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กลไกการส่งผ่านของนโยบายการเงินในประเทศไทย

Monetary Policy and the Transmission Mechanism in Thailand

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บทสรุป

ข้อคิดเห็นที่ปรากฏในบทความนี้เป็นความเห็นส่วนตัวของผู้เขียนโดยเฉพาะ ซึ่งไม่จำเป็นต้องสอดคล้องกับนโยบายของธนาคารแห่งประเทศไทย

บทความนี้มีจุดประสงค์ที่จะเสริมความเข้าใจในเรื่องกลไกการทำงานของนโยบายการเงิน (Monetary transmission mechanism) โดยการค้นคว้าข้อเท็จจริงเกี่ยวกับกลไกการส่งผ่านของนโยบายการเงินในประเทศไทย เพื่อศึกษาว่ามีช่องทางอะไรบ้างที่เป็นช่องทางสำคัญ รวมทั้งศึกษาระยะเวลาในการส่งผ่านผลจากการปรับเปลี่ยนนโยบายการเงินไปสู่ระดับราคาและการขยายตัวของระบบเศรษฐกิจ ทั้งนี้ด้วยการที่โครงสร้างของระบบสถาบันการเงินเป็นองค์ประกอบที่สำคัญยิ่งสำหรับกลไกการทำงานของนโยบายการเงิน บทความนี้จึงได้ศึกษาความรวดเร็วในการปรับตัวของอัตราดอกเบี้ยธนาคารพาณิชย์ต่ออัตราดอกเบี้ยนโยบายด้วย นอกจากนี้เพื่อช่วยในการประเมินประสิทธิภาพของนโยบายการเงินในประเทศไทย บทความนี้ได้เปรียบเทียบผลที่ได้กับผลการศึกษาในประเทศอื่นๆด้วย

กลไกการส่งผ่านของนโยบายการเงินในประเทศไทย

วิกฤตเศรษฐกิจที่ผ่านมา ได้ส่งผลกระทบอย่างสำคัญต่อระบบการเงินไทย โดยเฉพาะในส่วนของระบบธนาคารที่ได้รับผลกระทบอย่างกว้างขวาง จากปัญหาหนี้ที่ไม่ก่อให้เกิดรายได้และความเพียงพอของเงินกองทุนตามมาตรฐานสากล คำพูดที่ได้ยินได้ฟังในช่วงหลายปีที่ผ่านมา คือ ระบบการเงินของไทยไม่ทำงานหรือการทำงานไม่มีประสิทธิภาพ ทำให้การฟื้นตัวทางเศรษฐกิจทำได้ลำบาก และล่าช้ากว่าหลายประเทศที่มีวิกฤตการเงินเช่นเดียวกับประเทศไทย ประเด็นการปรับตัวของสถาบันการเงินที่ส่งผลกระทบในเชิงนโยบายคือ ระบบการเงินที่ทำงานอย่างไม่เต็มประสิทธิภาพ เป็นอุปสรรคสำคัญต่อการดำเนินนโยบายการเงินของธนาคารกลาง ทำให้ธนาคารแห่งประเทศไทย (ธปท.) ไม่สามารถใช้นโยบายการเงินเพื่อฟื้นฟูเศรษฐกิจได้อย่างเต็มที่ ปัญหาและอุปสรรคดังกล่าว จึงเป็นภารกิจของธนาคารแห่งประเทศไทย ในการศึกษาว่าภายใต้สภาวะแวดล้อมทางการเงินที่เปลี่ยนไปดังกล่าว กลไกนโยบายการเงินมีขบวนการทำงานอย่างไรในการกระตุ้นให้เกิดกิจกรรมทางเศรษฐกิจ และมีข้อจำกัดอะไรบ้าง เพื่อให้ธนาคารแห่งประเทศไทยสามารถเลือกใช้วิธีการในการดำเนินนโยบายการเงินอย่างเหมาะสมและมีประสิทธิภาพในการดูแลเศรษฐกิจในระยะข้างหน้า

บทความนี้จึงมีจุดประสงค์ที่จะเสริมความเข้าใจในเรื่องกลไกการทำงานของนโยบายการเงิน (Monetary transmission mechanism) โดยการค้นคว้าข้อเท็จจริงเกี่ยวกับกลไกการส่งผ่านของนโยบายการเงินในประเทศไทย ทั้งนี้การศึกษากลไกการทำงานของนโยบายการเงินคือ การวิเคราะห์การเปลี่ยนแปลงที่จะเกิดขึ้นในระบบเศรษฐกิจหลังจากที่ทางการได้ปรับเปลี่ยนทิศทางของนโยบายการเงิน เพื่อศึกษาว่ามีช่องทางอะไรบ้างที่เป็นช่องทางสำคัญ ในการส่งผ่านผลจากการปรับเปลี่ยนนโยบายการเงินไปสู่ระดับราคาและการขยายตัวของระบบเศรษฐกิจ นอกจากนี้เพื่อช่วยในการประเมินประสิทธิภาพของนโยบายการเงินในประเทศไทย บทความนี้ได้เปรียบเทียบผลที่ได้กับผลการศึกษาในประเทศอื่นๆ ด้วย

