บทบาทของอัตราแลกเปลี่ยนในการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อของไทย

Role of Exchange Rate in Monetary Policy under Inflation Targeting: A Case Study for Thailand

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กลุ่ม 3: บทบาทของอัตราแลกเปลี่ยนในการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อของไทย

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สายนโยบายการเงิน

ธนาคารแห่งประเทศไทย

กันยายน 2551

บทคัดย่อ

บทความนี้มุ่งวิเคราะห์บทบาทต่างๆ ของอัตราแลกเปลี่ยนในการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อในกรณีของไทย ทั้งการเป็นช่องทางส่งผ่านของอัตราดอกเบี้ยนโยบายที่ผ่านอัตราแลกเปลี่ยนให้เคลื่อนไหวไปยังราคาสินค้าและบริการในประเทศ บทบาทในการเป็นตัวปรับเพื่อลดทอนผลกระทบจากความเสี่ยงต่างๆ ต่อระบบเศรษฐกิจ รวมทั้งศึกษาถึงความเป็นไปได้ที่อัตราแลกเปลี่ยนจะมีบทบาทเพิ่มเติมในการบรรเทาภาวะเงินเฟ้อในปัจจุบัน โดยการศึกษาจะใช้แบบจำลองโครงสร้างขนาดเล็ก (Small Structural Model) ที่สามารถสะท้อนความสัมพันธ์ของอัตราแลกเปลี่ยนกับตัวแปรอื่นๆ ได้อย่างชัดเจนเป็นกรอบการวิเคราะห์หลักควบคู่ไปกับเทคนิคทางสถิติอื่นๆ ซึ่งผลการศึกษาชี้ว่า นอกจากบทบาททั่วไปในการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อแล้ว อัตราแลกเปลี่ยนยังอาจมีบทบาทเพิ่มเติมในการช่วยนโยบายการเงินดูแลเงินเฟ้อเพียงในบางกรณี ทั้งนี้ เมื่อเทียบกับการใช้อัตราดอกเบี้ยนโยบาย ผลจากแบบจำลองชี้ว่าอัตราแลกเปลี่ยนส่งผลต่อเงินเฟ้อได้เร็วแต่จะมีผลอยู่ในระยะที่สั้นกว่า ในขณะที่ผลต่อการขยายตัวทางเศรษฐกิจอาจมีไม่มากนักแต่ส่งผลที่ยาวนานกว่า ดังนั้น อาจกล่าวได้ว่าการใช้อัตราแลกเปลี่ยนเพื่อดูแลเงินเฟ้อ อาจเหมาะสมในภาวะเงินเฟ้อที่เกิดจากความเสี่ยงชั่วคราว อย่างไรก็ดี ประสิทธิผลของการใช้นโยบายดังกล่าวจะขึ้นอยู่กับความสามารถในการแทรกแซงอัตราแลกเปลี่ยนของทางการ (Controllability) และความสามารถในการส่งผ่านของอัตราแลกเปลี่ยนไปยังเงินเฟ้อโดยตรงและเงินเฟ้อคาดการณ์เป็นสำคัญ

* ผู้เขียนขอขอบคุณ ดร. อัมพร แสงมณี ผู้อำนวยการ ฝ่ายนโยบายการเงิน สำหรับข้อแนะนำและแนวคิดที่เป็นประโยชน์อย่างมาก ซึ่งมีส่วนช่วยให้บทความมีความสมบูรณ์ยิ่งขึ้น นอกจากนี้ ผู้เขียนขอขอบคุณ ดร. อัจนา ไวความดี รองผู้ว่าการ ด้านเสถียรภาพการเงิน ดร. ดวงมณี วงศ์ประทีป ผู้ช่วยผู้ว่าการ สายนโยบายการเงิน ดร. อมรา ศรีพยัคฆ์ ผู้อำนวยการอาวุโส สายนโยบายการเงิน ดร. พิชิต ภัทรวิมลพร ผู้อำนวยการ ฝ่ายวิจัยเศรษฐกิจ และดร. ทิตนันท์ มัลลิกะมาส ผู้อำนวยการ สำนักเศรษฐกิจมหภาค สำหรับข้อชี้แนะที่เป็นประโยชน์ รวมทั้ง ดร. รุ่ง โปษยานนท์ มัลลิกะมาส คุณเรจินา สวัสดิรณภักดิ์ ดร. อัศวิน อาฮูยา รวมทั้งสมาชิกทีมพยากรณ์และเศรษฐมิติ สำหรับข้อคิดเห็นและคำแนะนำในการสร้างแบบจำลอง นอกจากนี้ ผู้เขียนยังได้รับความอนุเคราะห์ข้อมูลจากสายตลาดการเงิน ธนาคารแห่งประเทศไทย คุณวรารัตน์ เขมังกรณ์ คุณปราณี สุทธศรี คุณบัณฑรี ปัณฑราช และคุณสุโชติ เปี่ยมชล รวมทั้ง คุณพงศ์ดนัย หวังธำรงค์วิทย์ ผู้ช่วยวิจัย

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Roles of Exchange Rate in Monetary Policy under Inflation Targeting: A Case Study for Thailand

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The views expressed in this paper are those of the authors and do not necessarily represent those of the Bank of Thailand.

Abstract

This paper addresses the roles of exchange rate in monetary policy under inflation targeting (IT) regime, with a particular focus on Thailand. The analysis will examine the role of exchange rate as a channel of monetary policy transmission mechanism, its role as a shock absorber and the plausibility of an additional role in mitigating inflationary pressure. To investigate these issues, the paper primarily employs a Small Structural Model to capture the relationship between the exchange rate and other macroeconomic variables, in conjunction with other statistical and econometric techniques. The analytical results indicate that, besides its conventional roles under IT, the exchange rate could take on an additional role in alleviating inflationary pressure only under specific circumstances. The finding suggests that the impact of exchange rate management in bringing down inflation is rapid and short-lived, while the impact on output is smaller but more long-lasting than the use of interest rate policy. Thus, the use of exchange rate in curbing inflation is only appropriate in the case of temporary inflation shock. It is, however, subject to limitations. The effectiveness of exchange rate management via foreign exchange intervention, i.e. the degree of controllability, is an important concern. Moreover, prolonged intervention can also distort resource allocation and delay structural adjustments of the real economy.

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บทสรุปผู้บริหาร

การดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อ (Inflation Targeting) โดยทั่วไปนั้น อัตราดอกเบี้ยนโยบายจะถือเป็นเครื่องมือหลักเครื่องมือเดียวในการส่งผ่านนโยบายที่เหมาะสมไปยังตัวแปรทางเศรษฐกิจต่างๆ โดยมีจุดมุ่งหมายหลักคือเสถียรภาพราคาที่เอื้อต่อการขยายตัวทางเศรษฐกิจที่ยั่งยืน อย่างไรก็ดี ในภาวะปัจจุบันที่เสถียรภาพราคาของประเทศถูกคุกคามจากราคาน้ำมันและราคาสินค้าโภคภัณฑ์ที่ปรับขึ้นไปอยู่ในระดับสูงจากการขยายตัวแบบก้าวกระโดดของประเทศเกิดใหม่ทั่วโลก ที่สำคัญคือจีนและอินเดีย ในขณะที่เศรษฐกิจไทยที่อยู่ในภาวะซบเซาในช่วง 2 – 3 ปีที่ผ่านมาเริ่มมีสัญญาณฟื้นตัว ทำให้การดำเนินนโยบายการเงินที่ต้องตึงตัวขึ้นเพื่อดูแลเงินเฟ้อ อาจส่งผลกระทบต่อการฟื้นตัวที่ยังเปราะบางของไทย ทำให้มีข้อเสนอแนะอย่างกว้างขวางถึงความเป็นไปได้ที่อัตราแลกเปลี่ยนจะมีบทบาทมากขึ้นเพื่อช่วยนโยบายอัตราดอกเบี้ยในการดูแลภาวะเงินเฟ้อ

ในการศึกษาความเป็นไปได้ดังกล่าว บทความนี้จึงมุ่งวิเคราะห์ถึงบทบาทต่างๆ ของอัตราแลกเปลี่ยนในการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อในกรณีของไทย เพื่อพิจารณาถึงความจำเป็นและความเหมาะสมในการเพิ่มบทบาทของอัตราแลกเปลี่ยนเพื่อช่วยบรรเทาภาวะเงินเฟ้อในปัจจุบัน โดยการศึกษาจะมุ่งเน้นการใช้แบบจำลองโครงสร้างขนาดเล็ก (Small Structural Model) ที่ถูกสร้างขึ้นให้เหมาะสมกับเศรษฐกิจไทยและสามารถสะท้อนปฏิสัมพันธ์ของอัตราแลกเปลี่ยนกับตัวแปรต่างๆ ได้ชัดเจนกว่าแบบจำลองขนาดใหญ่ทั่วไปที่มีโครงสร้างซับซ้อน รวมทั้งเทคนิคทางสถิติอื่นๆ ในการช่วยหาข้อสรุปของประเด็นที่สำคัญดังกล่าว

จากการศึกษาเบื้องต้น พบว่าในกรณีของไทย นอกจากอัตราแลกเปลี่ยนจะมีบทบาทในการส่งผ่านนโยบายและการช่วยลดผลกระทบจากความเสี่ยงต่างๆ แล้ว การเข้าดูแลอัตราแลกเปลี่ยนโดยตรงยังอาจสามารถช่วยลดแรงกดดันเงินเฟ้อได้ในบางกรณีเนื่องจาก 1) การเปลี่ยนแปลงอัตราดอกเบี้ยนโยบายส่งผลกระทบต่ออัตราแลกเปลี่ยนได้ไม่มาก ทำให้ผลของนโยบายส่งผ่านไปยังระดับราคาได้น้อย 2) การมองเศรษฐกิจผ่านแบบจำลองชี้ให้เห็นว่าการใช้อัตราแลกเปลี่ยนเพื่อช่วยนโยบายดอกเบี้ยในการดูแลเงินเฟ้อจะลดความผันผวนของเงินเฟ้อและอัตราดอกเบี้ยนโยบายลง และ 3) การเข้าดูแลอัตราแลกเปลี่ยนจะส่งผลโดยตรงให้ราคาสินค้านำเข้าที่เป็นตัวขับเคลื่อนแรงกดดันเงินเฟ้อในขณะนี้ปรับลดลงได้

อย่างไรก็ดี การใช้อัตราแลกเปลี่ยนเพื่อช่วยชะลอแรงกดดันเงินเฟ้อมีข้อจำกัดหลายประการ โดยเฉพาะลักษณะของอัตราแลกเปลี่ยนที่อ่อนไหวต่อปัจจัยต่างๆ ได้ง่าย ซึ่งอาจทำให้ความสามารถในการแทรกแซงอัตราแลกเปลี่ยนของทางการ (Controllability) มีจำกัดและมีประสิทธิผลอยู่เพียงในระยะสั้น นอกจากนี้ การเปลี่ยนแปลงของอัตราแลกเปลี่ยนดังกล่าวจะต้องส่งผลต่อเงินเฟ้อหรือเงินเฟ้อคาดการณ์อย่างมีนัยสำคัญเพื่อสะท้อนประสิทธิผลของการใช้นโยบายอัตราแลกเปลี่ยนอีกด้วย

ทั้งนี้ เมื่อพิจารณาถึงความเหมาะสม พบว่าอัตราแลกเปลี่ยนควรนำมาใช้เป็นเพียงนโยบายเสริมให้กับนโยบายอัตราดอกเบี้ยเพื่อดูแลเงินเฟ้อเท่านั้น เนื่องจากธนาคารกลางย่อมมีความสามารถในการดูแลอัตราดอกเบี้ยให้อยู่ในระดับที่เหมาะสมมากกว่าการดูอัตราแลกเปลี่ยน และถึงแม้ว่าการเข้าแทรกแซงอัตราแลกเปลี่ยนโดยตรงอาจส่งผลต่อราคาสินค้าได้เร็ว แต่ความอ่อนไหวของอัตราแลกเปลี่ยนต่อปัจจัยต่างๆ ทำให้ผลดังกล่าวคงอยู่ได้สั้นกว่าเทียบกับผลที่เกิดจากนโยบายอัตราดอกเบี้ย และหากแทรกแซงอัตราแลกเปลี่ยนเพื่อให้ได้ผลที่ยาวนานขึ้น อาจทำให้เศรษฐกิจปรับตัวต่อภาวะที่เปลี่ยนแปลงได้ช้าลง ส่งผลต่อเนื่องไปยังประสิทธิภาพในการจัดสรรทรัพยากรทางเศรษฐกิจในที่สุด

อาจกล่าวโดยสรุปได้ว่า อัตราแลกเปลี่ยนอาจมีบทบาทเพิ่มเติมในการช่วยนโยบายการเงินในการผ่อนแรงกดดันต่อเงินเฟ้อได้ในบางกรณี ทั้งนี้ พบว่า นโยบายดังกล่าวจะมีประสิทธิผลในการดูแลความเสี่ยงที่มีลักษณะชั่วคราว (Temporary) หรือเป็นความเสี่ยงในระยะสั้นเป็นสำคัญ โดยประสิทธิผลของนโยบายอาจเพิ่มขึ้นหากเป็นการดูแลความเสี่ยงที่ส่งผลต่อราคาสินค้านำเข้าที่อัตราแลกเปลี่ยนมีผลโดยตรง ดังนั้น ในภาวะการณ์ปัจจุบัน อาจมีความเหมาะสมที่จะดูแลอัตราแลกเปลี่ยนไม่ให้อ่อนค่าเร็วจนเกินไปในช่วงสั้นๆ ซึ่งนอกจากจะช่วยบรรเทาแรงกดดันเงินเฟ้อจากราคานำเข้าที่สูงได้แล้ว ยังอาจช่วยดูแลเงินเฟ้อคาดการณ์ไม่ให้อ่อนไหวไปกับค่าเงินที่ปรับอ่อนค่าอย่างรวดเร็วได้อีกด้วย

Executive Summary

Under inflation targeting regime (IT), the policy interest rate is generally a single instrument to signal policy stance towards various economic variables, with an ultimate goal of price stability and sustainable economic growth. Recently, nonetheless, continued increases in the world prices of oil and other commodities, due to the leapfrog expansion of emerging economies in particular China and India, exerted upward pressure on global inflation. As the Thai economic recovery started to emerge from the slowdown during the last 2-3 years, the tightening monetary policy to take care of such exogenously-induced inflation might be an unpopular move on the economic recovery. Questions therefore arise on the roles of exchange rate whether the exchange rate management should be used to supplement the conventional policy rate in bringing down inflation.

To address the questions with a particular focus on Thailand, this paper will examine not only the conventional role of exchange rate as a channel of monetary policy transmission mechanism and its role as a shock absorber, but also the plausibility of an additional role in mitigating inflationary pressure. The primary technique used to analyze aforementioned issues will be a Small Structural Model, specifically tailored for the Thai economy to answer this particular policy question. Due to its small size, the special characteristic of the model is that it allows tractability and versatility to capture the relationship between the exchange rate and other macroeconomic variables. In conjunction with the model, other statistical and econometric techniques will be used for cross-checking purposes.

The analytical results indicate that, besides its conventional roles as a channel of transmission mechanism and a shock absorber under inflation targeting framework, the exchange rate could take on an additional role in alleviating inflationary pressure under certain circumstance, particularly when inflation is caused by temporary shocks. The reasons are as follows. First, the mechanism through which the policy rate is transmitted to consumer prices via the exchange rate channel is weak. Second, evidence from a Small Structural Model indicates that the use of exchange rate to complement the policy rate in curbing inflationary pressure reduces the volatility of inflation as well as the policy rate. And last, exchange rate management is effective in bringing down import prices which are currently the main driver of domestic inflation.

The use of exchange rate may thus be a good supplement to the interest rate policy under inflation targeting regime. However, preconditions and limitations on the use of exchange rate need to be accounted for, at the same time, specific circumstances under which such use may be effective should be noted. The degree of exchange rate controllability plays an important part in determining the efficacy of the use of exchange rate in monetary policy. With regard to the volatile nature of exchange rate, the ability of the authorities to manage exchange rate, i.e. the degree of controllability, is limited and prone to be effective only in the short-run. In the long-run exchange rate movements closely link to underlying economic fundamentals and difficult to be successfully tampered by authorities. In addition, the effectiveness of such policy essentially depends on its influence on inflation expectations.

