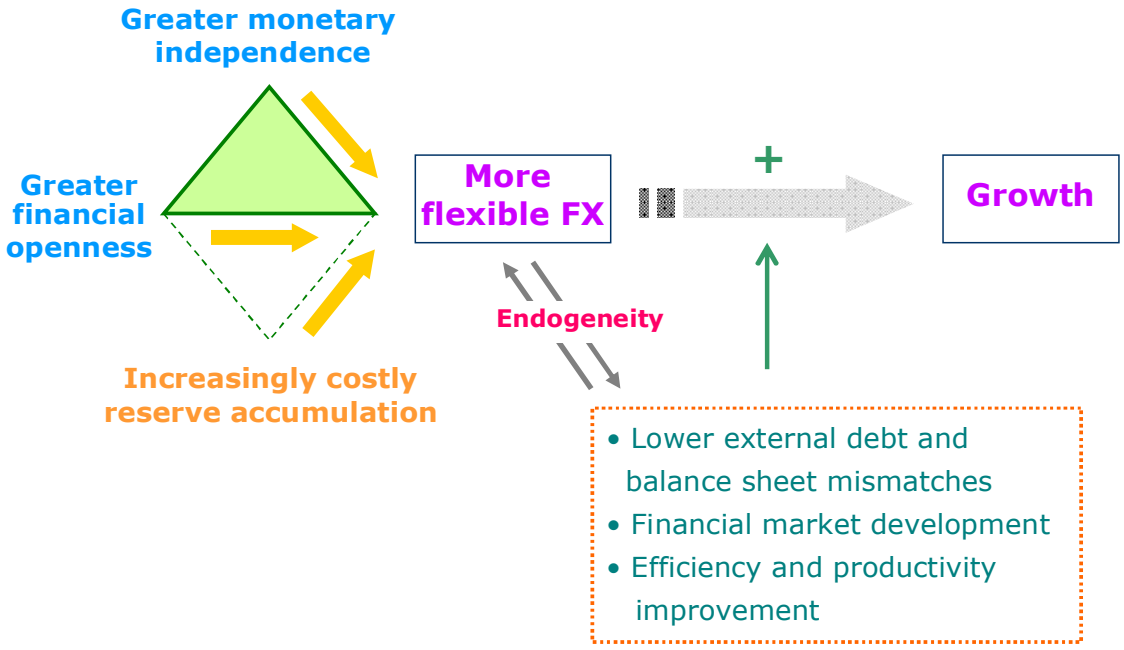


Figure 7: The binding trilemma and the endogeneity effects of exchange rate flexibility

and induces structural improvements in the business sector that foster greater efficiency. This will take the economy instead to a "virtuous cycle" of market-based exchange rate, strong fundamentals, and high and healthy growth.[29]

Empirical evidences in the past could well illustrate this appealing role of flexibility on both real and financial development. On the financial side, Kamil (2006) finds that under a floating exchange rate regime, firms in Latin America become more aware of exchange rate risk and reduce their exposure by closing their foreign currency position. In particular, firms' external debt is well matched by export income. Patnaik and Shah (2010) report the same result in the case of India. Interestingly, in Chile where there is a gradual exit from pegged regime, not only has there been a decrease in unhedged foreign currency-denominated debt, its derivatives market has continuously expanded (Gregorio and Tokman (2004)).

Improvement in the real sector that brings about resiliency of the business sector is also worth discussing. In Japan, after an unfavorable movement of the Yen under

[29] Ötker-Robe and Vavra (2007), studied countries' experiences in moving toward flexibility and showed that though well-preparedness could smooth the transition, fundamentals need not be fully developed before floating.

the Plaza Accord, firms adjust to difficulties in a number of ways (Klitgaard (1996), and Kohama and Urata (1988)). Firms are primarily encouraged to improve their productivity which induces better cost management and competitiveness. Moreover, firms shifted their production to high-profit-margin goods, which are basically less-sensitive to exchange rate variability since their competitiveness is based on quality. The high margin also provides firms more room to deal with adverse currency movements. Taiwan is another country that faced serious predicaments following the same Accord. However, despite adverse impact on export sector and manufacturing production, the negative effect was short-lived and it rather helped promote industrial upgrading in the longer run (Yingfeng (2008)).