กลไกการทำงานของนโยบายการเงิน เริ่มต้นจากการกำหนดนโยบายการเงินของธนาคารกลาง เพื่อที่จะควบคุมอัตราการเจริญเติบโตของประเทศ ปริมาณการผลิต และอัตราเงินเฟ้อ (ซึ่งเป็นเป้าหมายสูงสุดของการดำเนินนโยบายการเงิน) ให้อยู่ในระดับที่เหมาะสมและสอดคล้องกับโครงสร้างของระบบเศรษฐกิจ ทั้งนี้ ขั้นตอนระหว่างการกำหนดนโยบายและผลต่อภาคการผลิตที่แท้จริงนั้นขึ้นอยู่กับกลไกการทำงานของนโยบายการเงิน ซึ่งบทความนี้จะศึกษา

4 ช่องทางหลักด้วยกัน ได้แก่ 1) ช่องทางอัตราดอกเบี้ย (Interest rate channel) 2) ช่องทางสินเชื่อ (Credit channel) 3) ช่องทางราคาสินทรัพย์ (Asset price channel) และ 4) ช่องทางอัตราแลกเปลี่ยน (Exchange rate channel)

ด้วยการที่โครงสร้างของระบบสถาบันการเงินเป็นองค์ประกอบที่สำคัญยิ่งสำหรับกลไกการทำงานของนโยบายการเงิน ความรวดเร็วในการปรับตัวของอัตราดอกเบี้ยธนาคารพาณิชย์ ต่ออัตราดอกเบี้ยนโยบายจึงเป็นปัจจัยหลักที่จะกำหนดประสิทธิภาพของนโยบายการเงินในขั้นเบื้องต้น บทความนี้จึงได้ศึกษาถึงอิทธิพลของอัตราดอกเบี้ยตลาดซื้อคืนพันธบัตรระยะ 14 วัน ซึ่งเป็นอัตราดอกเบี้ยนโยบายของธปท. ที่มีต่อการปรับตัวของอัตราดอกเบี้ย ทั้งอัตราเงินฝากประจำ 3 เดือนและอัตราดอกเบี้ยให้กู้ยืมลูกค้ารายใหญ่ชั้นดี (MLR) ทั้งนี้ ในการศึกษาพบว่าอัตราดอกเบี้ยเงินฝากโดยปกติแล้วจะปรับตัวเร็วกว่าอัตราดอกเบี้ยเงินให้กู้ยืมและการปรับตัวดังกล่าวจะไม่สมบูรณ์ หรือหนึ่งต่อหนึ่ง นอกจากนี้ การศึกษายังได้พบว่าขนาดและความเร็วของการส่งผ่านลดต่ำลงหลังวิกฤตค่าเงิน ซึ่งสะท้อนถึงสภาพคล่องที่สูงกว่าช่วงก่อนวิกฤต รวมทั้งความอ่อนแอของระบบธนาคารพาณิชย์ของไทยหลังวิกฤตที่ไม่ทำงานตามปกติ

ในขั้นต่อไป การศึกษาได้ประเมินผลกระทบโดยรวมของนโยบายการเงินต่อตัวแปรเศรษฐกิจมหภาคหลัก ก่อนที่จะแยกผลกระทบนั้นตามช่องทางต่างๆที่กล่าวถึงข้างต้น ทั้งนี้การศึกษาเชิงวิเคราะห์นั้น ได้เน้นวิธีการทางเศรษฐมิติที่เรียกว่า Vector Autoregression (VAR) เป็นหลัก จากการวิเคราะห์ผลกระทบของนโยบายการเงินต่อเศรษฐกิจโดยรวมนั้น ได้พบข้อเท็จจริงหลักๆ เกี่ยวกับการปรับตัวของระบบเศรษฐกิจต่อการขึ้นอัตราดอกเบี้ยนโยบาย 3 ข้อ ซึ่งสามารถสรุปได้ดังนี้

1. ระดับราคาโดยรวมนั้นตอบสนองต่อการเปลี่ยนแปลงนโยบายการเงินเพียงเล็กน้อยในช่วงแรก แต่เริ่มลดลงหลังจากประมาณหนึ่งปี และมีผลที่ค่อนข้างจะยั่งยืนพอสมควร