The suitability for the use of exchange rate to supplement the policy rate in taking care of inflation also needs to be assessed. The central bank's ability to manipulate interest rate generally exceeds that of exchange rate. And despite the direct impact of foreign exchange intervention on price level, the sensitive nature of exchange rate results in its rather short-lived effect when compared to the effect of interest rate policy. The effort to prolong the effective impact of exchange rate to curb persistent inflationary pressure, on the other

hand, could lead to distortions in terms of resource allocation and delay the structural adjustment in the business sector.

Regarding aforementioned limitations, under inflation targeting, the policy interest rate should remain a major policy tool, while the use of exchange rate should only be supplementary and only applied to specific circumstances. This study finds intervention in the foreign exchange market effective only when carried out to curb the short-run or temporary shocks. Its efficacy could be amplified if the arising shocks pose impacts on import prices as exchange rate management can directly take charge. As a result, it might be suitable, under current situation, for the authority to dampen the speed of currency depreciation in the short-run so as to alleviate the impact from inflationary pressure mainly driven by hiking import prices. Such management could, in turn, help keep inflation expectations from being spurred by the accelerating depreciation.

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I. Introduction

In the wake of the currency crises in the late 1990s and early 2000s, increasing number of emerging market economies including Thailand have moved away from the fixed exchange rate regime to a more flexible exchange rate framework under inflation targeting regime (IT). Under IT, the policy interest rate is used as an explicit operating target to signal policy stance and maintain inflation within the target range, while exchange rate plays a lesser role. IT has served its purpose well in providing a nominal anchor during the low-inflation period until recently that the continued increases in the world oil and food prices exerted upward pressure on inflation. Such exogenously-induced inflationary pressure cast doubt on the efficacy of engineering interest rate to curb inflation under IT. Questions arose on the roles of exchange rate, including whether the exchange rate should have more role in supplementing the policy rate in containing such inflationary pressure.

On the theoretical front, mainstream literatures on IT do not appear to explicitly address the roles of exchange rate in the determination of the optimal monetary policy. For example, Bernanke *et al.* (1999) did not explicitly mention how exchange rate considerations should be integrated into the central bank's policy setting. A number of literatures factored in the exchange rate in the policy decision by incorporating the exchange rate into the reaction function of the policy interest rate. Taylor (2001) attempted to technically frame the relation between central bank policy rate and exchange rate by adding exchange rate terms to the traditional Taylor rule, nonetheless, he doubted the general merits of such modification since the exchange rate already had indirect impacts on output and inflation, and adding asset prices like exchange rate may destabilize monetary policy. Mishkin and Schmidt-Hebbel (2001) also pointed out that there should be no independent roles for exchange rate in monetary policy setting. Ball (1999), Obstfeld and Rogoff (1995) and Svensson (2000), however, proposed a dissimilar view. They argued that by integrating exchange rate into the Taylor rule, macroeconomic instability would be reduced.

In practice, however, the roles of exchange rate in monetary policy conduct are more observable than in theory. While the interest rate is typically presupposed to be a single instrument of monetary policy under IT, exchange rate seems to be an option available to monetary authority to attain price stability. The use of exchange rate in monetary policy in practice usually comes in the form of foreign exchange intervention. According to Hufner (2004), the empirical failure of the uncovered interest rate parity (UIP) made it natural for the central banks to carry out foreign exchange intervention in order to take direct charge on inflation. However, because central banks' ability to control their policy tool and trade offs between inflation and exchange rate volatility at acceptable costs were crucial when determining what would be employed as the central bank's operating target, the intrinsic worth of conducting monetary policy with direct regard to exchange rate was kept low. Furthermore, at analytical level, the issue on the explicit use of exchange rate under IT is likely to be country-specific – subject to the structural characteristics of that country. As reported by Carare and Stone (2002) as well as Stone (2002), some inflation targeting lite (ITL) countries such as Croatia and Romania used the exchange rate in combination with the interest rate as operating target while the sole use of exchange rate as operating target under IT was also found in Uruguay. Stone (2002) provided evidence on the foreign exchange intervention by some emerging market IT central banks for monetary policy purposes. For example, Bank of Slovenia intervened to offset the impact of exchange rate changes on prices and complement interest rate actions. Central Bank of Brazil used foreign exchange intervention to adhere to inflation target while Bank of Indonesia intervened to control base money and mitigate the depreciation pressure and exchange rate volatility. In the case of Thailand, the role of exchange rate in monetary policy is not explicit. Under the managed float regime, the Bank of Thailand intervenes occasionally to curb excessive volatility and extreme movements in exchange rate which may have detrimental effect on the economy.

This paper aims to address the roles of exchange rate in monetary policy under IT with a particular focus on Thailand, both the conventional roles as a channel of transmission mechanism and a shock absorber and the plausibility of an additional role in mitigating inflationary pressure. The primary technique used to analyze aforementioned issues will be a Small Model, specifically tailored for the Thai economy to answer this particular policy question. Earlier literature on the analysis of exchange rate is mainly DSGE-based [see for example, Bordo *et al.* (2007)], however, this paper chose a Small Model Approach for its advantages. A DSGE-type model is structural micro-founded, while a Small Model found the middle ground between theoretical and empirical basis. Also, due to its smaller size and less complex structure, a Small Model allows tractability and versatility. This paper will extend the analytical capability of the Small Model further to fulfill the objective of the analysis in addition to the analysis on the impact of shocks carried out by other Small Models previously constructed by the IMF staffs [see for example, Berg *et al.* (2006) and Aiyar and Tchakarov (2008)].

The paper is organized as follows. We begin by addressing conventional roles of exchange rate under inflation targeting regime in Chapter II. Next in Chapter III, we explore the circumstances where exchange rate might have a role under IT framework to complement conventional monetary policy tool in curbing inflation. Effectiveness of exchange rate as a channel of transmission mechanism is analyzed along with the degree of exchange rate pass-through to inflation and the UIP condition. In Chapter IV, the details on the construction of the Small Model will be outlined and the evidence on the roles of exchange rate will be explored by employing this specially-constructed Small Model. Chapter V arrives at the policy implications based on the evidence set out in the previous Chapters and examines the costs, the benefits, and the limitations of using exchange rate in monetary policy. Conclusions will then be drawn.

II. Conventional Roles of Exchange Rate under Inflation Targeting Framework

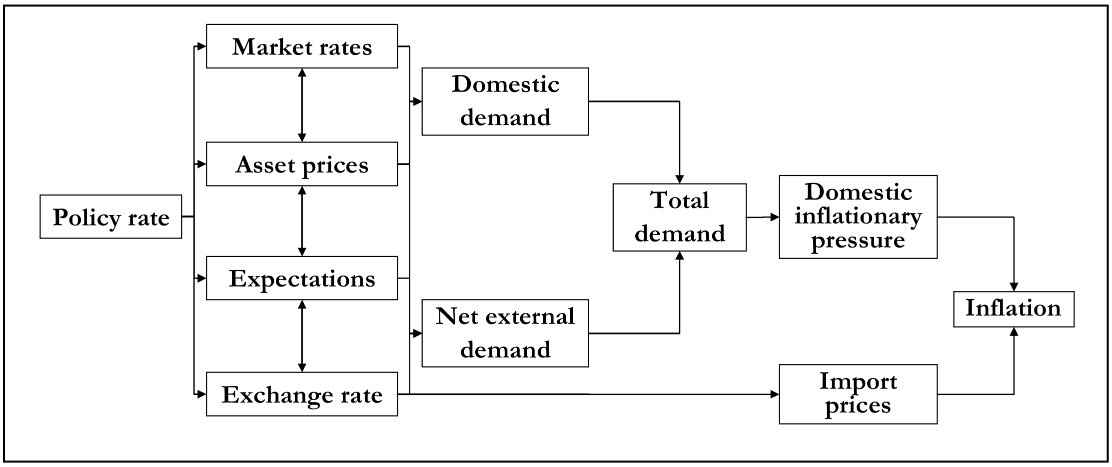
For a small open inflation–targeting economy like Thailand, exchange rate plays non-negligible roles. Conventionally, exchange rate is a channel of monetary policy transmission mechanism; moreover, it is also an effective shock absorber, which helps mitigating unfavorable impact of disturbances consequent of internal as well as external economic factors. However, the movement of exchange rate itself can also generate shocks to the economy, especially when such movements are not consistent with the underlying economic fundamentals.

2.1 A Channel of Transmission Mechanism

The monetary policy transmission mechanism is commonly known as the mechanism how policy-induced changes, either in the nominal money stock or the short-term nominal interest rate, can affect economic activities and inflation through various channels. Mishkin (1996) provided an overview and explanations for different but interlinked channels through which monetary policy actions influence the real economic variables such as aggregate output and employment. These are the traditional interest rate channel, the credit channel, and the channels operating through key asset prices such as the exchange rate and equity prices. The emphasis would be placed on the exchange rate channel in this paper.

The exchange rate is a part of the transmission mechanism in two main ways. First, it affects aggregate demand through net exports. Second, it affects inflation directly through the pass-through effect. In theory, the exchange rate channel is connected to the effect of policy-induced changes in interest rates through the Uncovered Interest Parity (UIP) condition, whereby interest differentials between domestic and foreign economies largely account for subsequent changes in exchange rates. Since changes in the exchange rate brings about changes in the relative prices between domestically produced goods and services and foreign-produced ones with some time lag, a depreciation of the home currency makes domestic products cheaper relative to foreign products, therefore boosting the net exports. As a result, the country's aggregate output and employment expand.

Figure 2.1: Transmission of Monetary Policy to Inflation



Besides the indirect channel via domestic demand growth, inflation can be induced by changes in the exchange rate according to the so-called pass-through effect. Exchange rate depreciation would directly have an impact on consumer prices by raising costs of imported goods – either final products or raw materials. The latter, incurring directly to domestic producers as reflected in the rising producer price index (PPI), would finally be passed on to consumers and drives up the consumer prices measured by the consumer price index (CPI).

Exchange rate pass-through into the producer price is likely larger than the consumer price. Pinto (2007) estimated the pass-through effects on consumer prices and producer prices in eight countries, comprising three developed economies and five emerging economies. Difference in the composition of the two indices[1] is one explanation for unequal pass-through effect on PPI and CPI (Bailliu and Fujii, 2004). Furthermore, because market participants acknowledge that inflation targeting central banks usually targeted and credibly reacted to curb CPI inflation rather than PPI inflation, producers might be refrained from passing on the rising cost to consumer prices.

The degree of pass-through from exchange rate to inflation also varies from country to country. Many studies, including those of Calvo and Reinhart (2000), Goldfajn and Werlang (2000), and Schmidt-Hebbel and Tapia (2002), have shown that exchange rate pass-through into price level is considerably higher for emerging than developed economies. Borensztein and De Gregorio (1999) presented similar results, and added that the degree of pass-through tends to be large in countries experiencing currency crises. However, empirical findings from Pinto (2007) supported the higher pass-through in developing economies only for the case of consumer prices but not the producer prices.

It was commonly observed that the pass-through from exchange rate changes to inflation was incomplete and declining. Low pass-through effect could result from the low inflation environment and credibility gained from monetary policy. Amitrano *et al.* (1997), Choudhri and Hakura (2001), Taylor (2000), Baqueiro *et al.* (2003), Gagnon and Ihrig (2004), and Bailliu and Fujii (2004) viewed that when the country's inflation was kept low, the pass-through would be low as well. Empirical evidences have been provided for the case of developed economies [Bailliu and Fujii (2004), Bouakez and Rebei (2005), Campa and Goldberg (2005), and Gagon and Ihrig (2004)], as well as for emerging economies [Manella *et al.* (2003), Ca'Zorzi *et al.* (2006), and Choudhri and Hakura (2006)]. Laiderman and Bar-Or (2000), Mishkin and Savastano (2001), Eichengteen (2002), and Schmidt-Hebbel and Werner (2002) proposed that credibility gains from the adoption of IT was responsible for keeping low inflation expectations following depreciation of the domestic currency. Study by Pinto (2007) showed that the pass-through from exchange rate movements to both CPI and PPI decreased after the adoption of IT in eight countries[2]. Chile was also found to share a similar experience [Edwards (2006), and De Gregorio and Tokman (2005)].

[1] The producer price basket is full with tradable goods, while consumer price basket includes both tradable and non-tradable goods.
[2] The sample consists of three developed countries (Canada, Sweden, and United Kingdom) and five emerging economies (Brazil, Mexico, South Korea, South Africa, and Czech Republic).

2.2 A Shock Absorber or Automatic Stabilizer

A small open economy like Thailand inevitably experiences shocks every now and then. These shocks could be of real or nominal nature, and their sources could range from commodity and capital markets abroad to domestic weather conditions. How well an economy responds to shocks depends very much on the nature of the shocks and the structure of the economy as well as its policy settings. To this end, the exchange rate might play an important role.

In the modern economies where the degree of trade and financial openness are continually increasing, the flexible exchange rate is believed to be an effective absorber of the unfavorable consequences of idiosyncratic shocks and real shocks such as terms of trade[3] shocks, productivity shocks, and real interest rate shocks. This chief advantage of the flexible-rate regime over fixed-rate regime gained early support by Friedman (1953). The logic is as follows. When the real external shocks hit an economy and subsequently forces the equilibrium real exchange rate to change (Obstfeld and Rogoff, 1995), under a flexible-rate regime, the nominal exchange rate would automatically adjust so that domestic nominal prices and wages are kept unaffected. Here, much of the impact on economic activities such as the swings in output is alleviated. The country is, therefore, shielded from the costly adjustment processes. The benefit becomes particularly more apparent in a country with the presence of wage rigidity (Meade, 1951).

The common external shocks for emerging economies are those that affect the prices of a country's exports and imports, i.e. the terms of trade shocks. With flexible exchange rate setting, their undesirable consequences are mitigated. For instance, we consider the case of terms of trade shock due to a universal fall in world price of goods that are main exports of a country. The deterioration in the terms of trade negatively affects the exporting country by reducing its income, economic activities as well as employment in the export sector. However, if the sudden drop in export prices is offset by domestic currency depreciation, home products will become more competitive in the world market. The initial falling demand for a country's exports due to an adverse impact of the terms of trade shock will then be restored through the effect of the weakening home currency. Movements of nominal exchange rate therefore help stabilize the country's output growth, income and employment level. On the contrary, under the fixed-rate regime, the country will have to adjust to a terms of trade disturbances through a contraction in output.

Previous works provide evidences regarding this role of exchange rate. Clarida and Gali (1994) used a structural VAR model with a set of long-run zero restrictions to decompose the real exchange rate series into three components – supply, demand and monetary shocks. They found demand shocks as a major cause of the real exchange rate fluctuations and that the exchange rate acts as a shock absorber. Broda (2001) and Edwards and Yeyati (2003) empirically investigated the effects of the terms of trade shocks on economic performance under the two polar of exchange rate regimes. They similarly reported that the terms of trade shocks have a smaller effect on growth in countries with a flexible exchange rate regime. Broda (2001) also pointed out that by letting nominal exchange rate depreciate when hit by negative shocks, the floating-rate regime yielded smoother real output paths relative to the fixed exchange rate.

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[3] Terms of trade is defined as the price of exports relative to the price of imports.

As mentioned above, the nature of the shocks hitting an economy also determines how well a country with flexible or fixed exchange rate responds to shocks. Whilst the floating exchange rate regime is better suited in coping with real shocks, the fixed exchange rate regime is superior in the case of nominal shocks (Parrado, 2004). Given a monetary shock which induces inflation, the adjustment process under the fixed-rate regime would be through changes in money supply or demand in a manner that leaves output unchanged. In contrast, under the floating-rate setting, domestic inflation driven by monetary shocks would cause the exchange rate to change and the nominal shocks will then be transmitted to the real economy. In countries where the private and public sectors have large foreign currency-denominated liabilities, flexible exchange rates might not effectively work (Eichengreen and Hausmann 1999) and possibly be an amplifier of shocks. When a country is negatively hit by the terms of trade shocks, its currency would be weakened. Such depreciation increases the value of the private and public debts in domestic currency terms. According to Calvo (2000), the sudden impact could make private institutions go bankrupt and the public sector become insolvent.