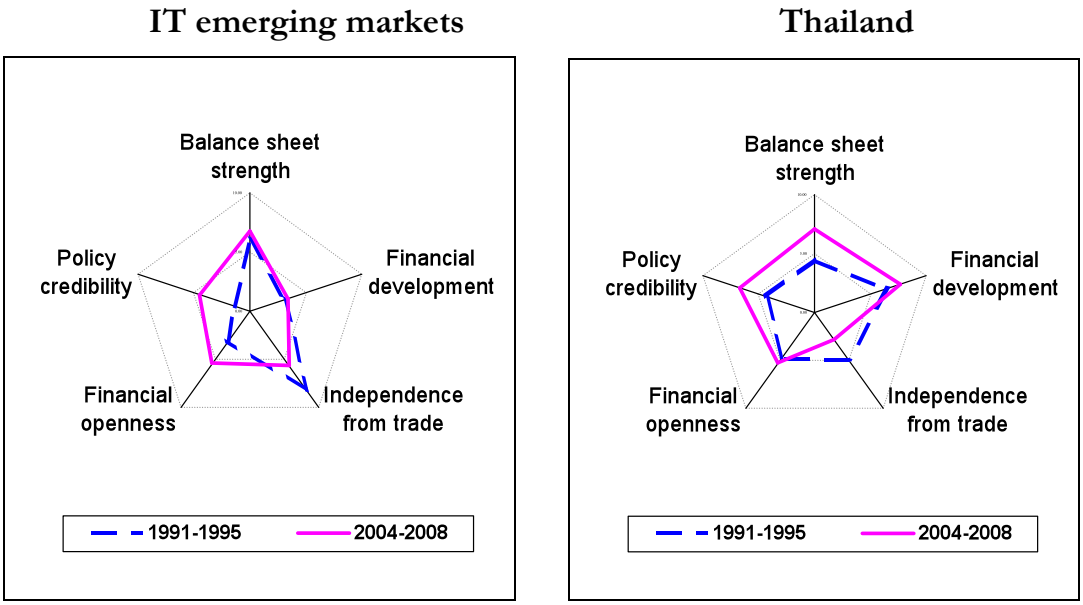
In sum, this section argues that the changing trade and financial landscape in the new globalization together with improving resiliency among emerging markets lend support to the increasing benefits of allowing the exchange rate to be more flexible. As economies grow more financially integrated and sophisticated, the role of flexible exchange rates as an automatic stabilizer is a crucial ingredient for economic policy aiming at maintaining macroeconomic stability. Not surprisingly, by the end of the last decade, the increasing importance of financial flows together with the success in building central bank autonomy and monetary credibility, and the resulting decline in inflation and exchange rate pass-through, led to the growing popularity of the flexible regime especially among the inflation-targeting economies. This trend started in economies with relatively lower levels of foreign-currency-denominated external debt such as Chile, South Africa, and Brazil, before gradually extending to other countries in part and parcel with a reduction in their degree of dollarization. Letting the exchange rate to be determined by the market forces are also found to help induce business sector adjustments, promote financial development, avoid resource misallocation, prevent a crisis due to currency misalignment, and reduce the risk of losses being transferred to the public sector.

3.4 Implications for Thailand

Thailand's macroeconomic policy framework after the Asian crisis of 1997 in terms of the trinity constraint can be generally characterized by monetary policy autonomy and capital mobility, while the exchange rate has become more flexible under a managed-floating regime. Over the past decade, the strength of monetary autonomy and the degree of capital mobility have been rising following the adoption of inflation targeting and as the financial accounts have been progressively more liberalized in an increasingly integrated world. However, the exchange rate may not have been as flexible as warranted by the theory. Like in most other economies in the region, in Thailand the central bank remained actively managing the exchange rate in order to mitigate excessive currency movements. Evidence shows that exchange rate volatility in Thailand in the recent period has been lower than almost all currencies in the region, and remained much lower than the level above which would be detrimental to economic growth.[30]