2. การตอบสนองของผลิตภัณฑ์มวลรวมในประเทศ (GDP) นั้นเป็นลักษณะคล้ายรูปตัว U โดยถึงจุดต่ำสุดหลังจากประมาณ 4 - 5 ไตรมาส และผลกระทบจางหายไปในเวลาประมาณ 11 ไตรมาส

3. เมื่อเปรียบเทียบกับองค์ประกอบต่างๆ ของอุปสงค์รวมแล้ว พบว่าการลงทุนดูเหมือนจะตอบสนองต่อการเปลี่ยนแปลงนโยบายการเงินมากที่สุด

อนึ่ง ข้อสังเกตเหล่านี้สอดคล้องกับผลการศึกษาในต่างประเทศที่ใช้วิธีการคล้ายกัน รวมถึงประเทศสหรัฐอเมริกา และประเทศต่างๆในยุโรปด้วย

สำหรับการวิเคราะห์ความสำคัญของแต่ละช่องทางของกลไกการทำงานของนโยบายการเงินนั้น พบว่าการส่งผ่านนโยบายการเงินผ่านช่องทางอัตราดอกเบี้ยและสินเชื่อ มีบทบาทที่สำคัญ ในขณะที่ช่องทางส่งผ่านทางอัตราแลกเปลี่ยน และทางราคาสินทรัพย์นั้นมีบทบาทน้อยกว่าเมื่อเปรียบเทียบกันแล้ว อย่างไรก็ตาม บทบาทของช่องทางสินเชื่อนั้น ดูเหมือนว่ามีความสำคัญที่ลดน้อยลงในช่วง 3 ปีที่ผ่านมา ซึ่งสะท้อนถึงการที่ภาคธุรกิจหันไปพึ่งพาแหล่งทุนที่ไม่ใช่ธนาคารเพิ่มมากขึ้น และความอ่อนแอของธนาคารพาณิชย์ทั้งระบบ ซึ่งมีสาเหตุหลักมาจากหนี้ที่ไม่ก่อให้เกิดรายได้ปริมาณมากที่เกิดขึ้นภายหลังวิกฤติค่าเงิน นอกจากนี้ ความอ่อนแอทางบัญชีและสถานะงบดุลของภาคธุรกิจ ได้เป็นปัจจัยหนึ่งที่จำกัดอุปสงค์เพื่อการลงทุนไว้ ส่งผลให้นโยบายการเงินมีประสิทธิภาพน้อยลง ทั้งการส่งผ่านโดยช่องทางสินเชื่อ และช่องทางอัตราดอกเบี้ย

ดังนั้นการฟื้นตัวของระบบธนาคารพาณิชย์และการลดหนี้ในงบดุลของภาคธุรกิจจึงเป็นขั้นตอนถัดไปที่สำคัญในการส่งเสริมให้นโยบายการเงินทำงานได้อย่างสมบูรณ์ ในขณะเดียวกันการปรับตัวของอัตราดอกเบี้ยธนาคารพาณิชย์ ต่ออัตราดอกเบี้ยนโยบายที่คล่องตัวขึ้นจะช่วยเพิ่มประสิทธิภาพให้แก่การทำงานของระบบการเงินด้วย ทั้งนี้ เพื่อเพิ่มประสิทธิภาพของนโยบายการเงินในอนาคต ธปท. ควรเตรียมการในด้านต่างๆ อาทิ การแก้ไขปัญหาสถาบันการเงิน การผลักดันการปรับโครงสร้างหนี้ในภาคเอกชน การพัฒนาตลาดรองของตลาดตราสารหนี้ และการพัฒนาเครื่องมือทางการเงินใหม่ๆ ซึ่งจะสร้างความคล่องตัวให้กับกลไกการทำงานของนโยบายการเงินของไทย และเอื้อต่อการรักษาเสถียรภาพของเศรษฐกิจไทย รวมทั้งเป็นรากฐานของการพัฒนาประเทศอย่างยั่งยืนต่อไป

1. Introduction

Understanding the transmission mechanism of monetary policy—especially the time lag involved between a policy change and its impact on inflation and output—is key to the successful conduct of policy. This paper attempts to improve our knowledge in this respect by addressing one key question: What are the stylized facts concerning the transmission of monetary policy in Thailand? With the emphasis on identifying the empirical regularities associated with monetary policy shocks in Thailand, the analysis carried out in this paper are of a positive rather than normative nature. We focus on what is rather than what should be.