Globalization has probably made the link between monetary policy actions and economic outcomes more uncertain and exposed an individual country to external shocks. Given these, the flexible exchange rates might be workable as a shock absorber, particularly in the case of real shocks, than the fixed exchange rate. It is then unsurprising to observe the recent trend towards a more flexible exchange rate regime.

2.3 A Source of Shocks

Exchange rate may be considered an asset price commonly known for its randomness and uncertain response with regard to policies. While the movement in exchange rate can act as an absorber for real shocks as cited in the previous section, the movement of exchange rate beyond its underlying economic fundamentals can adversely affect the economy and is hereby viewed as an independent source of shocks.

Generally observed, exchange rate is an erratic financial variable, which takes extreme values from time to time. The causes of this behavior could be the domestic policy deficiency or changes in fundamental factors such as the terms of trade. Furthermore, movements in the exchange rate can also result from expectations and accidental accumulation of information that is intrinsically difficult to interpret. Whilst the former drives the exchange rate to overshoot in the medium term, i.e. move beyond the extent warranted by underlying economic conditions, the latter leads to a short-term overreaction. Clearly, disturbances in exchange rate market itself can cause a sharp increase in exchange rate volatilities.

Several studies provided evidences for exchange rate shocks. Canzoneri et al. (1996) tested the stabilizing role of exchange rate in a number of European countries between 1970 and 1985. They cautiously concluded that '…the exchange rate seems to be acting more like an asset price rather than the shock absorber described by the literature on optimal currency areas…'. A study of Artis and Ehrmann (2000) reached the same conclusion. Exchange rate appeared to mostly reflect shocks originating in the exchange market itself for the UK, Sweden, Denmark, and to a less extent in Canada. In Sweden, about 90 percents of the variance of the exchange rate was explained by the exchange rate shocks[4]. Cobham (2002) set out the criteria used to identify large exchange rate changes and misalignments for the UK during 1979 and 2002. In nearly every phase movements of the exchange rate were unexpected and undesired, and were in that sense regarded as extraneous shocks to the UK monetary authority. Only few cases that exchange rate movements were seen as a useful automatic equilibrating or policy transmitting instruments.

Provided that exchange rate movements tend to follow a stochastic process and generate shocks to an economy, monetary authority typically will not completely hand off its exchange rate policy. To prevent detrimental effect on growth and employment resulting from the exchange rate shocks, inflation targeting central bank is legitimated to step in, either indirectly via interest rate – by taking exchange rate developments explicitly into account in the policy reaction function or directly through foreign exchange intervention as mentioned in the previous Chapter. Especially when movements of the exchange rate are driven by psychological factors, the scope of intervention may expand to influence expectation. Dominguez and Frankel (1993), Bofinger and Wollmershauser (2001), and Mishkin and Schmidt-Hebbel (2001) agreed upon carrying out foreign exchange intervention should the need arise. Emphasizing on the empirical failure of the UIP condition, Hufner (2004) saw foreign exchange intervention as an ordinary tool used by central banks to manage exchange rates. As long as foreign exchange intervention was not set out to achieve a particular level of exchange rate and carried out with finesse, it could play a useful role under an inflation targeting framework in containing the adverse effects of temporary exchange rate shocks on inflation and financial stability.

The theoretical roles of exchange rate under inflation targeting regime are essential to the overall economic stability. However, the conduct of foreign exchange intervention leaves open another major option for inflation targeting countries to take exchange rate as a supplement to the traditional tool, namely interest rate, in achieving target objectives. The following section will thoroughly investigate, in the case of Thailand, the plausibility of the direct management of exchange rate as the new avenue in inflation targeting conduct.

[4] Nevertheless, they pointed out that exchange rate shock does not transmit major disturbances to the price level or the real economy.

III. An Additional Role of Exchange Rate in Alleviating Inflationary Pressure

Under the circumstances where countries are faced with inflationary threats that could jeopardize the long-term sustainable growth, since the movements in exchange rates can directly affect inflation and output in theory, questions arose whether there might be a direct role of exchange rate in mitigating inflationary pressure.

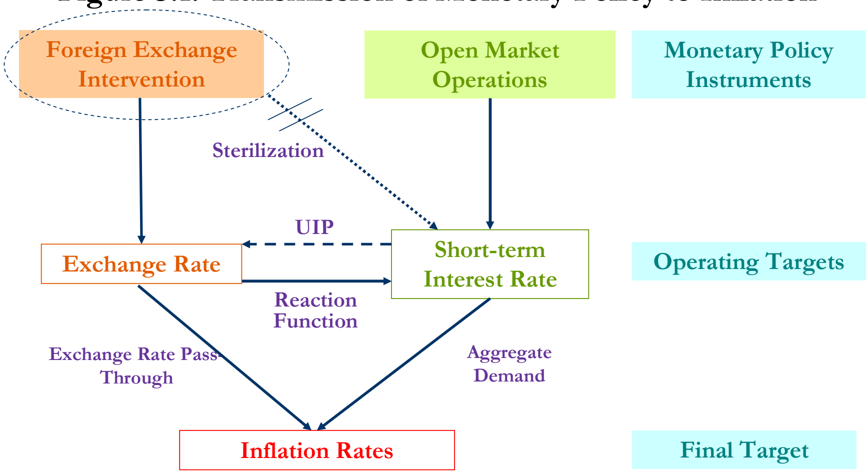
Hufner (2004) suggested the motivation behind the use of exchange rate in alleviating inflationary pressure was that the inflation targeting regime was foremost characterized by the lack of an explicit intermediate target. He argued that the exchange rate was considered a potential variable particularly in a small-open economy where exchange rate pass-through to inflation occurred faster than the effects of interest rate changes on inflation. To evaluate the preconditions set by Hufner, this section will therefore investigate the exchange rate for its efficacy in transmitting the policy rate to price level and draw conclusion on whether there is a case for exchange rate to directly mitigate inflationary pressure.

Effectiveness of exchange rate as a monetary policy transmission channel: The Building Block Approach

To affirm the results and lay ground for the analysis based on the Small Model in the forthcoming section, this part of the paper will use the conventional approaches in assessing the effectiveness of the exchange rate as a monetary policy transmission channel to inflation. The aims are first to evaluate the performance of the exchange rate channel as an existing avenue to contain inflation in order to make a case whether exchange rate is better managed as compared to being the intermediary for interest rate in affecting inflation and, second to check for consistency with results produced by the Small Model.

In evaluating the efficacy of the exchange rate as a transmission channel, the entire mechanism can be segmented into two major building blocks: the ability of changes in the policy rate to influence exchange rate changes and the degree of pass-through of exchange rate changes to price inflation.[5] (The mechanism is presented in Figure 3.1)

Figure 3.1: Transmission of Monetary Policy to Inflation



Source: Hufner (2004)

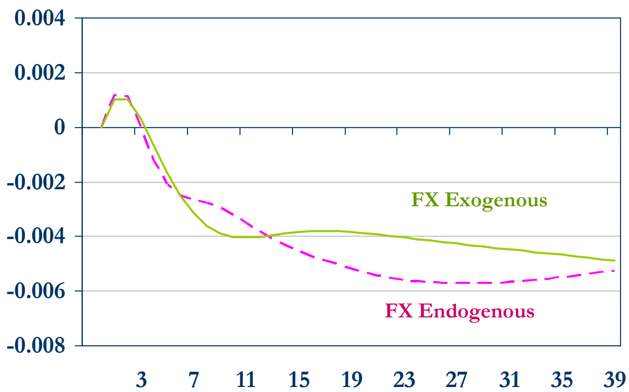
[5] The indirect channel from exchange rate changes to inflation via exports and aggregate demand is assumed to be marginal (as there should be lag effects) and will not be assessed.

3.1 Evaluating Overall Transmission Mechanism: VAR Approach

Prior to the evaluation for each building block, the overall ability of exchange rate as a transmission channel is evaluated using a parsimonious test following the work of Disyatat and Vongsinsirikul (2002) using Vector Autoregressive (VAR) technique. The approach investigates the relationship between each variable's dynamics in the system without imposing any causal directions on any particular variable pairs. It is performed twice with the adjustment on the exogeneity of exchange rate to shut out the exchange rate channel. The impulse responses that express the reaction of a particular variable when there is a shock to the other variables from the two estimations (with and without exchange rate channel) are then compared.

The baseline system includes the real GDP, CPI (both in log terms) and the policy rate (14-day repurchase rate until 2007 Q1 and 1-day repurchase rate from then on). The recursive ordering follows Disyatat and Vongsinsirikul (2002) that the real GDP is not affected contemporaneously while the policy rate responds to the innovations in GDP and CPI. The optimal lag is 2 as suggested by the Akaike Information Criterion and the Likelihood Ratio Test. To test the exchange rate as a channel of transmission, the first system runs the baseline model with exchange rate (THB/USD in log term[6]) as an exogenous variable, implying exchange rate movement does contribute to the movements of other variables in the system but not vice versa. The Asian Crisis dummy from 1997 Q2 to 1998 Q4 is also incorporated exogenously to account for extreme conditions that might contaminate the dynamics of the model.[7] As a result, the channel through which the exchange rate can help transmit the impact of the policy rate onto other variables is blocked off. The impulse response is then compared with the system, which endogenizes exchange rate as a channel of monetary policy transmission.

Figure 3.2: VARs Result: Impulse Response of Price Level to One Standard Deviation Innovations in Policy Rates



Note: The VAR system is estimated in the baseline case with the real GDP, CPI (both in log term) and the policy rate as endogenous variables and the Asian Crisis dummy and the exchange rate in terms of THB/USD as exogenous variables. The effectiveness of the FX channel is tested by treating exchange rate as an endogenous variable in the model. The optimal lag is 2.

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[6] The Nominal Effective Exchange Rate (NEER) is also used and the results are similar.

[7] It is also proven to help mitigate the 'Price Puzzle' found in various works as the root cause of the price puzzle may only lie on the insufficient reaction of interest rate to large shocks in the economy (Balke and Emery, 1994).

The impulse responses of price levels to one standard deviation shocks in the policy rate (around 1.3 percent), shown in Figure 3.2 reveals only a slight difference between the two cases.[8] This, therefore, implies the low ability of the policy rate to be transmitted to inflation via the exchange rate channel.

Meanwhile this relatively low effectiveness of the exchange rate as a transmission channel can be driven by either one of the building blocks aforementioned (or even the indirect effect via aggregate demand). To further scrutinize this issue, the two building blocks need to be tested separately.

3.2 Block I: Uncovered Interest Parity

On the theoretical front, the Uncovered Interest Parity (UIP) condition is the basis upon which the impact of interest rate changes on exchange rate is analyzed. An unexpected fall in the central bank's policy rate affects market interest rates such as bank deposit rates, and instantaneously leads to the depreciation of the domestic currency. This is due to the fact that lower domestic interest rates, relative to interest rates on comparable assets denominated in foreign currency, renders domestic assets less attractive. To ensure that investors are indifferent between holding domestic and foreign-currency assets, it requires the domestic currency to depreciate to a level that equalizes the risk-adjusted returns on assets denominated in each of the two currencies. The basic UIP equation can be written as:

$$s^e_{t+k} - s_t = (i_{t,k} - i^*_{t,k}) \qquad 3.2.1$$

Where s_t is the nominal exchange rate expressed in terms of local currencies per unit of foreign currency in terms of local currency, s^e_{t+k} is expected exchange rate k periods from now (all exchange rates are in natural logarithmic term), $i_{t,k}$ and $i^*_{t,k}$ are the k-period yield on domestic and foreign assets respectively.

Since the basic UIP involves market expectations of future exchange rate, the estimation has to be modified. Following the methodology used by Pongsaparn (2007) to get around such limitations by assuming that the forward rate observed in the market can be rewritten as the expected exchange rate and risk premium.

$$f_{t+k} = s^e_{t+k} + \eta_{t,t+k} \qquad 3.2.2$$

For f_{t+k} is the forward value of exchange rate in a contract expiring at time t+k and $\eta_{t,t+k}$ is the risk premium. If rational expectation is assumed,

$$s^e_{t,t+k} = s_{t+k} + \varepsilon_{t,t+k} \qquad 3.2.3$$

We therefore have

$$\Delta s_{t,t+k} = (i_{t,k} - i^*_{t,k}) + \eta_{t,t+k} + \varepsilon_{t,t+k} \qquad 3.2.4$$

---

[8] Only impulse responses of price levels are shown as the analysis focuses on the transmission mechanism of the exchange rate channel on curbing inflation. The impulse responses for other variables are available upon request.

The equation used to test for the validity of the UIP condition is as follows:

$$\Delta s_{t,t+k} = \alpha + \beta(i_{t,k} - i^*_{t,k}) + \varepsilon_{t,t+k} \qquad 3.2.5$$

The test on the validity of the UIP condition for Thailand provides an important implication on the conduct of monetary policy. The rejection of the UIP could suggest that the policy rate may not be well-transmitted to the exchange rate as intended by the authority and hence weaken the impact of the policy towards the main targets. This allows the possibility to directly manage exchange rate to achieve policy objectives under inflation targeting.

The survey on the UIP literatures by Andrew *et al.* (2004) suggested that many possible approaches have been explored. Most have found the UIP condition to be violated especially during short-horizon[9] with β to be uniformly less than unity with the average of -0.88 [Fama (1984) and Froot and Thaler (1990)]. Similar results were cited in surveys by MacDonald and Taylor (1992) and Isard (1995), among others. More recent survey reported a larger-size coefficient (-3 to -4) [See McCallum (1994) and Engle (1996)]. The negative coefficient may explain the recent development in financial market instruments and risk tolerance of investors. Carry trade behavior is a universal example that profits can be made by betting against the UIP. Investors borrow in the low-yield currency such as the Japanese Yen to invest the high-yield currency such as the Australian Dollar to gain higher interest as well as currency returns. This causes the subsequent depreciation in the Japanese Yen and appreciation in the Australian Dollar rather than the reverse as suggested by the UIP.

Despite the short-run failure, evidence on a longer-maturity revealed better performance of the UIP. Chinn and Meredith (2001) found the estimate of β closer to one when longer-term bonds and longer-horizon of exchange rate changes were used. Another approach to verify the validity of the UIP over a longer horizon is by using the co-integration technique focusing on the long-run relationships in the equation. The test relied on the relationship between the spot and forward rates (Zivot, 2000) as well as between interest rate term structures (Georgoutsos and Kouretas, 2001) both of which implied the validity of the UIP.

In the case of Thailand, Pongsaparn (2007) performed the test on the UIP relationship bilaterally between Thailand and major partners. She found little evidence in support of the UIP.

The paper also performs a similar test with a slightly different approach. We only select the bilateral relationship between the Thai baht and the US dollar and perform a test on three different types of interest rates – policy rates, 3-month and 1-year government bond yield – since the policy rate can be quite rigid. The Fed Funds rate and the US government bond yields are obtained from the Federal Reserves Statistical Database. The policy rate will be tested at an annual maturity regardless of the actual maturity of one day as the derivation of daily frequency from the monthly data could be inappropriate. The 3-month bond yields are also transformed to account for the holding period of 3 months by the simple equation, $i_{t,t+3} = (1 + yield_t^{3mo})^{1/4} - 1$.

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[9] Chaboud and Wright, 2003 have found that the UIP condition can be satisfied in a very short run (5 minutes interval).

For the test of the strong form UIP ([α,β] = [0,1]), the risk premium is assumed away which is a rather strong assumption. Alternatively, equation 3.2.5 is tested assuming the risk premium (α) is constant, i.e. the weak form of UIP is valid. To support the weak form, the following conditions must be satisfied (Pongsaparn, 2007).