The motives for active exchange rate management during the recent time seem to rest on the importance of the export sector as a main driver of economic growth. Considering economic and financial features that are key determinants of the degree of a country's vulnerability to exchange rate fluctuations—namely, balance sheet mismatches, the degree of financial development, export reliance, financial openness, and policy credibility—we find that Thailand has been successful in reducing the vulnerability to exchange rate shocks in many aspects, both relative to the past and relative to other inflation-targeting emerging markets (Figure 8). Clearly, improvements in the external balance sheet, financial development, and policy credibility all contribute to increased resilience of the country to exchange rate shocks. The fact that greater financial openness makes the economy more susceptible to external instability is one of the reasons the authorities should allow for more flexible exchange rate to enhance its role as a natural absorber of external shocks. The only feature that seems to present as a drawback of a hand-off on exchange rate management is the increasing reliance of the Thai economy on international trade, through which channel exchange rate instability can greatly

[30]This statement is inferred from a comparison of the volatility measure of the bilateral exchange rates during the period of Jan-August 2010, and the result from the regression analysis in this paper.



Source: Authors' calculation.

Note: A composite index, scaled from 0 to 10, is calculated for each factor based on data listed in Appendix E. IT emerging market group comprise 16 economies that are classified as emerging markets by the IMF definition and have adopted inflation targeting by 2007 (see Stone et al. (2010) for a complete list of countries included).

Figure 8: Comparison of financial robustness of IT emerging markets vs. Thailand 1991-1995 and 2004-2008

undermine overall macroeconomic performance and stability.

Export growth and its consequences on employment and economic growth are clearly legitimate concerns under the export-led growth strategy often used by low income economies striving to move to the middle income status by making good use of natural resources and low cost advantage. But once the new income status has been reached, the growth strategy must be revisited to overcome new challenges of the growth process in order to move on to the next stage, to avoid getting caught in the so-called "middle income trap". For Thailand, which belongs to the middle income category like many other countries in the region, one of the key challenges to the export-led growth model is the rapid emergence of newly emerging countries, particularly China, India, and Vietnam, as new low cost centers. Unlike these newly emerging economies, Thailand at its current stage of development no longer has ample access to the main factors of production: capital investment has not been revived since the 1997 crisis and the domestic labor market has been tightened for some time which has put upward pressure on wages. Given 1)

Thailand's no absolute advantage in the cost of production of ordinary export goods, 2) the increasingly globalized trade which creates a fierce competition for export markets and a possible competitive currency devaluation, and 3) the recent global financial crisis in the advanced countries which suppresses global demand, the old growth model that relies much on exchange rate competitiveness to spur export growth appears to be inadequate to take the country to the next stage. There is even a risk of Thailand falling from the middle income category without the fast-acting solutions to the long-run problems of maintaining high growth and increasing international competitiveness.

In order to move Thailand forward in the environment of growing competition, a new growth model may be needed. Although it is not yet clear what should be the specific prescription for an optimal growth strategy for Thailand at this stage, it is agreeable that one of the major ingredients should be a move toward a more balanced growth, perhaps the one led by productivity improvement and innovations. More balanced growth would navigate the focus toward the strength of domestic demand which, in turn, can sustain economic growth by lessening the exposure to the complexity of global competition and insulating it against any foreign shocks. In the meantime, innovation-led economy, whose products are of high profit margin and are quality-based in nature, would enhance the nation's competitiveness, bring about resiliency to any price shocks and, importantly, drive the economy itself toward a higher stage of development. To achieve these, policymakers must strive to get the right incentives for the business sector to climb up the quality and technology ladders as well as to adjust sufficiently quickly to the rapidly evolving regional and global environment.

Regarding the role of the exchange rate policy in facilitating the transition to the next stage of development, experiences in various countries suggest that more flexible exchange rate regime can induce the business sector to build greater resiliency through reduced balance sheet vulnerability, better exchange rate risk management, and improved production efficiency and productivity. Those adjustments, in turn, contribute to higher level of economic and financial development. There is also evidence that a flexible exchange rate on a steadily appreciating trend is not always bad for an economy. For

one thing, it is a natural consequence of stronger fundamentals of a growing economy. But more importantly, by lifting the purchasing power, appreciating currency provides incentives for the domestic private sector to establish new investment and upgrade its technology, contributing to greater overall productivity. Higher relative price of non-tradable as a result of appreciating currency, in addition, would support an expansion of the service sector which adds high value to the domestic economy.