How can monetary authorities influence the level of activity in the economy? There are a number of different but related channels through which changes in the stance of monetary policy affect the real economy. They include the traditional interest rate channel, the credit channel, the exchange rate channel, and the asset price channel.[1] We will discuss each of these in turn and attempt to gauge their relative importance in Thailand. While the impact of monetary policy on the real economy and prices are determined by the monetary transmission mechanism taken as a whole, and by their respective importance, the regulatory framework of banking, as well as banking practices specific to each country and the structure of assets and liabilities also play a role in influencing the reactions by non-financial agents to interest rate changes. In addition, the degree of liquidity constraints related to bank practices influences the extent to which household and business expenditures are affected by monetary policy. For example, ceilings on indebtedness and large down-payment requirements hamper the ability of consumers to substitute between present and future expenditure, limiting the impact of changes in monetary policy on consumption. This constraint has been significant in Thailand as the consumer credit business has not really been developed until recently and, to a large extent, the desire by households to raise their spending when interest rates fall has been limited by their current earnings.

Our strategy for analyzing the transmission mechanism in Thailand is to first obtain a good quantitative assessment of the dynamic consequences of a change in the policy controlled interest rate on the main macroeconomic variables. Armed with these estimates, one could then gauge the overall impact of policy and attempt to disentangle the channels through which it takes place. In doing so, this paper relies heavily on the use of vector auto-regressions (VARs). These are dynamic systems of equations that examine the inter-relationships between economic variables, imposing minimal assumptions about the underlying structure of the economy, which—given the limited knowledge and lack of consensus about the transmission mechanism in Thailand—is a distinct advantage. VARs have also been used extensively to study monetary transmission in other countries so we can readily compare our results for Thailand with the international evidence.[2]

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[1] A concise overview of the channels of monetary transmission is given by Mishkin (1996).

[2] A brief technical summary of the VAR methodology is presented in Appendix A.

The paper is organized as follows. We begin by examining the degree of pass-through from market interest rates to banks' retail rates in Section 2, which—given Thailand's heavy reliance on bank lending—constitutes a key element of the transmission mechanism. Results from our VAR analysis are then presented in Section 3. We start by exploring possible measures of monetary policy to be used in the VAR before going on to estimating a simplified basic model, which is then extended to examine the sensitivity of different components of aggregate demand—private consumption, investment, exports, and imports—to monetary shocks. Next, we analyze the main channels through which monetary policy is transmitted to the real economy by comparing the output response to monetary shocks when successive channels of transmission are blocked off in the VAR, to the baseline response when the channel of interest is allowed to operate. Differences in the path of output gives an indication of the importance of that particular channel in acting as a conduit for monetary policy. Finally, we present a summary VAR that we feel captures the key elements of the transmission mechanism in Thailand. Section 4 concludes and some technical details are collected in an appendix.

2. Interest Rate Pass-Through in Thailand

A key dimension of the monetary transmission mechanism lies in the size and speed with which retail interest rates respond to changes in policy or money market interest rates. Retail rates are important because they represent the marginal cost of new credit as well as the opportunity cost of funds in the economy, especially in the countries such as Thailand where non-bank sources of finance are still limited. We therefore begin our exploration of Thailand's transmission mechanism by attempting to gauge the pass-through from money market rates (we use the 14-day repurchase rate, RP14) to bank lending (MLR) and deposit (3-month fixed term) rates, and discuss possible sources of stickiness associated with movements in retail rates.[3] To obtain a better sense of how sensitive retail rates in Thailand are to money market rates, the speed and size of the pass-through will be compared to those of other countries and their stability over time will also be examined by comparing the results from using the entire sample—from January 1989 to March 2002—with those obtained with data only up to December 1995. This should provide us with an indication of how the pass-through has been affected by the 1997 crisis.

We conduct our analysis using two methodologies—each with its own advantages—common in the literature, the dynamic multiplier method and the error-correction model (ECM). The dynamic multiplier method, as popularized by Cottarelli and Kourelis (1994), involves estimating a simple dynamic model in which the relevant retail rate is regressed on lagged values of itself and a money market. The degree of pass-through is then measured by looking at the estimated impact of changes in money market rates on retail rates at different horizons (we focus on the impact, 3-

[3] We choose RP14 as our money market rate since it is a better predictor of retail rates than the overnight rate. In any case, the results were similar using the overnight rate.

month, 6-month, and the long-run multipliers).[4] Since augmented Dickey-Fuller (ADF) tests indicate that all of our interest rate series are I(1), the regressions were run in first differences. One drawback of such a specification, however, is the loss of long-run information about the level of the variables.[5]

Our second estimation methodology overcomes this problem by incorporating the long-run information in the first difference regression through the use of cointegration techniques. The underlying idea is that non-stationary time series can drift apart in the short run, but are governed by a stable equilibrium relationship in the long-run. If variables are cointegrated, the relationship between them can be modeled through an error correction model. Since we cannot reject cointegration between each retail rate and RP14, we estimate the ECM using the two-step Engel-Granger procedure.