- The hypothesis of β = 1 is not rejected.
- The hypothesis of β = 0 is rejected to ensure the significant influence of interest rate differentials on exchange rate changes.
- The relationship must not be spurious so the ADF test on the residuals must be rejected.

The estimated results are reported in Table 3.1. The UIP validity is rejected, even the weak form, in all cases which are consistent with the literature using the same yield horizon. However, the estimated coefficients are positive and hence imply no evidence on the carry-trade-type transactions between the two countries. The statistically significant value of β coefficients in the case of policy rates and 1-year government bond do not imply meaningful impact of interest rates on exchange rate changes as the test on error terms indicates that the relationships are unstable.

Table 3.1: Test of the UIP Conditions on the Thai Baht against the US dollar

	α	β	F(β=1)	F(β=0)	ADF test on ε	Adjusted R^2
Policy Rate	5.121 (0.000)	2.417 (0.000)	4.729 (0.032)	**13.751 (0.000)**	(0.192)	0.390
3-month Government Bond	1.202 (0.013)	2.662 (0.651)	**0.080 (0.778)**	0.206 (0.651)	(0.000)	0.004
1-year Government Bond	5.025 (0.000)	3.925 (0.001)	9.249 (0.003)	**23.134 (0.000)**	(0.147)	0.422

Note: The estimation using the OLS technique adjusted for the Newey-West standard errors. (GMM estimation can also be used as in Chinn and Meredith (2004). However, the monthly frequency has less overlapping sample with the estimating horizon, therefore, the simple OLS should yield similar results). The data is at monthly frequency starting from 2000M1 to 2008M6 with changes in THB/USD exchange rate over the testing horizon as a dependent variable. The 3-month bond yield is adjusted for the holding period of 3 months. The significance levels are reported in parenthesis.

The explanations on the invalidity of the UIP for Thailand lies in the similar fields as suggested in the literatures. It ranges from the existence of the time-varying risk premium, imperfect capital mobility across borders, the peso problems, to the variable risk perception of international investors. The failure of the UIP implies the weak link on the first building block of the transmission channel. The result tends to make the case for the direct exchange rate management or 'intervention' in order to effectively pass-through the optimal policy to keep the inflation and growth in check. In addition, Isard (2006)'s finding that the exchange rate intervention is effective given the failure of the UIP relationship should add more support to the direct use of exchange rate policy.

3.3 Block II: Degree of Exchange Rate Pass-through

As Hufner (2004) mentioned, to ensure that the use of exchange rate policy is effective in containing inflationary pressure, the degree of pass-through of exchange rate to inflation is the key requirement. The process operates directly through the effect of exchange rate movements on prices, and indirectly via the impact of exchange rate movement on aggregate demand, which then affect prices (Stone *et al.*, 2008).

The traditional theory behind this test lies in the simplified assumption based on the validity of Purchasing Power Parity (PPP) that prices of tradable goods expressed in the same currency are equalized across countries. However, empirical evidence (in the previous section) revealed otherwise that the exchange rate pass-through is incomplete in most cases. Studies by Ca' Zorzi *et al.* (2007), Sahminan (2002), McCarthy (2000) and Choudhri and Hakura (2006) suggested that the degree of exchange rate pass-through in developing countries is higher than that of the more developed ones.

In terms of methodology, various approaches have been explored in estimating degree of exchange rate pass-through to import prices as well as to domestic consumer price index. The approaches include the parsimonious VAR (Ca' Zorzi *et al.*, (2007)) to investigate the dynamic and responses of prices to exchange rate, single equation Error Correction Model (Choudhri and Hakura, 2006 and Mihaljek *et al.*, 2000) as well as the Error Correction Model as a system (VECM) based on the long-run relationship of PPP that might help explain the short-run variation in price changes in response to exchange rate changes (Sahminan, 2002).

The estimation of the pass-through effect in this paper relies on the VECM[10] technique used in Sahminan (2002) based on the PPP assumption. As the single equation can only provide one long-run linear relationship in the variable space, using the VECM estimation should yield the best-selected linear relationship for the estimated system (Scott, 1995). The model is modified from the original PPP-based as suggested in Hooper and Mann (1989) and Campa and Goldberg (2002) such that exchange rate changes are assume to be transmitted to changes in CPI via import prices rather than estimating the impact on import prices directly. This modification is tailored to fit the objective of monetary policy effectiveness as domestic price condition is our final goals. To explain the dynamics of the price levels, the modified model includes price measurements (CPI or CPI of imported goods) as the variable of interest; the Dubai oil price index and manufacturing production index (MPI) to account for supply and demand conditions that can pose impact on the price dynamics; exchange rate as our 'controlled' variable; and producer price index (PPI) to proxy domestic costs (only with the system with CPI) and import prices in dollar term to represent the cost in foreign countries.

According to Sekine (2006), exchange rate pass-through can be divided into impacts of exchange rate fluctuations to import prices, called 'first-stage pass-through' and those of import price movements to consumer prices, or 'second-stage pass-

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[10] A Vector Error Correction model (VECM) is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. The VEC has co-integration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. The co-integration term is known as the *error correction* term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. (EViews)

through'. The estimation will indirectly analyze the effectiveness of both stages of pass-through from the comparison between the degree of pass-through from exchange rates to the conventional domestic CPI and that in the case of consumer import CPI. The difference in ability to pass-through exchange rate changes to these price measures should help shed some light on the effectiveness of each stage of pass-through.

Estimation and Empirical Results

The system of equations selected variables that should help explain the dynamics of the price levels in Thailand. The Dubai oil price is used to account for the external supply shocks, and the MPI represents supply and demand conditions of the economy. The import price in dollar terms approximate foreign prices and PPI reflects domestic production costs.

The data for the estimation is at monthly frequency starting from 2000 M1 until 2008 M6. (to avoid the structural break on the series between 1997 M7 – 1999 M12) The CPI and PPI are obtained from the Ministry of Commerce and the seasonalized series will be used. The Dubai oil price is obtained from Bloomberg and transformed to an index for scaling purposes. Spot exchange rate is the reference rate published by the BOT and the import price index is also obtained from the BOT website. All series enter the model in natural logarithmic form. The CPI of imported goods is constructed by taking items that are likely to be imported or contain a significant share of imported components from the basket for the index composition. The share of these imported items accounts for 33 and 27 percents of the total weight in the headline and core CPI basket respectively.

The recursive ordering is imposed to the system with oil price to be the least contemporaneous with other variables. The next least contemporaneous is the foreign price levels which may only subject to the price of oil or other commodities. MPI is assumed to be affected by the external production cost while exchange rate is assumed to be contemporaneously correlated with variables above. Finally, domestic production costs should simultaneously move with variables earlier mentioned. As a result, the ordering ranges from oil price, imported price, MPI, exchange rate, domestic cost (only in the system with CPI).

From the choice of variables and ordering, the long-run price equation of our interest (from the entire system) is represented as

$$P_t = \beta_0 + \beta_1 oil_t + \beta_2 Pm_t + \beta_3 mpi_t + \beta_4 e_t + \beta_5 c_t \qquad 3.3.1$$

where β is the co-integrating vector, P_t is the seasonalized consumer price index (to be interchanged with consumer price index based on import prices), oil_t is the Dubai oil price index constructed by the authors from the Dubai oil price, Pm_t is the import price in US dollar term, mpi_t is the manufacturing production index, e_t is the exchange rate in terms of Thai baht per US dollar and c_t is the cost of domestic producers proxied by producer price index (only for the CPI equation).

Given the co-integrating long-run relationship above, the short-run dynamics of the model can be captured by an error correction representation of the form:

$$\Delta P_t = \alpha_0 + \alpha_1 (ECM_{t-1}) + \sum_{i=1}^{p} \gamma_{1i} P_{t-i} + \sum_{i=1}^{p} \gamma_{2i} \Delta oil_{t-i} + \sum_{i=1}^{p} \gamma_{3i} \Delta Pm_{t-i}$$
$$+ \sum_{i=1}^{p} \gamma_{4i} \Delta mpi_{t-i} + \sum_{i=1}^{p} \gamma_{5i} \Delta e_{t-i} + \sum_{i=1}^{p} \gamma_{6i} \Delta c_{t-i} \qquad 3.3.2$$

where $ECM_t = P_t - \beta_0 - \beta_1 oil_t - \beta_2 Pm_t - \beta_3 mpi_t - \beta_4 e_t - \beta_5 c_t$.

Before the estimation, the unit root tests are performed to verify that all series are non-stationary for the use of the co-integration techniques. Results reveal that we cannot reject the null hypothesis of unit roots for all variables. Test statistics are reported in Table 3.2.

Table 3.2: Unit Root Tests on Variables in the VECM

Variable	t-statistics	5% Critical Value
CPI	3.2307	-2.8900
CPI of imported items	0.7486	-2.8912
Dubai	0.7947	-2.8903
Imported prices	-2.3648	-2.8906
MPI	0.1449	-2.8903
Exchange rate (THB/USD)	-0.7834	-2.8900
PPI	2.3120	-2.8906

Note: The Augmented Dickey Fuller test is performed. The optimal lags for the test are selected by the Schwarz Information Criterion (SIC).

Results from the unit root tests allow for the possibility that the variables in the system are co-integrated. The test for co-integrations employs Johansen (1995)'s procedure. The lag length for the test is selected using the Akaike Information Criterion to be of 2 both systems. Results from the co-integration test are presented in Table 3.3.

Table 3.3: Co-integration Test Results

	Eigenvalue	Trace Statistics	5% Critical Values	Significance Level	Null Hypothesis
CPI	*0.304*	*109.081*	*95.754*	*0.004*	*r = 0**
	0.256	*73.513*	*69.819*	*0.025*	*r = 1**
	0.208	44.486	47.856	0.100	r = 2
	0.121	21.616	29.797	0.320	r = 3
	0.077	8.965	15.495	0.369	r = 4
CPI of import items	*0.271*	*78.688*	*69.819*	*0.008*	*r = 0**
	0.219	*47.999*	*47.856*	*0.049*	*r = 1**
	0.174	24.019	29.797	0.200	r = 2
	0.040	5.432	15.495	0.761	r = 3
	0.015	1.470	3.841	0.225	r = 4

Note: The co-integration tests employ Johansen's procedure (1995). The lag length is suggested by AIC of 2 lags for both systems. The test suggests there are two co-integrating vectors for each of those systems.

From the co-integration test, the long-run equilibrium relationship among the variables can be obtained. By normalizing co-integrating vectors with respect to the price measures, the equations can be written as follows:

For the conventional CPI,

$$CPI_t = 0.692 + 0.040oil_t + 0.822Pm_t + 0.084mpi_t + 0.206e_t - 0.224c_t$$
$$\qquad (1.679) \qquad (5.024) \qquad (2.080) \qquad (3.710) \qquad (1.319)$$

with error correction term of

$$CPI - CPI^* = -0.130$$
$$(-4.394)$$

For the CPI for imported items,

$$CPI\_M_t = -0.090 + 0.490oil_t - 0.125Pm_t - 0.225mpi_t + 1.057e_t$$
$$\qquad (4.028) \qquad (-0.186) \qquad (-1.406) \qquad (3.992)$$

with error correction term of

$$CPI\_M - CPI\_M^* = -0.003$$
$$(-0.200)$$

Note: t-value in parenthesis

The estimates from co-integration test report significant long-run impact of exchange rate on price measures and all the statistically significant coefficients have correct signs.[11] The result further implies that, in the long-run, exchange rate pass-through to domestic price (measured by the CPI) is incomplete while the degree of pass-through to price of consumer imports is much higher. However, the error correction terms reflecting the speed of adjustment towards the equilibrium in long-run for the import CPI is rather low. Such result might be explained by the high volatility of the series during the period of hikes in oil price, by which reflecting the longer time needed for the price to revert back to its equilibrium.

By imposing the co-integrating relationship to the systems for short-run dynamics, the responses of prices to exchange rate shocks can be obtained. The 1-year average response of CPI inflation when exchange rate moves by 1 percent is 0.13 percent while the 1-year average response of CPI for imported items stages at a higher rate of 0.20 percent.[12]

The higher magnitude of exchange rate impact on import-oriented inflation compared to the conventional CPI reflects significant higher degree of pass-through to domestic consumer. The interpretation of this result is two-folds. First, it has indirectly proven that the first-stage pass-through to import price could be more effective than the second-stage. One of the major root causes, especially in the case of emerging markets, is the significant fraction of administrative prices in consumer basket that could nullify impact of exchange rate movements on the price-setting behavior. In addition,

[11] The coefficient for producers' cost has the wrong sign for both cases which are consistent with the previous study of Sahminan (2002) for Thailand.

[12] Literatures also suggest the evidence of time-varying pass-through that the degree of exchange rate pass-through has declined over time due to the low and stable inflation environment, increasing competition and degree of openness. (Sekine (2006), and Amstad and Fischer (2006)) This paper, however, leaves out the issue as the structure of the VECM requires samples over long horizon.

aggressive domestic market competition as well as the world competition owing to the country's openness can also contribute to the sluggish transmission from import prices to domestic inflation. Second, the higher sensitivity of import price to exchange rate suggests that if exchange rate policy were to be used in curbing inflationary pressure, the efficacy would have been enhanced in the case of inflation that was transmitted through import prices. The internally driven inflation, therefore, should be alleviated by the use of conventional interest rate policy.

The significant degree of exchange rate pass-through to inflation in Thailand suggests that this building block of the transmission mechanism is effective. However, the weak performance of the UIP proven in the previous section implies that the monetary policy transmission may not be fully effective. The argument for the direct exchange rate management to curb inflationary pressure is therefore well supported at this point.

Setting the circumstances and controllability on exchange rate aside, this Chapter points out that exchange rate management to achieve price stability may be a valid option to the authority. However, the interaction between exchange rate changes and other economic variables is yet to prove that there is the total net benefit to the overall economy from such policy. The next Chapter constructs a Small Model to assess the roles of exchange rate and how exchange rate management to cope with inflationary pressure performs and interacts with the entire system.

IV. Evidence on the Roles of Exchange Rate: a Small Model Approach

In the previous Chapters, the roles of exchange rate were examined in light of existing theoretical and empirical investigations to set stage for further analyses. This Chapter employs a Small Model as an analytical tool to investigate the roles of exchange rate with a particular focus on the case of Thailand. The Chapter will be partitioned into several sections. To begin with, the first section will provide some background on the tool, a Small Model, along with a brief account on the Bayesian estimation. Within this section, the structure of the model will be laid out and explained. Having set out the model, the following sections will then investigate the roles of exchange rate by means of model simulations to facilitate insightful understandings of the dynamics and mechanism of the economic system. Such investigations will enable us to draw policy implications in the following Chapter.

4.1 A Small Model for Thailand

4.1.1 A Small Model: an Introduction

A Small Model presented here is a macroeconomic model that postulates the relationship between macroeconomic variables within a simple and tractable framework. It combines New Keynesian notions of nominal and real rigidities with the real business cycle elements of Dynamic Stochastic General Equilibrium (DSGE) modeling with rational expectations. The model allows for the role of aggregate demand in determining output and inertia both in nominal and real terms following the New Keynesian tradition. At the same time, the main variables in the model are endogenous to the model in line with general equilibrium concept while the model set-up incorporates random shocks and rational expectations, which depends on the agents' forecasts. Thus, the model appears semi-structural in that each equation will have economic interpretation consistent with underlying theoretical framework, at the same time, empirical expositions such as inertia are accounted for. To put it simply, the model of this type is a compromise between data-intensive regression-based model [such as the Bank of Thailand Macroeconomic Model (BOTMM) and Vector-autoregressive Model (VAR)] and structural micro-founded model [namely, Dynamic Stochastic General Equilibrium (DSGE) type model].