For Thailand, active exchange rate management may have been warranted in the past when the private sector was tied down by excessive vulnerability to exchange rate swings and did not have adequate adjustment capacity. The empirical analysis in this study, however, supports that the business sectors are now well equipped with strong fundamentals to cope with greater exchange rate flexibility. Thailand's current macroeconomic framework, which is under the configuration of inflation targeting and greater financial openness, also requires assistance from exchange rate to be a first-line shock absorber. Lastly and importantly, exchange rate flexibility would allow for market-based adjustment process. In this increasingly integrated world, greater flexibility of the economy is needed. Sluggish adjustment process implicitly assisted by the central bank interventions may no longer be sufficient to survive this rapidly changing environment and may potentially be an obstacle to long-term economic prosperity. Moreover, in so doing the economy will not be able to get out of a vicious cycle of government subsidies, private sector vulnerability, and low growth.

To draw a conclusion for Thailand, given relatively low flexibility of the Thai baht under the current regime, Thailand with already stronger economic and financial structure shall not fail to allow the economy to reap the long-term benefits from higher exchange rate flexibility. The bottom line is that, while dampening sharp jumps in the currency movements remains essential to maintain macroeconomic stability in the short run for Thailand as a small open economy, when taking a longer view of economic growth, the policymakers should consider an increased exchange rate flexibility as part of the policy package that will drive Thailand forward in a healthy and sustainable manner.

4 Concluding Remarks

Thanks to the globally low inflation and subdued macroeconomic environment over the past decade, the inflation targeting framework in Thailand may yet to be put to a stern test. The apparent success of the IT framework in Thailand in this benign environment therefore should not breed complacency for the policymakers going forward. Indeed, the aftermath of the recent global crisis has marked the beginning of a new global economic and financial landscape that will have important implications and warrant a reassessment of the adequacy of our current monetary policy framework in coping with the new challenges.

This paper highlights two key challenges to the future of monetary policy in Thailand in this new environment. The first is how to deal with the greater threat to financial stability posed by a more powerful procyclicality mechanism inherent in the financial system. The second is how to sustain long-run growth potential of the economy and avoid being marginalized by the new global and regional growth process.

We argue that the three existing policy tools, namely the policy interest rate, regulatory measures and the exchange rate, will have to work in a more integrated and more forward-looking manner to strengthen the current inflation targeting framework in the face of the above challenges. Our finding that procyclicality plays a complex role in the endogenous development of financial instability, combined with the uncertainty regarding the nature and timing of shock, justifies the use of a rule-based macroprudential policy to tame procyclicality at source. The macroprudential policy recommended should be thought of as part and parcel of the monetary policy framework to strengthen the financial system's resiliency at the structural level, rather than a competing counter-cyclical tool.

To address the second challenge, and in light of several limitations on the export-led growth strategy especially in the new environment, we argue that a continuation of active exchange rate management to support the export sector will most likely cannot sustain high growth in Thailand through the next decade. The evidence, indeed, suggests that Thailand is well-positioned to benefit from more flexibility going forward, which in turn will help spur private sector's adjustments and ultimately ensure a more resilient and

prosperous Thailand.

The roles of the macroprudential policy and the exchange rate prescribed above will supplement and strengthen the existing inflation targeting framework. With a more robust financial system and stronger economic fundamentals brought about through well-designed prudential measures and a proper role of the exchange rate, the policy interest rate can then be focused on its best role as a counter-cyclical policy tool aimed at maintaining price stability and promoting sustainable growth. Moreover this proposed policy configuration will also preserve all the merits of inflation targeting regime, especially in terms of transparency and accountability.

As a case in point, consider a hypothetical scenario of larger and more volatile capital flows that threaten to trim near-term growth and/or cause asset price bubbles. A more flexible exchange rate, serving as the first line of defense, will help absorb capital flow shocks by limiting expected currency gain as well as raising investment risk through higher volatility. Meanwhile, the macroprudential measures will help curb incentives to speculate on domestic asset markets. This combination of policy tools therefore helps deter short-term speculative flows in the first place, and helps strengthen financial stability. Furthermore, to the extent that the remaining fundamentals-driven capital flows are likely to be more persistent, greater exchange rate flexibility will elicit earlier adjustments on the part of private sector, to prepare for a new global financial and economic environment. Delaying adjustments at this critical juncture will likely have severe implications for Thailand's growth potential in the longer term.