The results for the 3-month deposit rate are shown in Table 1. The immediate pass-through from RP14 to the 3-month deposit rate is quite low for both samples, with a 100 basis point rise in RP14 translating into less than a 6 basis points increase in the deposit rate. As the horizon becomes longer, however, it is apparent that the speed of pass-through has declined after the crisis, with the 3-month deposit rate adjusting—in response to a 100 basis points change in RP14—by only around 43 basis points in the long run compared to 70 basis points in the pre-crisis sample.[6] A clearer picture of how interest rate pass-through has changed over time can be obtained from the left-hand panel of Figure 1, which shows results from a series of rolling regression estimated using a 50-month moving window. While the impact multiplier has been relatively stable, the interim and long run multipliers has fallen with the inclusion of crisis year data. Finally, Table 1 also shows the results from the ECM model. While this methodology tends to give a lower degree of pass-through, they are generally in line with those from the multiplier method. Importantly, they confirm that the long-run pass through and speed of adjustment has indeed declined after the crisis.

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[4] The calculation for the multipliers is provided in Appendix B.

[5] Since we are mainly concerned with the response of retail rates to changes in the money market rates (rather than the determinants of the level of retail rates), this problem is not too serious.

[6] Results from levels regression (not shown) show higher long run pass-through of around 0.9 and 0.7 for the whole and pre-crisis samples, respectively.

Table 1: Pass-through to 3-Month Deposit Rate

Method	Period	Immediate	3-month	6-month	Long-run	Speed of Adjustment
Dynamic multiplier	1989M1-1995M12	0.057	0.402	0.612	0.700	
	1989M1-2002M3	0.059	0.317	0.399	0.429	
ECM: Engel-Granger	1989M1-1995M12				0.500	0.147
	1989M1-2002M3				0.350	0.070

Notes: The dynamic multiplier model was run with 6 lags. The ECM models were both estimated using 4 lags.

Table 2: Pass-through to Minimum Lending Rate

Method	Period	Immediate	3-month	6-month	Long-run	Speed of Adjustment
Dynamic multiplier	1989M1-1995M12	0.089	0.328	0.521	0.558	
	1989M1-2002M3	0.041	0.239	0.356	0.389	
ECM: Engel-Granger	1989M1-1995M12				0.400	0.101
	1989M1-2002M3				0.356	0.080

Notes: The dynamic multiplier model was run with 6 lags. The ECM models were both estimated using 4 lags.

Figure 1: Interest Rate Pass-Through

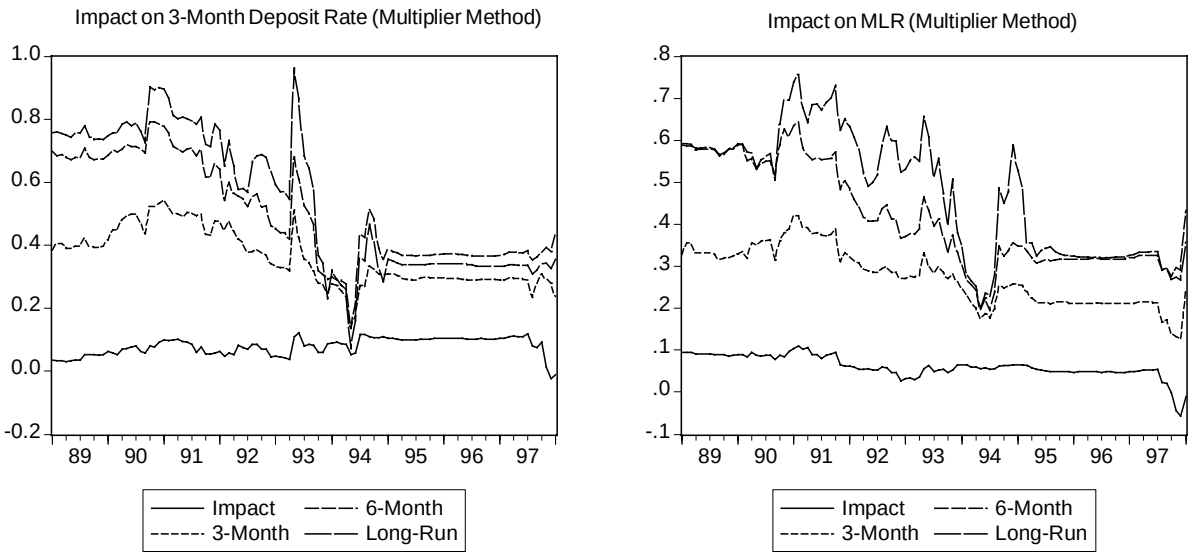

Table 3: Results from Cottarelli and Kourelis (1994)

Country	Impact	3 months	6 months	Long Run
Germany	0.38	0.67	0.83	1.04
Australia	n.a.	0.35	0.67	0.81
US	0.41	0.97	0.97	0.97
UK	0.82	1.02	1.04	1.04
Denmark	0.07	0.25	0.38	0.71
Finland	0.13	0.20	0.27	0.60
Singapore	0.27	0.71	0.82	0.95
Indonesia	0.20	0.74	0.74	1.00
Philippines	0.24	0.64	0.64	0.64
Malaysia	0.13	0.28	0.37	0.44
Japan	0.03	0.22	0.35	0.53
Thailand	0.09	0.33	0.52	0.56

Notes: The table shows dynamic multipliers for measures of minimum lending rates.