The main advantage of the model is its simplicity, tractability and versatility. By its sheer size of only 10-20 equations, the model allows us to keep track of the shock propagation and the dynamics of variables to gain understanding of how the economy functions. For its tractability and simplicity, the model is versatile enough to answer the calls for extensive range of policy analyses. Berg, Karam and Laxton (2006) and Harjes and Ricci (2008) used a model of this type on the Canadian and South African economies respectively to analyze the impacts of various shocks. Aiyar and Tchakarov (2008) employed a small model on the Thai economy to assess the possible impact of a US slowdown on Thai growth. Hunt (2006) utilized such model on Iceland, New Zealand, Canada, the UK and the US to derive efficient monetary policy frontiers under a range of alternative monetary policy rules. Argov *et al.* (2007) put a small model to test on the credibility issues of monetary policy in Israel. Bearing in mind the simplicity of the model, the model has apparent drawbacks. It is unable to address deeper structural and policy issues, for example, the impacts of changes in consumers' preferences, fiscal sustainability and tax structures.

Aforementioned literature employed a small model of the setting similar to that initiated by Berg *et al.* (2006) with some non-linear extensions in the case of Argov *et al.* (2007). In this paper, we tailored the model to capture the feature of the Thai economy as well as the policy questions we aim to answer.

4.1.2 The Model Structure

The model features a small open economy along the New Consensus in Macroeconomics.[13] Inflation is a monetary phenomenon under the control of the monetary authority. Aggregate demand has a short-term impact on real variables while the supply-side determined equilibrium level of unemployment is relevant. The model encompasses a blend between forward-looking features[14] to capture rational expectations and stylized inertia in both aggregate demand and aggregate supply equations. The model is a two-country model featuring the Thai economy as a small open economy and the US economy as a representative for the rest of the world. For the Thai economy, there are five main equations: aggregate demand, aggregate supply, exchange rate equation, monetary policy rule and current account equation. Three main equations characterize the US economy: aggregate demand, aggregate supply and monetary policy rule. The model allows for internal as well as external shocks (from the US) to the Thai economy. The details on the calculation of each variable and the complete model can be found in Appendix I and II respectively.

Aggregate Demand

$$ygap_t = \beta_1 ygap_{t-1} + \beta_2 ygap_{t+1} - \beta_3 (r_t - r^*) + \beta_4 (z_t - z^*) + \beta_5 ygap_t^f + \varepsilon_t^y \qquad 4.1$$

Domestic output gap depends on both lagged and expected output gap, the real interest rate, the real exchange rate as well as the demand from the rest of the world. It is not the level *per se* but the deviations from the steady states of these variables that matter. The residual term captures other temporary exogenous factors such as the fiscal policy and other demand shocks. The lag term suggests habit persistence in consumption or adjustment costs of investment while the future expected term is consistent with the new micro-founded IS curve, which was derived from theories of consumption, assuming a forward-looking utility-maximizing representative agent.

Aggregate Supply

$$\pi_t = \delta_1 \pi 4_{t+4} + \delta_3 \pi 4_{t-1} + \delta_2 ygap_t + (1 - \delta_1 - \delta_3)(\pi_t^f + \Delta er_t) + \varepsilon_t^p \qquad 4.2$$

Aggregate supply or the augmented New Keynesian Phillips curve[15] encompasses the dynamics of inflation (both lag and lead), output gap and imported inflation (represented by changes in the nominal exchange rate and the foreign price). The forward-looking term of inflation may reflect the central bank credibility[16] or it can also capture staggered price-setting assumption in the same fashion as Calvo (1983).[17] The backward-looking component indicates nominal inertia, which may be consequent of

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13 See Agenor (2002), Arestis (2007) and Berg *et al.* (2006)
14 As found in the micro-founded model, see for example Woodford (2003)
15 See also Svensson (2000) and Walsh (2003) for the derivation of the New Keynesian Phillips curve.
16 King (2005) argued for an importance of the expectations channel in the case of the UK.
17 See Clarida, Gali and Gertler (1999)

adjustment costs. The residual term captures other exogenous supply shock, not already present in the model, such as the oil price shock.

Exchange Rate Equation

$$z_t = z^e_{t+1} - \gamma_2 (r_t - r^f_t - risk)/4 - \gamma_3 CA_t + \varepsilon^z_t \qquad 4.3$$

The failure of UIP was clearly evident as posited in the previous Chapter and the relevant literature, therefore the exchange rate equation is modified. The real exchange rate is a function of the expectation of future exchange rate, the real interest rate differentials as well as the current account position, which has played an important role in determining exchange rate in the Thai economy, particularly, over the past few years. The residual term captures any other movements of exchange rate exogenous to the model.

The expectation of future exchange rate is modeled as follows:

$$z^e_{t+1} = \lambda z_{t+1} + (1-\lambda) z_{t-1} \qquad 4.4$$

Current Account Equation

$$CA_t = \tau_1 (z_t - z_{t-1}) - \tau_2 ygap_t + \tau_3 ygap^f_t + \varepsilon^{CA}_t \qquad 4.5$$

The current account position is a function of the real exchange rate, domestic and foreign output gap. The real exchange rate factors into the prices of exports and imports while the higher domestic demand usually induces higher imports and worsens the current account position. An expansion in foreign demand, on the other hand, helps improve the current account position.

Monetary Policy Rule

$$i_t = \alpha_1 i_{t-1} + (1-\alpha_1)\left[r^* + \pi_{t+1} + \alpha_2 (\pi 4_{t+4} - \pi^*) + \alpha_3 ygap_t\right] + \varepsilon^i_t \qquad 4.6$$

Nominal interest rate responds to the output gap and the deviation of inflation from its target, the equilibrium real rate of interest as well as expected inflation. The lagged interest rate features interest rate smoothing[18] as evident in practice. In an inflation targeting country, inflation forecasts play an important role as a nominal anchor. Due to lags in the monetary policy transmission mechanism, changes in the policy rate engineered by the monetary authority need to be forward-looking. Furthermore, exchange rate is assumed to have no bearings on the interest rate setting under inflation targeting framework. Although some literature on open-economy inflation targeting include exchange rate in the policy reaction function [see for example, Cavoli and Rajan (2006) and McCallum (2006)], others doubted the benefits of doing so [See Batini *et al.* (2007)].

The Rest of the World

The rest of the world is represented by the US. The structure of the equations are similar, except there would be no foreign influence or feedback from the Thai economy.

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[18] See Rotemberg and Woodford (1997) and Clarida, Gali and Gertler (2000)

Aggregate Demand

$$ygap_t^f = \beta_1^f ygap_{t-1}^f + \beta_2^f ygap_{t+1}^f - \beta_3^f (r_t^f - r^f*) + \varepsilon_t^{yf} \quad 4.7$$

Aggregate Supply

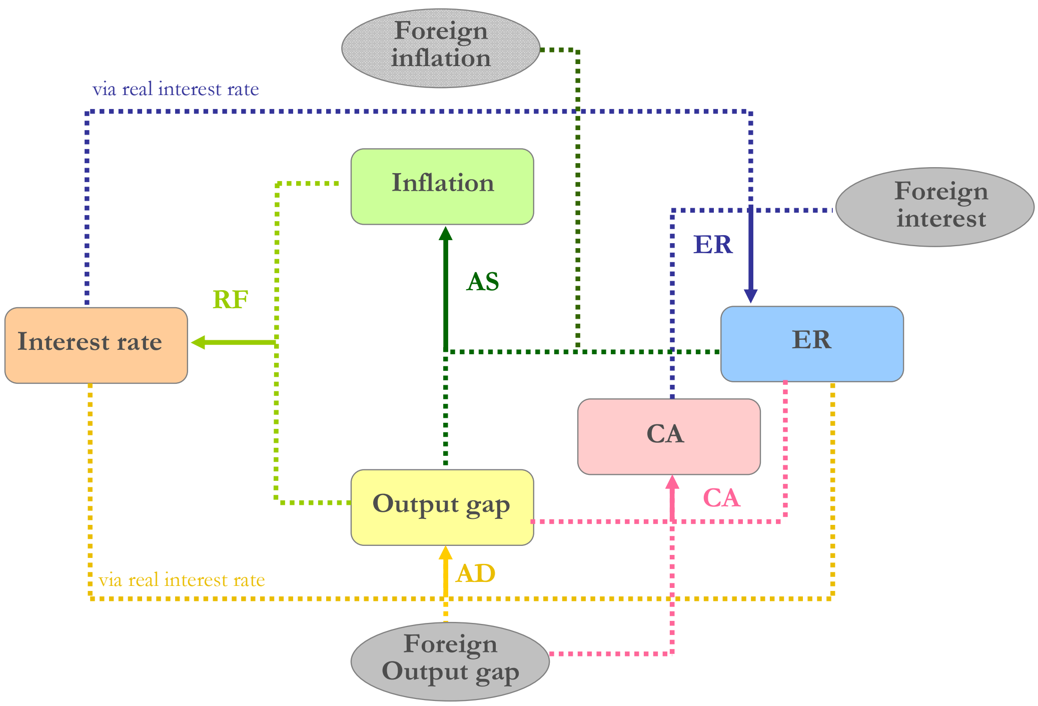
$$\pi_t^f = \delta_1^f \pi 4_{t+4}^f + (1-\delta_1^f)\pi 4_{t-1}^f + \delta_2^f ygap_t^f + \varepsilon_t^{pf} \quad 4.8$$

Monetary Policy Rule

$$i_t^f = \alpha_1^f i_{t-1}^f + (1-\alpha_1^f)\left[r^f * + \pi_{t+1}^f + \alpha_2^f(\pi 4_{t+4}^f - \pi^f*) + \alpha_3^f ygap_t^f\right] + \varepsilon_t^{if} \quad 4.9$$

To summarize the overall mechanism of the model, see Figure 4.1. Inflation is determined by output, foreign inflation and exchange rate while output itself is driven by the real interest rate and exchange rate. Both inflation and output then drive the interest rate via the monetary policy rule, while the interest rate feeds back into output directly and indirectly via the exchange rate.

Figure 4.1: An Overview of the Small Model



4.1.3 The Parameter Estimation

The model's parameters are estimated with Bayesian techniques based on Schorfheide (2000). The techniques have been applied to comprehensive DSGE models, such as Smet and Wouters (2003) on the euro area and Juillard *et al.* (2006) on the US economy. The Bayesian methods gained the middle ground between econometric estimation based on time series data and calibration. Fitting individual equations to the data were subject to the Lucas Critique, thus, did not serve well in policy analyses. On the other hand, despite its relatively more solid theoretical ground, calibration ignores some features exhibited in the time series data and does not directly yield itself to formal statistical inferences. In parameter estimations, Bayesian techniques allow contributions from both the priors and particular features of the data and aim to characterize the posterior distribution of the parameters. Based on the Bayes formula, assuming that both data and parameters are random variables, where Y^T is a set of observable data over a sample period T, $p(\theta)$ is a set of priors, the posterior density of the model parameters, θ, is given by:

$$p(\theta | Y^T) = \frac{L(Y^T | \theta) p(\theta)}{p(Y^T)} = \frac{L(Y^T | \theta) p(\theta)}{\int p(Y^T | \theta) p(\theta) d\theta} \quad 4.10$$

Bayesian estimation was programmed in Dynare[19] on Matlab[20], whereby, the likelihood is evaluated for given parameters. The likelihood is then combined with the prior density and maximized to find the posterior modes. With these posterior modes as the starting value, we estimate parameters by drawing from the posterior density using the Metropolis-Hastings algorithm with 2,000 replications. The acceptance rate for each draw was 20 percent and convergence was then achieved.[21]

The assumptions regarding the distribution of the priors for the parameters of the model are tabulated in Appendix III. The prior values for means and standard deviations are chosen to reflect our view and understandings of the structure of the Thai economy, while benchmarked by parameters of comparable models[22] wherever possible. Some priors have been modified to prevent a failure of estimation algorithm. The type of the priors' distribution is chosen based on its particular admissible range of values, for example, the beta distribution is chosen for its 0 to 1 range. General conventional guidelines were observed in setting the priors.[23] For instance, lags in monetary policy transmission mechanism imply relatively higher inertia than forward-looking components in aggregate demand equation, therefore, β_1 should be greater than β_2 while the sum of β_3 and β_4 should be less than β_1. In aggregate supply equation, the forward-looking component δ_f should be well below 0.5 from empirical evidence. Given that Thailand is an inflation-targeting country, the interest rate responses to inflation should be higher than the responses to output gap, therefore, 1.5 and 0.5 were chosen respectively.

To estimate the model we use 5 and 3 main variables for Thailand and the US respectively.[24] In the case of Thailand, we use the real GDP, headline inflation rate, the policy rate, the real bilateral exchange rate of the Thai Baht vis-à-vis the US Dollar and the current account. We use the real GDP, headline inflation rate and the Fed Funds rate for the US. Based on the combination of data, understandings of the economy, relevant literature as well as model stability, steady-state values were carefully chosen for all but the real exchange rate, the steady state of which is derived from the Bayesian estimate. The estimation sample is 2000Q1-2008Q1 to avoid structural break in the wake of the financial crisis. Parameter estimates are found to be robust within the post-crisis estimation period. However, if the sample were extended to cover the pre-crisis and the crisis period (1994-1999), structural changes would be reflected in the estimation results.

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[19] Dynare is a Matlab-based software provided by Michel Juillard and his team (see Dynare website (www.cepremap.cnrs.fr/dynare) for further details.

[20] Versions R2006a and R2007a

[21] Refer to Kamenik (2007), Griffoli (2007) and Ermolaev *et al.* (2008) as well as Dynare website for further details on Bayesian estimation using Dynare.

[22] Berg *et al.* (2006), Aiyar and Tchakarov (2008), Harjes and Ricci (2008) and Argov *et al.* (2007)

[23] See further details in Berg *et al.* (2006) and Aiyar and Tchakarov (2008)

[24] Data sources for Thailand are the Bank of Thailand (for the policy rate, the nominal bilateral exchange rate and the current account), NESDB (for the real GDP) and Ministry of Commerce (for headline inflation rate). The US data is taken from Bloomberg.

The posteriors are reported in Appendix III. Although most estimated parameters were consistent with the priors, the deviations of posteriors from priors for some were non-negligible. The estimated parameter on the exchange rate term in the output gap equation was well below that of the prior, 0.03 compared to 0.10, implying that the extent to which the exchange rate has an impact on output was less than expected. The effect of exchange rate on output is via net exports, and consistently, it appears that the role of exchange rate was rather small in the current account equation as well. This could be accounted for by the domination of high-tech manufacturing products in the structure of exports rendering overall exports less sensitive to exchange rate changes. Another parameter of concern is the estimated parameter on the lag of policy rate in the reaction function, which was 0.87 compared to the prior of 0.50. This demonstrates persistence in interest rate changes as evident in the movement of the policy rate. Notably, in the exchange rate equation, the estimated parameter on interest differentials was well below that of the prior (0.08 compared to 0.50). This confirms a weak relationship between interest rate and exchange rate as posited in the failure of UIP condition in the earlier Chapter.

4.2 Assessing the Roles of Exchange Rate using the Small Model

This section employs the Small Model set out in the preceding section to analyze the various roles of exchange rate: as a channel of monetary policy transmission mechanism, as a shock absorber and whether exchange rate might be used in conjunction with the policy rate to alleviate inflationary pressure. The analysis is carried out by means of simulation exercises programmed in Iris[25] on Matlab[26].

4.2.1 The Role of Exchange Rate as a Channel of Monetary Policy Transmission Mechanism

The traditional role of exchange rate under inflation targeting regime is a channel of transmission mechanism. In relation to the previous Chapters, where the relevant literature has already been reviewed on this front, this section will perform an empirical test based on the Small Model to evaluate how well the exchange rate is assuming its task in transmitting the impact of monetary policy on to the economy.

Exercise 1

In this exercise, we innovate (shock) the policy interest rate by 1 percent through ε_t^i and see how it propagates through the economic system. We compare the impacts of such a shock on the baseline case against the case with exogenized exchange rate. The baseline case refers to the case where the model functions normally without any imposed restrictions. In the case where we exogenize the exchange rate, we force the exchange rate to assume the steady-state value throughout the simulation range, i.e. the exchange rate channel is closed.

If the impacts on the economy – hereby, we focus primarily on output and inflation – do not differ significantly in the two cases, this implies the exchange rate does not perform well as a channel of monetary policy transmission.