The global economic and financial landscape will certainly continue evolving. The future of monetary policy will as a consequence be shaped by new forces of change. For Thailand to successfully navigate this ever changing and ever more challenging environment, it is crucial for the policy makers to place greater emphasis on building a more robust, more efficient and more resilient economic and financial system. Failing to take this longer-term view of the economy, handling future risks as they present may be too daunting a task.

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A Proofs for Model of Financial Instability

In this appendix, we prove key results cited in section 2.1

Uniqueness Condition *Under the contraction condition 2.7, there is a unique stable asset market equilibrium.*

Proof. We assume a continuous excess demand function $t(i, p_t) + n_t(i, p_t) - N : [0, \infty] \mapsto [-2N, 2N]$ that cuts zero at least once so that an equilibrium always exists. For no loss of generality, consider any arbitrary pair of prices $p^0 < p^1$. Since banks' demand slopes upwards while the passive demand slopes downwards, condition 2.7 implies that

$$\begin{aligned} n_t(i, p^1) - n_t(i, p^0) &< t(i, p^0) - t(i, p^1) \\ t(i, p^1) + n_t(i, p^1) - N &< t(i, p^0) + n_t(i, p^0) - N \end{aligned}$$

That is, any part of the excess demand function is always downward-sloping in price. The method of successive approximations can be employed to solve for a unique stable equilibrium, akin to how a unique fixed point is guaranteed in the contraction mapping theorem. □

Proposition 1 *The slope along any two points of banks' demand is decreasing in h.*

Proof. The objective is to establish that, for any arbitrary p^1 and p^0, the left hand side of the contraction condition 2.7 is decreasing in h. Using equation 2.5, the left hand side of condition 2.7 is

$$\begin{aligned} \left| n_t(i, p^1) - n_t(i, p^0) \right| &= \left| \frac{n_{t-1} p_{t-1}}{p^0} \left(\frac{1-h}{h} \right) - \frac{n_{t-1} p_{t-1}}{p^1} \left(\frac{1-h}{h} \right) \right| \\ &= n_{t-1} p_{t-1} \left(\frac{1}{h} - 1 \right) \left| \frac{1}{p^0} - \frac{1}{p^1} \right| \end{aligned} \tag{A.1}$$

which is decreasing in h for any p^1 and p^0. □

Proposition 2 *If $n_2^* p_2^* > n_1^* p_1^*$, then n_2 is a contraction mapping of n_3, namely there exists $k < 1$ such that for any p^1 and p^0*

$$\left| n_2(i, p^1) - n_2(i, p^0) \right| \leq k \left| n_3(i, p^1) - n_3(i, p^0) \right| \tag{A.2}$$

Proof. Using banks demand equation 2.5 evaluated in period-2 and period-3 equilibria, we have

$$\begin{aligned} \left| n_2(p^1) - n_2(p^0) \right| &= \left(\frac{1-h}{h} \right) n_1^* p_1^* \left| \frac{1}{p^0} - \frac{1}{p^1} \right| \\ \left| n_3(p^1) - n_3(p^0) \right| &= \left(\frac{1-h}{h} \right) n_2^* p_2^* \left| \frac{1}{p^0} - \frac{1}{p^1} \right| \end{aligned}$$