Table 2 and the right-hand panel of Figure 1 present the results from similar analysis using the minimum lending rate (MLR). For the pre-crisis sample, the impact multiplier is quite low at 8.9 percent, and long run pass-through of around 56 percent is again incomplete. The ECM regressions also suggest that the long run pass-through has declined along with the speed of adjustment. The latter points to a half-life of around 8 months for the whole sample, compared with just over 6 months using only pre-crisis data.[7] To get a better handle on Thailand's interest rate pass-through, Table 3 presents the results for other counties obtained by Cottarelli and Kourelis (1994) using the dynamic multiplier method. Although the size and speed of the pass-through between 1989 and 1995 in Thailand is comparable to some countries such as Japan, Malaysia, and Finland, they are generally smaller and slower than most other developed countries.

2.1. Why are retail rates in Thailand relatively 'sticky'?

Retail rates may be sticky for a number of reasons. First, informational asymmetries implies that raising bank credit rates may lead to a deterioration in the average creditworthiness of borrowers (due to adverse selection and moral hazard problems) and will not necessarily result in a proportionate increase in banks' expected income. In addition, switching costs—associated with gathering new information—reduces the incentive for depositors and especially borrowers to change banks when others are offering better rates, allowing banks to hold-off on adjusting retail rates (Lowe and Rohling, 1992). At the same time, banks may be reluctant to pass on rate increases to its customers because they are wary of losing them along with established client-specific information which are costly to obtain. Thus banks may be constrained by an implicit interest rate insurance, especially when they are investing in long-term relationships. Certainly in cases where borrowers prefer stable interest payments, a bank may charge a less variable interest rate than its marginal cost of funds for which it is compensated with a higher premium (Fried and Howitt, 1980). Finally, since money market rates contain a high level of 'noise' and given that there are adjustment costs to changing rates, banks may be prepared to do so only if they believe that movements in money market rates are durable.

[7] The half-life of a series refers to the amount of time needed for it to adjust half way to its long run equilibrium following a shock. It is calculated as $log(0.5)/log(1-s)$ where s is the speed of adjustment coefficient.

These adjustment costs tend to be greater the less competitive the banking system is. From the Thai experience, it appears that financial liberalization in the early 1990s, which included the removal of interest rate ceilings and the establishment of the BIBF, resulted in a more competitive market structure that played a part in increasing the degree of interest rate pass-through. Looking forward, once remaining problems in the banking system are sorted out, the trend towards increased competition should resume and bring about a higher degree of sensitivity of retail rates to money market rates.

In summary, the evidence in this section indicates that interest rate pass-through in Thailand is generally lower than those in developed countries. Moreover, the sensitivity of retail rates to money market rates appear to have declined in the aftermath of the 1997 financial crisis, undoubtedly a by-product of unresolved banking sector problems and high liquidity in the system, as well as the changing competitive landscape associated with a smaller number of active financial institutions and less capital inflow. We also find that the 3-month deposit rate is generally more responsive to changes in RP14 than the MLR, most likely a reflection of the fact that the market for deposits is more competitive with lower switching costs.[8] With this in mind, we now turn to more direct analysis of the monetary transmission mechanism.

3. VAR Results

3.1. Indicator of Monetary Policy

Before estimating the VAR, we need to choose an indicator of monetary policy. To guide us in this respect, this section studies the information content of various measures of money aggregates and market interest rates that are plausible candidates. Our maintained assumption is that if policy affects the real economy, then our measure of monetary policy should be a good reduced-form predictor of important macroeconomic variables. To anticipate our results, we generally find the 14-day repurchase rate to be a superior forecaster of the economy although M1 also appears to contain important information about future activity.

In the same spirit as Bernanke and Blinder (1992), we estimated equations that forecast some measure of economic activity by six lags of itself, the log of consumer price index (CPI), the logs of M1 and M2 money supplies, and six lags of both the overnight rate (ONR) and the 14-day repurchase rate (RP14).[9] Our focus is on the predictive power of money and interest rates. The measures of economic activity that

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[8] The faster response of deposit rates may also reflect the tendency of banks to adjust first those asset and liabilities which are closest to the source of shock in terms of maturity.