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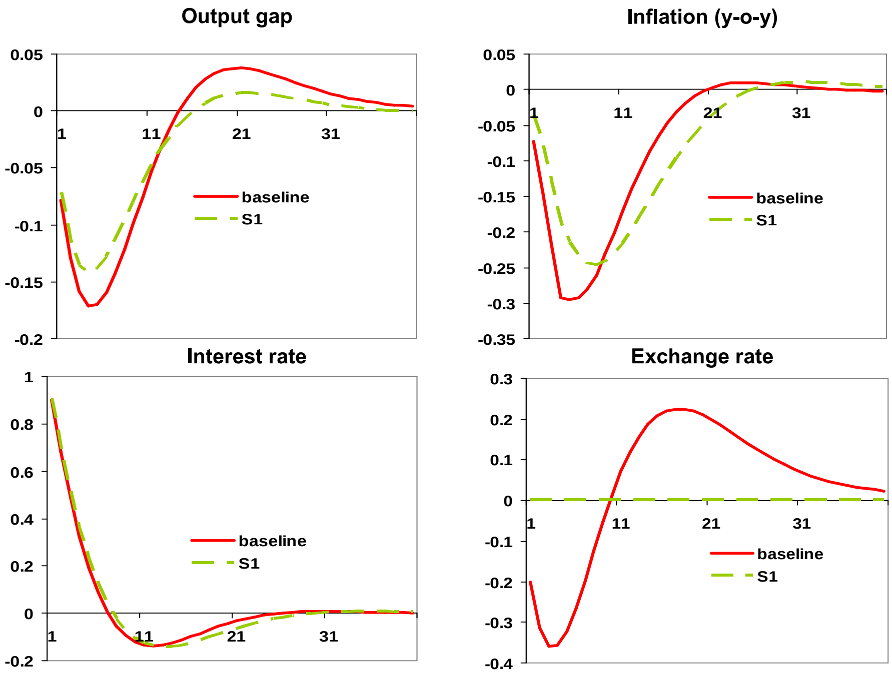
[25] Iris is a Matlab-based software developed by Jaromir Benes. See Iris website (www.iris-toolbox.com) for further details.

[26] Versions R2006a and R2007a

Figure 4.2: Shock to the Policy Rate – with and without Exchange Rate Channel



Note: 'baseline' refers to the model with exchange rate channel and 'S1' refers to the model without exchange rate channel

The Findings

It was evident that the impact of policy rate shock on output and inflation do not vary significantly. In the first year, the average impact of interest rate shock on output and inflation is 0.13 percent and 0.18 percent respectively in the baseline case compared to 0.12 percent and 0.11 percent respectively in the case without exchange rate channel. Such results imply that the exchange rate may not be a strong channel of monetary policy transmission mechanism. This is, nonetheless, unsurprising since the relationship between interest rate and exchange rate is rather weak as is clear from the parameter estimate.

Table 4.1: Impact of Policy Rate Shock on Inflation and Output

percentage	Average Q1-Q4	Average Q5-Q8
Inflation (baseline)	-0.18	-0.28
Inflation (w/o ER)	-0.11	-0.23
Output (baseline)	-0.13	-0.15
Output (w/o ER)	-0.12	-0.12

4.2.2 The Role of Exchange Rate as a Shock Absorber

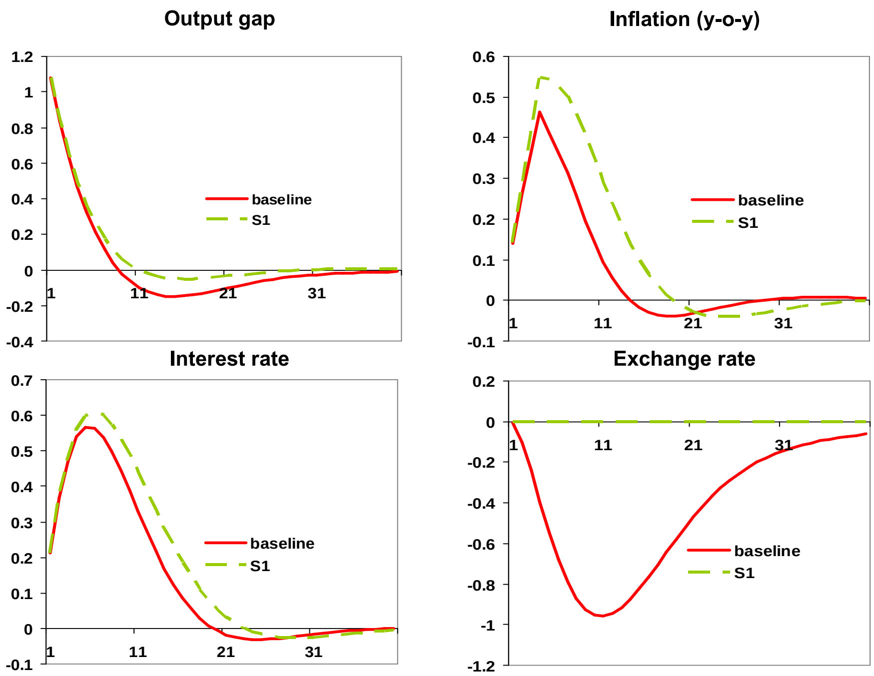
Whether exchange rate acts as a shock absorber or a source of shocks is widely debatable as clearly evident in the literature (refer to Chapter II for discussions). This section aims to test the role of exchange rate as a shock absorber in the presence of two different types of shocks: output (real) and inflation (nominal) shocks.

Exercise 2

In this exercise, we separate the experiment into two sets. In the first set, we innovate output by 1 percent through ε_t^y and in the second set, we innovate inflation by 1 percent through ε_t^p . We then compare the impacts of these shocks on the baseline case against the case with exogenized exchange rate.

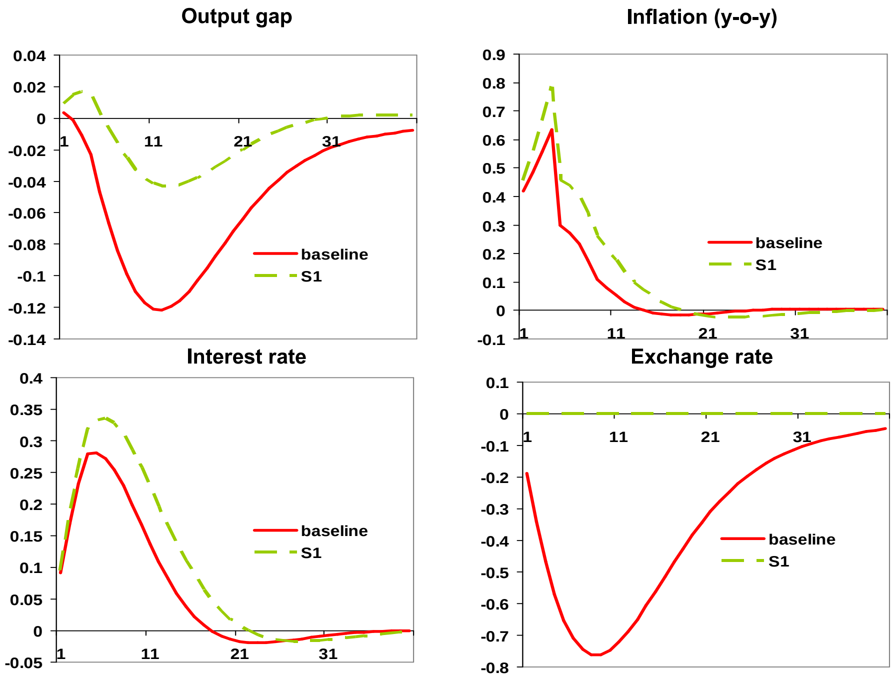
If the exchange rate acts as a shock absorber, the impact of shocks on output and inflation in the baseline case (with exchange rate) should be lower than the case with exogenized exchange rate (without exchange rate).

Figure 4.3: Output Shock – with and without Exchange Rate



Note: 'baseline' refers to the model with exchange rate channel and 'S1' refers to the model without exchange rate channel

Figure 4.4: Inflation Shock – with and without Exchange Rate



Note: 'baseline' refers to the model with exchange rate channel and 'S1' refers to the model without exchange rate channel

The Findings

In both cases of output and inflation shocks, exchange rate clearly helps alleviate the impact of shocks on inflation. With exchange rate, adjustment in inflation is faster in both cases, which implies lower degree of inflation persistence. This may have an impact on inflation expectations, which play an important role on the effectiveness of monetary policy.

In the case of output shock, it is apparent that exchange rate helps speed up the correction process in restoring output to its steady state. This implies that the damage, which may arise from unfavorable output shocks, will be corrected faster with exchange rate than without.

In the case of inflation shock, however, exchange rate exacerbates the negative impact of the shock on output.

Table 4.2: Impact of Output Shock on Inflation and Output

percentage	Average Q1-Q4	Average Q5-Q8
Inflation (baseline)	0.31	0.34
Inflation (w/o ER)	0.35	0.51
Output (baseline)	0.75	0.17
Output (w/o ER)	0.76	0.23

Table 4.3: Impact of Inflation Shock on Inflation and Output

percentage	Average Q1-Q4	Average Q5-Q8
Inflation (baseline)	0.52	0.25
Inflation (w/o ER)	0.61	0.41
Output (baseline)	-0.01	-0.07
Output (w/o ER)	0.01	-0.01

A plausible explanation to account for the distinctive consequences of different shocks on output, in particular, are the impacts of shocks on the movement of exchange rate.

In the case of output shock, on the one hand, the shock induces an increase in inflation, compounded effect of an increase in output and inflation result in an increase in the policy rate leading to exchange rate appreciation. On the other hand, an increase in output worsens the current account position, which only slightly softens the appreciation. The overall appreciation then moderates the positive shocks on output and inflation. In the case of inflation shock, inflation and output are lowered from an increase in the policy rate in response to inflation, and further exacerbated by an appreciation of exchange rate.

To sum up, the exchange rate somewhat mitigates the impact of shocks on inflation and output in the case of output shock but not necessarily so in the case of inflation shock. Thus, the role of exchange rate as a shock absorber is less clear-cut, depending very much on the type of shocks hitting the economy. The result is consistent with the literature reviewed in Chapter II and the study by Parrado (2004). Parrado (2004) suggested that under inflation targeting regime, inflation and output volatility depends primarily on exchange rate system. In the case of real shocks, exchange rate should be left flexible to act as a shock absorber, on the other hand, facing with nominal shocks, exchange rate should be managed.

4.2.3 The Use of Exchange Rate in Conjunction with the Policy Rate to Alleviate Inflationary Pressure

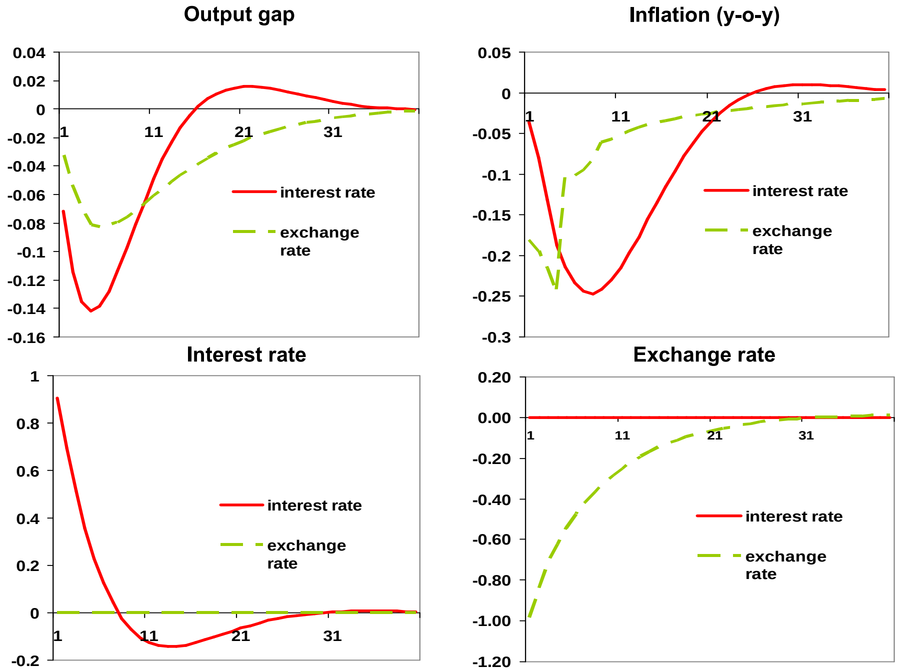
Under inflation targeting framework, the policy interest rate is practically the only tool used to ensure inflation remains within the target range. However, in an advent of supply shocks, especially when such shocks were originated abroad such as the oil price shocks, to keep inflation within the target range, the policy rate needs to be raised by so much that it might have undesirable consequences on the economy. Whether exchange rate may be used here to alleviate inflationary pressure and lessens the need for substantial hikes in the policy rate is a timely debate.

First, we investigate the rationales behind the use of exchange rate in comparison to interest rate in curbing inflation. Then, we evaluate the impact on the economy if we were to use exchange rate to supplement interest rate. These issues are investigated via simulation exercises based on an important assumption that the central bank can entirely manage exchange rate by means of sterilized intervention and to some extent control the exchange rate movement. The assumption of controllability in exchange rate will be tested in the following Chapter.

Exercise 3

Here, we examine the impact of an interest rate shock in comparison with an exchange rate shock. To compare the like and the like, we engineer the magnitude of exchange rate shock to the level that yields a comparable impact on inflation as a one-percent interest rate shock. We find that a one-percent increase in the interest rate (keeping exchange rate constant) results in a 0.25 percent (maximum) reduction in inflation, this magnitude of inflation reduction can be achieved by a shock of 0.52 percent appreciation in the exchange rate equation through $\varepsilon_t^{\tilde{x}}$ (keeping interest rate constant).

Figure 4.5: Shock to the Policy Rate and Shock to the Exchange rate



Note: 'interest rate' refers to the model with policy rate shock and 'exchange rate' refers to the model with exchange rate shock.

The Findings

Clearly, given the same extent of disinflation (of 0.25 percent), the impact of exchange rate shock on inflation is faster but relatively short-lived. While disinflation of 0.25 percent is achieved in the 8th quarter in the case of a one-percent increase in interest rate, it can be reached within 4 quarters given a shock of 0.52 percent in the exchange rate equation. This is clearly due to the fact that, exchange rate appreciation directly feeds into lower import prices while there is a transmission lag in the case of interest rate. Consequent of the lag, the effect on inflation lasts longer for interest rate shock as is clear from Figure 4.5. Regarding output, in the case of exchange rate shock, the negative impact on output is somewhat smaller but more long-lasting.

Table 4.4: Impact on Inflation and Output of Interest Rate and Exchange Rate Shocks

percent	1% Interest Rate	0.52 % Exchange Rate
Inflation (Maximum)	-0.25	-0.25
Output (@ max inflation)	-0.10	-0.08
Horizon (Qs)	8	4

Based on the result of this exercise, since the exchange rate can help contain inflationary pressure within a shorter time span than interest rate, there is a case for the use of exchange rate to complement the use of the policy rate in curbing inflation, particularly if that inflation shock is considered temporary. Nonetheless, we need to bear in mind some drawbacks on the use of exchange rate, which will be elaborated further in the following Chapter.

Exercise 4

In this exercise, we modify the baseline model to account for the use of exchange rate in response to inflation shock. If we were to use exchange rate to curb inflation, besides the regular determinants of exchange rate present in the exchange rate equation, we attach a part on exchange rate reaction function to inflation.

However, the exchange rate that appears in the exchange rate equation is the real exchange rate, while in practice, intervention is carried out on the nominal exchange rate. It is, thus, necessary to carry out some transformation.

Assuming controllability, to alleviate inflationary pressure, the change in the nominal exchange rate will react to inflation deviation from the target (assumed to be its steady state) as represented in the following equation (note that, subscript I refers to intervention).

$$\Delta er_{I,t} = -\mu(\pi_t - \pi^*) \qquad 4.11$$

μ is a policy choice, which reflects the degree of exchange rate management as a supplement to the interest rate policy in curbing inflationary pressure. The higher the μ, the more exchange rate will move in response to inflation deviation from its target.