Choosing $k = n_1^* p_1^* / n_2^* p_2^* < 1$ completes the proof. □

B Exchange Rate and Growth: Estimation Results

Table B1: Main Results

Fixed-effects Panel Regressions, 1980-2008

Dependent Variable: Log of Real per Capita GDP (five-year averages)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log of real GDP per capita (lag)	0.978***	0.975***	0.977***	0.972***	0.985***	0.975***	0.996***	0.989***
	(127.56)	(126.98)	(128.94)	(127.35)	(121.59)	(119.74)	(90.77)	(86.00)
Investment rate	0.144***	0.152***	0.151***	0.161***	0.148***	0.173***	0.149***	0.168***
	(3.96)	(4.18)	(4.18)	(4.50)	(4.08)	(4.18)	(4.03)	(3.13)
Average schooling	0.005**	0.004*	0.004**	0.003	0.004**	0.005**	0.003	0.003
	(2.28)	(1.91)	(2.02)	(1.27)	(2.02)	(2.25)	(1.27)	(1.03)
Trade openness	0.030***	0.030***	0.030***	0.028***	0.033***	-0.013	0.020*	0.014
	(3.23)	(3.25)	(3.23)	(3.06)	(3.47)	(0.45)	(1.85)	(0.97)
Political stability	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001	0.001*
	(3.54)	(3.48)	(3.63)	(3.48)	(3.67)	(3.37)	(1.04)	(1.71)
FX flexibility	-1.031***	-1.128***	-1.049***	-1.302***	-1.500***	-0.676	-1.248***	-0.731*
	(5.25)	(5.65)	(5.41)	(6.36)	(5.00)	(1.49)	(5.09)	(1.79)
FX flex * IT regime		0.536**						
		(2.22)						
FX flex * Appreciation			0.539***					
			(2.75)					
FX flex * New millennium				0.714***				
				(3.76)				
Financial development					-0.025***			
					(3.03)			
FX flex * Financial development					0.900**			
					(2.38)			
Export/GDP						0.093*		
						(1.77)		
FX flex * Export/GDP						-1.002		
						(0.88)		
Financial openness							-0.001	
							(0.07)	
FX flex * Financial openness							0.291**	
							(2.06)	
External debt/GDP								0.003
								(1.00)
FX flex * Externaldebt/GDP								-0.081**
								(2.04)
Constant	0.076	0.099*	0.083	0.137**	0.026	0.088	-0.026	0.013
	(1.42)	(1.84)	(1.56)	(2.50)	(0.46)	(1.52)	(0.35)	(0.20)
Obs	349	349	349	349	348	349	285	206
No. of countries	74	74	74	74	74	74	74	47
F-test that all fixed effects = 0	2.64	2.63	2.64	2.59	2.81	2.59	2.57	1.74

Notes: t-statistics in parentheses. *, **, and *** represent significance at 10%, 5%, and 1% level, respectively. The numbers of countries and observations used in regression (8) drop significantly due to unavailability of short-term external debt data for some countries in the sample, mainly industrial economies.

Table B2: Sub-period Regressions
Cross-section OLS Regressions, Subperiods 1990-1999 and 2000-2008
Dependent Variable: Log of Real per Capita GDP (period averages)

	1990-1999	2000-2008
Log of initial real GDP per capita	0.907***	0.908***
	(29.54)	(32.60)
Investment rate	0.206***	0.157***
	(4.92)	(3.26)
Average schooling	-0.001	0.001
	(0.45)	(1.08)
Trade openness	-0.009*	-0.002
	(1.84)	(0.39)
Political stability	0.001	0.000
	(1.05)	(0.13)
FX flexbility	**- 0.880*** **	**0.714** **
	(3.01)	**(2.18)**
Constant	-0.025	-0.025
	(1.65)	(1.64)
Obs	72	74
Adj. R-squared	0.979	0.983

Table B3: Threshold Effects of Exchange Rate Flexibility
Fixed-effects Panel Regressions, 1980-2008
Dependent Variable: Log of Real per Capita GDP (five-year averages)

	(9)	(10)	(11)
FX flexibility	-1.297***	-0.657	-0.758
	(2.67)	(1.13)	(1.32)
FX flex * Dummy(High flex)		-0.714**	-0.752**
		(1.96)	(2.07)
FX flex * IT regime			2.13**
			(2.29)
Other growth determinants[a]	Included	Included	Included
Other interaction terms[b]	Included	Included	Included
Constant	-0.033	-0.034	-0.017
	(0.48)	(0.48)	(0.25)
Obs	206	206	206
No. of countries	47	47	47
F-test that all fixed effects = 0	1.84	1.87	1.88

Note: Test statistics for other growth determinants and other interaction terms are omitted in this table to save space. [a] Other growth determinants include, as in Table A1, lagged real GDP per capita, investment rate, average schooling, trade openness, and political stability. [b] Other interaction terms include financial development indicator and external debt level, interacted with FX flexibility.