[9] Lags of the CPI are included since it is presumable real money and real interest rates that affect real variables. Also, once many lags are used, there is little difference between including the price level or the inflation rate in the equation. In addition, the baht/US exchange rate was also included to partly control for the crisis of 1997-98.

we examine include the manufacturing production index (MPI), the private investment index (PII), and the private consumption index (PCI).[10] In addition, we also assessed the relative performance of the candidates against two variables that central banks commonly follow, real credit and the CPI. The sample period encompasses 1989M07 to 2001M12 and all data are seasonally adjusted. Table 4 shows the marginal significance level for the hypothesis that all lags of a particular variable can be excluded from the equation predicting the relevant macro variable. A small value indicates that the column variable is important for predicting the row variable.

Table 4: Marginal Significance Level of Monetary Indicators

Marginal significance level from exclusion test (F-stat), 6 lags
Sample: 1989M7-2001M12 (From 1993M7 for PCI)

Forecasted Variable	M1	M2	ONR	RP14
MPI	0.020	0.010	0.055	0.004
PII	0.001	0.010	0.330	0.214
PCI	0.100	0.345	0.919	0.428
Real Credit	0.638	0.183	0.000	0.010
CPI	0.463	0.408	0.989	0.335

Table 4 indicates that with respect to the MPI, the RP14 is by far the best predictor. It also does very well in predicting real credit and better than all the others in forecasting CPI, although the predictive power here is not very high. However, it is apparent that M1 also contains high predictive power even in the presence of RP14, and actually does best in predicting PII and PCI. When measured against RP14 and M1, ONR and M2 contain less information about future values of the macro variables of interest. Table 5 shows the results when the regressions were run in first differences, and generally confirm the conclusion that emerges from the regressions in levels with, if anything, stronger results for RP14. Overall, it appears that the 14-day repurchase rate is the best predictor of the MPI, real credit and CPI, while M1 contains important information about future values of PII and PCI. These results contrast with those of Bernanke and Blinder (1992) for the US where the Fed Funds Rate was found to be the single best predictor of activity with monetary aggregates containing little information.

One drawback of using these Granger-causality-type tests to assess predictive power is that the right-hand side variables are not orthogonal and thus may not reflect the true importance of each variable as a measure of policy. For example, suppose that RP14 was truly an exogenous policy variable which moved M1, which in turn affects the real economy. Then RP14 might be insignificant in a regression that includes M1 despite the

Table 5: Marginal Significance Level of Monetary Indicators

Marginal significance level from exclusion test (F-stat) 6 lags, first difference
Sample: 1989M8-2001M12

Forecasted Variable	M1	M2	ONR	RP14
MPI	0.030	0.092	0.093	0.011
PII	0.088	0.162	0.354	0.277
PCI	0.059	0.444	0.708	0.060
Real Credit	0.699	0.410	0.000	0.000
CPI	0.470	0.039	0.703	0.003

[10] These measures were chosen because data were available monthly and because they are widely used as indicators of economic conditions. The MPI index used excluded liquor.

fact that it is the genuine driving force. To check robustness of the conclusion, therefore, we also look at a different measure of predictive power which does not suffer from this problem, namely variance decompositions from a VAR with orthogonalized residuals. These give the percentage of the variance of the forecasted variable attributable to each right-hand side variables at different horizons. The results are presented in Table 6. Each row presents the results from a VAR with 6 lags of the variable to be forecasted, the price level, the two money supplies, and the two interest rates. The Baht/US exchange rate was included as an exogenous variable. Each entry is the percentage of variance of the row variable attributable to the column variable at a 24 month horizon.[11] Using this alternative metric, the results confirm the importance of RP14 and M1 in predicting the macro variables of interest with RP14 performing best with respect to the MPI, PII, and real credit, while M1 doing better against the PCI and the CPI.