From exchange rate identity:

$$\Delta z_t = \Delta er_t - \pi_t + \pi_t^f \qquad 4.12$$

Intervention does not have an impact on π_t^f but changes in the nominal exchange rate does have an impact on domestic inflation π_t. Thus, the change in the real exchange rate consequent of intervention on the nominal exchange rate becomes:

$$\Delta z_{I,t} = \Delta er_{I,t} - \Delta \pi_{I,t} \qquad 4.13$$

From the aggregate supply equation, a one-percent change in nominal exchange rate induces a *(1-δ_1-δ_3)* change in inflation, therefore:

$$\Delta z_{I,t} = \Delta er_{I,t} - (1 - \delta_1 - \delta_3)\Delta er_{I,t} \qquad 4.14$$

$$\Delta z_{I,t} = -(\delta_1 + \delta_3)\mu(\pi_t - \pi^*) \qquad 4.15$$

The current level of real exchange rate is determined by two components: R,t (which represents the regular determinants as present in the exchange rate equation) and I,t (which represents the changes consequent of intervention on the nominal exchange rate). Hence:

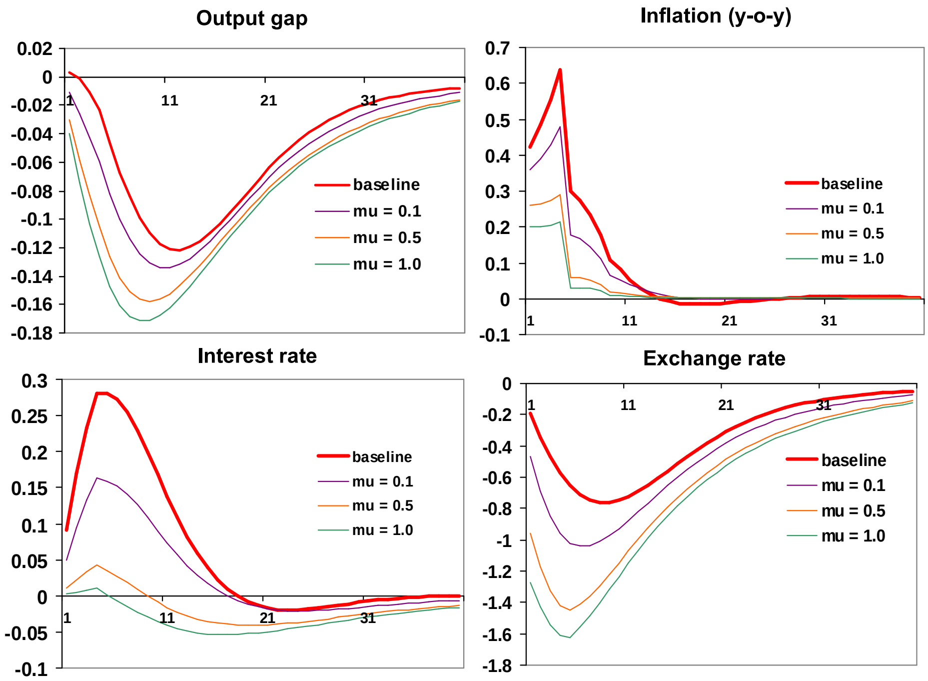
$$z_t = z_{t-1} + \Delta z_{R,t} + \Delta z_{I,t} \qquad 4.16$$

Since intervention cannot affect the past value of real exchange rate, with the use of exchange rate to curb inflation through intervention, the original exchange rate equation (4.3) then becomes:

$$z_t = z_{t+1}^e - \gamma_2(r_t - r_t^f - risk)/4 - \gamma_3 CA_t - (\delta_1 + \delta_3)\mu(\pi_t - \pi^*) + \varepsilon_t^z \qquad 4.17$$

We then simulate inflation shock and compare the impact on inflation and output in the baseline case against the case with the augmented exchange rate equation above – allowing for a variation in μ between 0.1 and 1.0 to reflect the policy choice.

Figure 4.6: Inflation Shock – Baseline and the Use of Exchange Rate



Note: 'baseline' refers to the model with normal exchange rate equation (equation 4.3) and 'mu = x' refers to the model with an augmented exchange rate equation (equation 4.17) where x is the value of μ in the augmented exchange rate equation.

The Findings

The use of exchange rate to supplement the policy rate in curbing inflationary pressure is effective in bringing down inflation by allowing smaller hikes in the policy rate. The higher the value of μ, the more inflation , both in average and volatility terms, will be brought down and the less the interest rate has to go up in response to inflation. Nonetheless, disinflation comes at a cost in terms of loss in output, partially consequent of increased appreciation in exchange rate. The costs are higher, the more exchange rate is used to curb inflation (i.e. the higher μ). Noticeably, the value of μ as high as 1.0 nearly hijacks the role of the policy rate as the monetary policy instrument as the movement of interest rate is very small compared to that of exchange rate in response to inflation shock. Bearing in mind, we have an important assumption that nominal exchange rate is entirely controllable.

Table 4.5: Impact of Inflation Shock on Inflation and Output

percentage	Average Q1-Q4	Average Q5-Q8	Volatility Q1-Q20
Inflation (baseline)	0.52	0.25	4.5
Inflation (μ=0.1)	0.41	0.15	2.6
Inflation (μ=0.5)	0.27	0.05	1.1
Inflation (μ=1.0)	0.21	0.03	0.7
Output (baseline)	-0.01	-0.07	0.2
Output (μ=0.1)	-0.03	-0.11	0.1
Output (μ=0.5)	-0.07	-0.14	0.1
Output (μ=1.0)	-0.09	-0.16	0.1

This Chapter sets out a new analytical tool – a Small Model for Thailand and confirms that although exchange rate may not be a powerful channel of monetary policy transmission due to its weak relationship with the policy interest rate, the exchange rate does have a role as a shock absorber, particularly in the case of real shocks. Furthermore, setting aside the controllability issue which will be examined in the next Chapter and the costs in terms of output loss, the exchange rate may be effectively used in alleviating inflationary pressure, provided that such pressure was initiated from an inflation shock considered temporary. These results set stage for the policy implications.

V. Policy Implications

Consistent results found in Chapter III and Chapter IV suggested that exchange rate plays crucial roles in the economy, not as a channel of monetary policy transmission but as a shock absorber and a plausible supplementary option to help moderate inflationary pressure. On the latter, not only the inflationary pressure is alleviated, the model suggests that the response of exchange rate to excessive inflation provides relatively low inflation volatility compared to the baseline. However, the use of such policy needs to be carried out with extreme cautions whereby prerequisites, costs and limitations as well as appropriate macroeconomic conditions should be carefully observed. This Chapter is set out to examine the issue of exchange rate controllability, costs and limitations of managing exchange rate and appropriate conditions for which the exchange rate may be used. Having done so, a conclusion can then be drawn.

5.1 Degree of Controllability: Effectiveness of Intervention

In utilizing exchange rate to curb inflationary pressure, there are different degrees at which exchange rate can be manipulated. The intensity ranges from slowing down the depreciation of exchange rate that can exert further pressure on inflation, to manipulating the strengthening of currency to help ease the inflationary pressure mounting from other factors. Regardless, under the managed floating regime, the key requirement for exchange rate management is the ability of authorities to control movements in exchange rate. As exchange rate can be seen to often overreact to shocks or overshoot changes in fundamental, i.e. misalign from equilibrium values in the short run, exchange rate can become a source of shock itself. This feature of short run exchange rate contributes to great difficulties for authorities to tamper exchange rate level.

So far, the empirical evidence on effectiveness of intervention has not been conclusive though studies found intervention can have an impact upon exchange rate and its volatility. In the matter of sterilization, monetary models suggest that only unsterilized intervention can influence exchange rates (Mishkin, 2008). However, Isard (2005) argued that if sterilized intervention can signal future changes in interest rate policy, exchange rate can then be affected, while Dominguez and Frankel (1993) found significant impact of intervention on the G3 exchange rates. They also suggest that such success could be enhanced if the interventions are publicly announced, performed in the internationally concerted manner, and in the case where monetary and fiscal policy stances are consistent. Fatum and Hutchison (2002) and Ito (2003) evaluated foreign exchange interventions in Japan and found them to be ineffective or even counterproductive; and exchange rates moved in opposite direction of what intended by the intervening authority. Lian An and Wei Sun (2008) reached no different results, but added that intervention tended to be effective if infrequently performed. Disyatat and Galati (2005) suggested that intervention could be more effective in emerging markets due to the smaller size of foreign exchange markets, better informed central bank relative to the market participants and more coordinated direction of intervention within the region. If there was any effectiveness in manipulating exchange rate, it was usually for the short-run. In the long run, exchange rate seemed to co-integrate with fundamentals and managing exchange rate could be costly.

Setting aside sterilized versus unsterilized intervention, tests for effectiveness of intervention can be carried out following Sangmanee (2002) and Disyatat and Galati (2005). The paper estimates the reaction function for the Bank of Thailand's intervention and subsequently uses the reaction function as an instrumental variable to investigate the impact of intervention on market expectation. This market expectation can be estimated as properties of the implied probability density functions (PDFs) derived from the call-option price. In this paper, we circumvent the task of estimating such PDFs[27] and extracted the implied volatility and other properties from Reuters and JP Morgan database.

The goal is to examine the ability of intervention to change the current level (spot and nominal effective exchange rates: NEER) and market expectation on future exchange rates. Implied volatility reflects market's forecasts on future exchange rate's fluctuations; risk reversal which is gauged by the difference in the call-option price and the put-option price measures the skewness or probability that the market predicts future exchange rate will depreciate vis-à-vis probability to appreciate; and finally, strangle or kurtosis measures probability of extreme movement in the future rates.

The data is at daily frequency from January 5, 2004 to July 31, 2008. We use the reference THB/USD rate published on the Bank of Thailand's website as our spot rate. As previously mentioned, market expectations are extracted from the daily exchange rate, while PDFs are from Reuter and JP Morgan.[28] The paper uses 1-year constant horizon to reflect a forward looking view of market expectations.

Estimation and Empirical Results

To test for effectiveness of intervention, spot rate and NEER are expressed in the first difference form as dependent variables, while the implied volatility, risk reversal and strangle enter the equation in levels. The explanatory variables are the net intervention and its lags (5 lags) as well as the lagged dependent variables. In addition, to control for the impacts of news and announcements on the market, the paper uses stock market index from the Stock Exchange of Thailand (SET) as it should well reflect the overall market view on a given day.

In the investigation of how interventions influence the exchange rates, the issue on contemporaneous nature of the intervention decision and exchange rate properties is essential. The intervention is usually triggered by sharp changes in exchange rate, volatility and market expectation which can also be affected by the intervention itself. As a result, the estimation is subject to the simultaneity bias. To identify the simultaneity problem in the estimation, the parsimonious granger causality test is performed to test whether changes in market expectations statistically cause the central bank to intervene. The test statistics are reported in Table 5.1. The result indicates the presence of simultaneity bias in the relationship between most changes in market expectations and the contemporaneous decision of the central bank's intervention. Consequently, the instrumental variable technique is required for a consistent estimation on the intervention effectiveness.

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[27] For estimating method of the implied PDFs, see Cox and Ross (1976) and Sangmanee (2002).

[28] Due to the confidentiality of the data, the daily NEER, calculated for a given weight of Thailand's major trading partners, and the daily net intervention will not be disclosed in the paper.

Table 5.1: Granger Causality Tests from the Market Statistics to Intervention Decision

Statistics	Significance Level of F-statistics
ΔSpot	0.0044*
ΔNEER	0.3159
Implied volatility	0.0043*
Risk Reversal	0.7177
Strangle	0.0050*

Note: Granger Causality Test is performed using 5 lags to be consistent with the dynamics assumed in the previous section. The significance level in the table is for testing whether the market expectations influence intervention decision. The * represents the statistically significance causal relationship tested.

As the estimated equation is proven to have simultaneity bias, the instrumental variables are used to obtain consistent estimates. The instrumental variables include the distances at time t-1 to t-5 of the spot rate when the exchange rate is above ($spot^H$) and below ($spot^L$) the historical average as well as NEER, implied volatility, risk reversal; and strangle, which could partly help explain movements in net intervention without being correlated to the error terms at time t. The Hausman test on the equation is also performed and cannot reject the hypothesis of consistent OLS estimates. The Newey-West estimated variance-covariance matrix is used to adjust standard errors in the presence of autocorrelated error. The significance levels of intervention coefficient on market expectation are presented in Table 5.2.

Table 5.2: Significance Levels of Intervention Coefficients on Spot Rates, NEER and Market Expectations

Dependent Variables	Significance Level of Intervention	Significant Level of Changes in Stock Prices
ΔSpot	0.5579	0.0003*
ΔNEER	0.5989	0.6680
Implied volatility	0.0001*	0.0002*
Risk Reversal	0.8092	0.1639
Strangle	0.2890	0.7896

Note: The equation is estimated with the OLS technique corrected for simultaneity bias using instrumental variables. The instrumental variables are the distances at time t-1 to t-5 of the spot rate, NEER, implied volatility, risk reversal and strangle from their historical averages. The daily data range from the period of January 5, 2004 to July 31, 2008. Explanatory variables are five lags of net interventions (in absolute terms in the implied volatility equations), lags of endogenous variable and difference in log value of the SET index.

The results from reaction function and the test for intervention effectiveness reveal that the intervention is performed, on average, during times when spot rates, volatility and risk reversal significantly deviate from the historical average. However, the intervention seems successful to only slowdown the speed of exchange rate changes.

These findings are consistent to the previous study carried out by the BOT, and also in conjunction with the theoretical purpose of intervention by the central banks in mitigating overly sharp movements in the exchange rate. In order for exchange rate policy to be effective in curbing inflation, the success might only be for the case of decelerating the depreciation and containing inflation expectation rather than manipulating for the appreciation to help prevent price acceleration.

However, the nature of data could be a drawback to the estimation on spot rates as well as NEER. The prevailed rates are taken at the end of the day and these rates could already incorporate the impact of intervention which might explain the insignificant impact of the intervention on the spot rates. Additionally, the results are evaluated subject to statistical criteria that require significant number of success for the intervention to be effective. Nevertheless, 'controllability' in consideration of the market operation may require much smaller number of success of the intervention.

5.2 Duration of Controllability: Ability to Mitigate Longer-run Shocks

The nature of exchange rate mimics asset price behaviors. Movements in exchange rate contain not only current market condition, but also, as in the last section, reflect a forward-looking view of the market on future fundamentals. The short-run nominal movements can deviate from the fundamentals due to news and information; however, the movements toward fundamentals are expected in the long run. Intervention in the foreign exchange market therefore will only be effective to curb the short-run or temporary shocks. Nevertheless, there is no guarantee on the success of the effort to intervene in a longer duration even the large amount of resources is at the expense.

The argument is similar in terms of the real exchange rates. Literatures have found evidence of long-term co-movement between real exchange rate and economic fundamentals. [See reviews on equilibrium exchange rate issues from Driver and Westaway (2002) and MacDonald (2000)] The effort to manipulate real exchange rate at any particular level is unsustainable in long run regardless of the nominal level since price adjustment will gradually bring real exchange rate in line with fundamentals.

As a result, the intervention policy may only be suitable and prone to be effective in curbing temporary shocks. Any exchange rate manipulation away from its path for an extended period is likely to result in the higher cost as well as the lower probability of success.

5.3 Assistance on Curbing Inflation Expectations

The effectiveness of exchange rate policy in mitigating inflation mostly lies in the degree of exchange rate pass-through to import prices and domestic inflation as discussed above. However, the other merit of the exchange rate management is to curb sharp exchange rate movements that can fuel higher inflation expectation. In this situation, the authority can directly intervene when the speed and magnitude of depreciation seem to overshoot the fundamentals. Such action, not only can prevent the sharp depreciation and excessive volatility that could be harmful to the real sector, but can also contain expectation from further depreciation that could lead to higher inflation expectation in a spiral as well.