C List of Sample Countries Used in Regression Analysis

Advanced	Latin Amer. & Carib.	Middle East & N. Africa	Sub-Saharan Africa	East Asia & Pacific	Europe & Central Asia	South Asia
Australia	Argentina	United Arab Emirates	Botswana	China	Bulgaria	India
Canada	Bolivia	Bahrain	Cote d'Ivoire	Indonesia	Hungary	Sri Lanka
Switzerland	Brazil	Cyprus	Kenya	Korea, Rep.	Poland	Pakistan
Germany	Chile	Algeria	Mali	Mongolia	Russian Federation	
Denmark	Colombia	Egypt, Arab Rep.	Mozambique	Malaysia	Slovak Republic	
Spain	Costa Rica	Iran, Islamic Rep.	Niger	Philippines		
France	Dominican Republic	Israel	Togo	Singapore		
United Kingdom	Guatemala	Jordan	Uganda	Thailand		
Iceland	Honduras	Kuwait	South Africa	Vietnam		
Italy	Jamaica	Morocco	Zambia			
Japan	Mexico	Qatar				
Netherlands	Nicaragua	Saudi Arabia				
Norway	Panama	Yemen, Rep.				
New Zealand	Peru					
Sweden	Paraguay					
Turkey	Trinidad and Tobago					
	Uruguay					
	Venezuela, RB					

D Definitions and Sources of Variables Used in Regression Analysis

Variable	Description	Source
GDP	Log of real GDP per capita	IMF's International Financial Statistics (IFS)
Investment rate	Gross fixed capital formation (% GDP)	IMF's IFS
Average years of total schooling	Average years of total schooling for population of age 15 and above	Barro and Lee (2010) educational attainment database
Public spending on education	Public spending on education (%GDP)	World Development Indicator (WDI)
Political stability	A composite index of the political stability based on government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and bureaucracy quality. Risk ratings range from 0 (highest risk) to 100 (least risk)	International Country Risk Guide (ICRG)
Democratic accountability index	A measure of degree of free and fair elections and how responsive government is to its people. 0 (least democratic) to 6 (most democratic)	ICRG
Trade openness	Total value of exports plus imports (% GDP)	Authors' construction using data from WDI
Bilateral exchange rate flexibility	Annual average of absolute monthly changes in the bilateral exchange rates	Authors' calculation using data from Bloomberg and IFS
NEER exchange rate flexibility	Annual standard deviation of monthly NEER	Authors' calculation using data from IFS and BIS statistics
Exponentially weighted moving average of FX volatility	$vol_t = w * vol_t + (1-w) * return_t^2; w = 0.94$ $return_t = \frac{FX_t}{FX_{t-1}}$	Authors' calculation using data from Bloomberg
Financial development	Sum of private credit and stock market capitalization as ratio to GDP	Authors' calculation. Domestic credit to private sector and stock market capitalization from WDI
Export to GDP	Export value to GDP	WDI
Financial openness	1) Capital account openness index	Chinn and Ito (2008)
	2) Sum of gross capital inflows and outflows to GDP. Capital flows consist of FDI, portfolio investment, and other investment	Author's calculation using data from IFS
External debt exposure	Short-term external debt stock to GDP	Authors' calculation using data from WDI

E Data used for constructing the composite indices of structural and financial vulnerabilities

	Thailand		IT emerging markets[a]	
	1991-1995	2004-2008	1991-1995	2004-2008
Balance sheet vulnerability				
External debt (%GDP)	46.9	32.1	41.2	38.1
Short-term (%total external debt)	41.7	31.2	20.6	16.0
Trade openness				
Exports (%GDP)	38.3	73.4	23.8	31.6
Imports (%GDP)	43.6	69.9	25.1	37.6
Energy import (%energy use)	40.5	44.3	27.0	27.1
Financial development				
Money M2 (%GDP)	77.1	103.7	32.3	46.8
Private credit (%GDP)	113.3	104.8	31.9	33.3
Stock traded value (%GDP)	64.6	50.7	45.0	24.1
Bond market cap (%GDP)	9.5	49.9	12.0	35.2
Exposure to financial flows				
Gross flows (%GDP)[b]	15.1	11.8	8.0	10.6
Volatility of financial flows[b, c]	2.3	4.9	1.2	2.4
Capital account openness index[d]	-0.21	-0.09	-0.17	0.99
Proxies for policy credibility				
Average CPI inflation (% annual)[b]	5.0	2.8	16.4	4.9
Inflation volatility	2.0	1.7	3.7	1.8

Source: Bank of Thailand, Stock Exchange of Thailand, World Bank, and BIS

Note: [a] The IT emerging markets group consists of 16 emerging market countries that adopted inflation targeting by mid-2007 (See Stone, et al. 2009 for detailed classification).

[b] 1990-1999 vs 2000-2008

[c] Measures as coefficient of variation = s.d./mean

[d] Chinn and Ito (2010)