5.4 Contradiction to Short-term Growth and Resource Misallocation

To curb inflationary pressures, the exchange rate has to be geared to prevent exchange rate depreciation, either level or speed. Given the significant pass-through on import prices, the slowdown in the rate of depreciation would help alleviate the pressure on domestic prices from rising import costs. However, this 'appreciating' pressure seems to contradict the economic target in favor of growth, especially during the period of supply shocks when the prevailing inflation is often stemmed from high production costs.[29] In addition to higher costs, exporters may face with declining profits and deteriorating price competitiveness in the world markets from the strengthening currency.

However, if the intervention is carried out only to curb short-run expectations or temporary shocks, the adverse impact may only be short-lived and the impact on exports and growth could be marginal. Furthermore, the true competitiveness of a country's export should be best reflected by the Real Effective Exchange Rate[30] (REER) as it represents home country's prices in foreign currency compared to those of trading partners. In the case of Thailand, the evidence has pointed out that Thai exporters have great ability to adapt well as exchange rates move against their preference especially during 2006 – 2007 when the Thai baht appreciated by more than 15 percent against the US dollar as exports continued to grow at a two-digit rate. In addition to the exporters' ability to adapt, the REER at the time was only slightly appreciated, implying the relatively small loss of price competitiveness compared to partners as well as competitors. As a result, should the intervention be performed only for the short-term, potential impact on the export sector may be marginal. After all, one must note that the ultimate benefit of the intervention, if effective, is the imminent disinflation that helps alleviate the high production cost going forward.

The other point of concerns drawn from the result regards the possible increase in exchange rate volatility if exchange rate were to use in counteracting with inflation. The rise in volatility appears to be more important and affecting to the real sectors and financial market than the trend development to the extent that the exchange rate fluctuation could be quite rapid. In this case, the only remedy is the utilization of hedging instruments, if available. As a result, the consequence of exchange rate management for inflation could in fact be more complicated.

The other drawback of intervention in deviating exchange rate from its current 'equilibrium' level is the possible resource misallocation as the market forces lack of the price mechanism to aid optimal allocation. This issue only becomes significant concern for the economy, if the authority uses exchange rate intervention to counteract shocks that are persistent. The optimal response of the economy to such shocks is to allow the economy to adjust to the new environment. The intervention may cause an unnecessary delay to the adjustment process especially for the private sector and hence result in misallocation of resource in the medium-to-long term.

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[29] This dilemma appears to be similar to the conventional tightening in monetary policy by raising interest rates.

[30] REER is calculated from NEER deflated by relative inflation of home and trading partners, not solely the THB/USD exchange rate.

5.5 The Optimal Use: Exchange Rate Policy as a Supplement, not a Substitute

The result in the previous Chapter suggests that exchange rate management under inflation targeting regime may be useful in alleviating inflationary pressure. Over and above the prevailing costs and limitations of the policy, one has to keep in mind that such policy can only be supplemental to the main instrument, namely policy interest rate. This is to be supported by many important reasons.

Under inflation targeting, the central banks are pledged to use policy interest to achieve the long-term economic goals. The use of exchange management policy to pursue price stability without changes in policy rates or any consistent signal from the authority could play down the policy effectiveness to achieve the set goals.

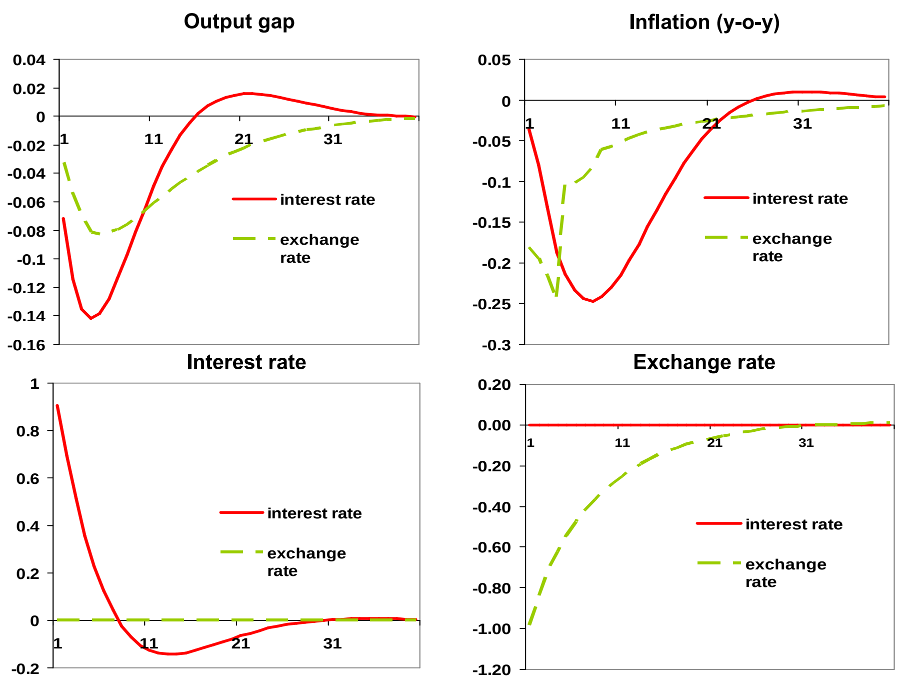
In addition, Stone *et al.* (2008) made an important point that the use of other policy tools other than interest rate under inflation targeting economies may lead to confusion over the commitment of the central bank to inflation target in the context of weak policy implementation. Such confusion on the part of the public and the financial market could eventually back-fire the policy goals or lead to deterioration in the central bank's credibility. However, there could be room for the single act of exchange rate policy in the short-term when implementation of the interest policy would have become unpopular and imposes significant adverse effects on the real economy.

According to the sensitive nature of the exchange rate to news and information, its management can be more cumbersome and requires more resources while the central banks have better control on their policy interest rate through the use of policy tools such as open market operations (OMOs)

The exchange rate policy also has limitations since the intervention against depreciation can exhaust international reserve that has a zero bound. The Asian Crisis in 1997 has proven that the rate of reserve depletion can be non-linear. The lower outstanding amount has more impacts on investor (speculator)'s sentiments and the rundown can be at a much faster rate relative to the period with abundant reserves. On the contrary, the resource for central banks to influence policy rate does not face the same limitations.

Moreover, in light of the ability to fight inflation, exchange rate can be directly managed and hence provide the immediate impact on inflationary pressure relative to interest rate policy. However, results from the Small Model indicate that the impact of exchange rate on inflation is more short-lived compared with the impact of interest rate changes in the case for Thailand. Moreover, given the same impact on inflation, exchange rate tends to have a smaller but more long-lasting adverse impact on output. The impulse response from the Small Model is re-presented in Figure 5.1.

Figure 5.1: Shock to the Policy Rate and Shock to the Exchange rate



Note: 'interest rate' refers to the model with policy rate shock and 'exchange rate' refers to the model with exchange rate shock.

The result has an important policy implication. Due to its speed and precision, exchange rate should be used to address only temporary inflation shock to help contain inflation expectations. Moreover, it may be used to address temporary inflation shock during the time when the economy is relatively weak to moderate the damage on output. This is essentially because the use of interest rate to curb inflation under such circumstances may exacerbate the negative impact of inflation shock on output and induced downward-spiral effect on aggregate demand through the bank-lending channel.

Under the circumstances where inflation is persistent and the economy is not experiencing soft patches, the use of interest rate is more appropriate since it has a prolonged effect on inflation despite a shorter but sharper impact on output. Owing to its short-lived effect on inflation, the use of exchange rate to curb persistent inflationary pressure will require prolonged intervention, which could lead to distortions in terms of resource allocation as previously discussed let alone the controllability issue.

Hence, under inflation targeting, the policy interest rate should remain as a policy instrument, while the use of exchange rate should only be supplementary and only applied to a specific circumstance.

VI. Concluding Remarks

The empirical results reveal that exchange rate plays important roles under inflation targeting regime in the case of Thailand. Despite it being a rather weak channel of transmission, exchange rate performs as a shock absorber to the economy. Not until recently that the global inflation environment has faced an increase in inflation norm, has the ability of exchange rate to swiftly alleviate inflationary pressure from higher import prices captured more attention of policymakers and the academia. In response to the issue, the Small Model suggests that exchange rate may have an additional role in mitigating inflationary pressure, but only under specific circumstances due to its volatile nature. Furthermore, preconditions and limitations on the use of exchange rate, such as controllability and its short-lived impact, need to be accounted for. After all, the use of exchange rate can thus be only supplement to the use of interest rate as the policy tool under inflation targeting regime.

Regarding the complex and intriguing nature of the exchange rate related actions, appropriate communication scheme on how much the central banks should be transparent on the policy usage is required. This is first, to minimize confusions of the public on the commitment of central banks under the inflation targeting regime and second, the well-designed communication scheme can lead to more effective policy conduct. To such extent, central banks have to ensure the public that foreign exchange intervention is determined and conducted in the most prudent manner with a support of the tight governance arrangements.

It is also important to bear in mind that the policy implications have been drawn based on a Small Model, the structure of which is subject to certain limitations. For its simplicity and tractability, it may not be able to capture the complete dynamics of the economy. Moreover, another apparent limitation lies in the model's two-country feature with the US representing the rest of the world. In the past, this feature may not be a distance away from reality. Nonetheless, changing landscape of the global economy has played down the role of the US. Developments of a more comprehensive foreign sector to better reflect the rest of the world is currently underway.

Apart from the limitations in terms of the model's structure itself, the Small Model and other complementary analytical tools were constructed to reflect the past and present economic structure. Going forward, the constantly changing economic structure may no longer warrant similar policy conclusions. The globalization trend, which will bring about the continuously evolving behaviors and instruments in the financial market, could gradually alter the structure of monetary policy transmission mechanism (Ahuja *et al.*, 2008) and produce more uncertainty to the efficacy of exchange rate management. Furthermore, the ongoing liberalization of international capital flows, especially the case of emerging markets like Thailand, will add on to the uncertainty for such policy use.

Not only will globalization bring about structural changes, it may also cause unduly volatile international capital movements, leading to the likely increase in exchange rate volatility. In that case, the limited degree of exchange rate controllability will further be exacerbated, while the required amount of resources for each attempt in exchange rate management will certainly mount. On the production side, exporters and importers may suffer from a higher degree of exchange rate fluctuations; hereby posing negative impacts on economic growth. In short, the inflation-output tradeoff (i.e. the sacrifice ratio) is deemed to be worsened rendering the use of exchange rate for inflation purposes more costly.

To mitigate the possible adverse impacts from the changing financial landscape as well as the higher degree of globalization on output and to enhance policy efficacy, well-developed financial market is the key requirement. Meanwhile, the availability of financial instruments, particularly hedging tools, is one of the essential steps that can facilitate both the real and financial sectors in coping with the higher degree of uncertainty along this adjustment period.

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Appendix I: Variable definitions and calculations

y_t and y^f_t is the real GDP for Thailand and the US respectively

$ygap_t = 100 \times \log(y_t / \text{Hodrick-Prescott filtered } y_t)$

$ygap^f_t = 100 \times \log(y^f_t / \text{Hodrick-Prescott filtered } y^f_t)$

CPI_t and CPI^f_t are consumer price indices for Thailand and the US respectively (1994 = 100)

$\pi_t = 400 \times \log(CPI_t/CPI_{t-1})$ and likewise $\pi^f_t = 400 \times \log(CPI^f_t/CPI^f_{t-1})$

$\pi 4_t = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$ and similarly $\pi 4^f_t = (\pi^f_t + \pi^f_{t-1} + \pi^f_{t-2} + \pi^f_{t-3})/4$

i_t is the policy rate (14-day repurchase rate until 2006 Q4 and 1-day repurchase rate from 2007 Q1 onwards)

i^f_t is the fed funds rate (in percentage per annum)

$r_t = i_t - \pi_{t+1}$ and $r^f_t = i^f_t - \pi^f_{t+1}$

fx_t is the bilateral exchange rate expressed in terms of Thai bahts per one US dollar

$z_t = 100 \times \log(fx_t \times CPI^f_t / CPI_t)$

$\Delta er_t = \Delta z_t + \pi_t - \pi^f_t$

CA_t is the ratio of current account balance to GDP (in percentage)

Appendix II: The Small Model

The Thai economy

$$ygap_t = \beta_1 ygap_{t-1} + \beta_2 ygap_{t+1} - \beta_3 (r_t - r^*) + \beta_4 (z_t - z^*) + \beta_5 ygap_t^f + \varepsilon_t^y$$
$$\pi_t = \delta_1 \pi 4_{t+4} + \delta_3 \pi 4_{t-1} + \delta_2 ygap_t + (1 - \delta_1 - \delta_3)(\pi_t^f + \Delta er_t) + \varepsilon_t^p$$
$$z_t = z_{t+1}^e - \gamma_2 (r_t - r_t^f - risk)/4 - \gamma_3 CA_t + \varepsilon_t^z$$
$$z_{t+1}^e = \lambda z_{t+1} + (1-\lambda) z_{t-1}$$
$$CA_t = \tau_1 (z_t - z_{t-1}) - \tau_2 ygap_t + \tau_3 ygap_t^f + \varepsilon_t^{CA}$$
$$i_t = \alpha_1 i_{t-1} + (1-\alpha_1)\left[r^* + \pi_{t+1} + \alpha_2 (\pi 4_{t+4} - \pi^*) + \alpha_3 ygap_t\right] + \varepsilon_t^i$$

The rest of the world (the US)

$$ygap_t^f = \beta_1^f ygap_{t-1}^f + \beta_2^f ygap_{t+1}^f - \beta_3^f (r_t^f - r^{f*}) + \varepsilon_t^{yf}$$
$$\pi_t^f = \delta_1^f \pi 4_{t+4}^f + (1-\delta_1^f)\pi 4_{t-1}^f + \delta_2^f ygap_t^f + \varepsilon_t^{pf}$$
$$i_t^f = \alpha_1^f i_{t-1}^f + (1-\alpha_1^f)\left[r^{f*} + \pi_{t+1}^f + \alpha_2^f (\pi 4_{t+4}^f - \pi^{f*}) + \alpha_3^f ygap_t^f\right] + \varepsilon_t^{if}$$

Identities

$$\Delta z_t = \Delta er_t - \pi_t + \pi_t^f$$
$$\pi 4_t = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$$
$$r_t = i_t - \pi_{t+1}$$
$$\pi 4_t^f = (\pi_t^f + \pi_{t-1}^f + \pi_{t-2}^f + \pi_{t-3}^f)/4$$
$$r_t^f = i_t^f - \pi_{t+1}^f$$

Appendix III: Priors and posteriors of parameters

Domestic				
	Priors			Posteriors
Parameter	Mean	Standard Error	Distribution	Mean
β_1	0.70	0.20	Beta	0.73
β_2	0.10	0.03	Beta	0.08
β_3	0.10	0.03	Gamma	0.05
β_4	0.10	0.03	Gamma	0.03
β_5	0.10	0.03	Beta	0.10
δ_1	0.30	0.06	Gamma	0.25
δ_2	0.25	0.06	Gamma	0.22
δ_3	0.30	0.06	Gamma	0.34
α_1	0.50	0.10	Beta	0.87
α_2	1.50	0.50	Gamma	1.51
α_3	0.50	0.10	Beta	0.52
λ	0.50	0.20	Beta	0.56
γ_2	0.50	0.50	Gamma	0.08
γ_3	0.50	0.50	Gamma	0.03
τ_1	0.30	0.50	Gamma	0.00
τ_2	0.90	0.50	Gamma	1.43
τ_3	1.30	0.50	Gamma	0.70
Foreign				
	Priors			Posteriors
Parameter	Mean	Standard Error	Distribution	Mean
β^f_1	0.70	0.20	Beta	0.68
β^f_2	0.10	0.03	Beta	0.08
β^f_3	0.10	0.03	Gamma	0.08
δ^f_1	0.20	0.06	Gamma	0.46
δ^f_2	0.30	0.06	Gamma	0.28
α^f_1	0.50	0.10	Beta	0.89
α^f_2	2.00	0.40	Gamma	1.72
α^f_3	0.50	0.10	Beta	0.49