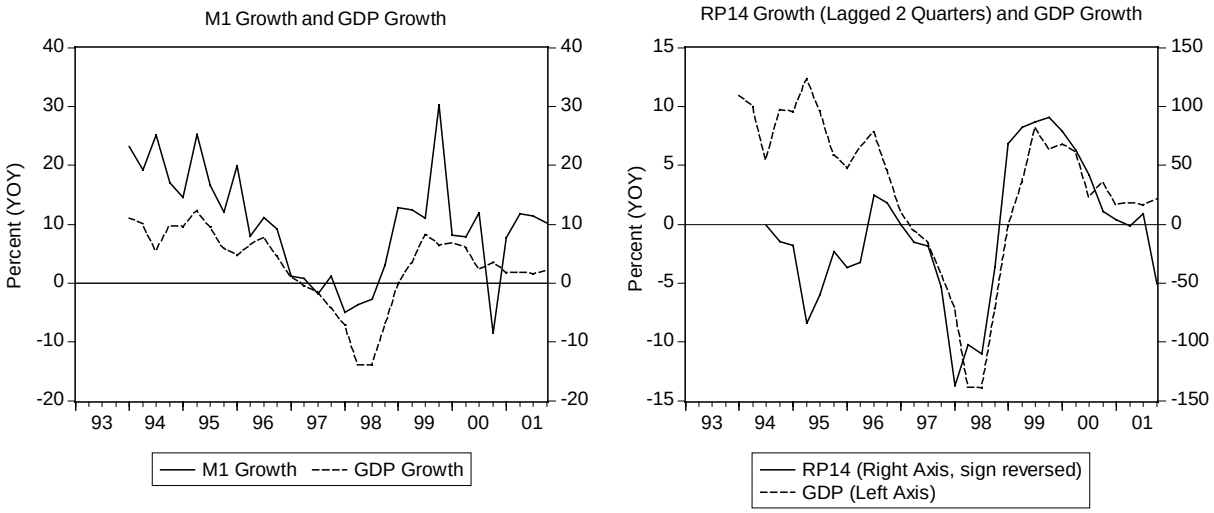
Table 6: Variance Decompositions of Activity Variables

Sample 1989M7-2001M12 (From 1993M7 for PCI) 24 Month Horizon, 6 lags

Forecasted Variable	Own Lags	CPI	M1	M2	RP14	ONR
MPI	33.58	10.85	11.63	3.46	38.28	2.20
PII	40.89	4.77	12.46	3.44	33.87	4.57
PCI	31.55	17.60	30.69	4.84	14.01	1.30
Real Credit	43.94	4.07	5.12	15.55	30.43	0.89
CPI	37.75	-	36.10	15.98	9.98	0.18

Given the importance of RP14 and M1, we examine the relationship between these two variables and GDP. The first thing to note, as suggested by Figure 2 which plots year-on-year growth rates of GDP against M1 and RP14, is that M1 and GDP appear to move together while RP14 tends to lead changes in output by around 2

Figure 2: GDP, M1, and RP14 Growth



[11] The VARs were identified using the standard recursive assumption with the variables ordered as they appear in the table.

quarters.[12] These visual impressions are confirmed by statistical tests in Table 7 which shows that M1 growth does not cause GDP growth while growth in RP14 does. At the same time, RP14 Granger causes M1 as shown in the bottom panel of Table 7. Overall, these results indicate that while M1 and GDP tend to move together contemporaneously, RP14 leads both of them. Given that monetary policy works with a lag, it is reasonable to conclude that RP14 is a better indicator of monetary policy actions than M1 whose movements are more like to contain substantial endogenous demand determined component. Indeed, it is now well recognized that monetary aggregates typically depend on non-policy influences. For example, if BOT operating procedure involves some smoothing of short-term interest rates, as has been the case in Thailand, then shocks to money demand will be partially accommodated by the central bank. As a result, changes in monetary aggregates will reflect both changes in money demand as well as policy, and their innovations will not be accurate measures of monetary policy.[13]

Table 7: Granger Causality Tests

Null Hypothesis:	Probability
M1, RP14, and GDP Growth (1993Q1-2001Q4: 4 Lags)	
GDP Growth does not cause M1 Growth	0.070
M1 Growth does not cause GDP Growth	0.080
GDP Growth does not cause RP14 Growth	0.574
RP14 Growth does not cause GDP Growth	0.023
M1 and RP14 (1989M7-2001M12: 6 Lags)	
M1 does not Granger Cause RP14	0.648
RP14 does not Granger Cause M1	0.040

Nevertheless, the results do indicate that M1 contains important information about real economic developments that could be utilized in a macroeconomic model. Be that as it may, we found the impulse response functions to RP14 shocks in a VAR to be almost identical with or without the inclusion of M1. This suggests that the additional information about interest shocks provided by including M1 in a VAR that already includes GDP, CPI, and RP14 is negligible. This is, in some respects, not totally unexpected given our previous finding that M1 and GDP tend to move together contemporaneously. Consequently, to conserve degrees of freedom, M1 is left out in the analysis below but noting that the results are essentially unchanged when it is included.

[12] Indeed M1 growth and GDP growth have a correlation coefficient of 0.72 while the coefficient for RP14 growth and GDP growth is only 0.04.

[13] The fact that the output response to a money shock is much smaller when M1 is replaced by M0, an aggregate which is more directly under the control of the BOT, along with the small contribution of M1 relative to RP14 in the variance decomposition of output is consistent with the idea that much of the variation in M1 is demand-determined.

3.2. Basic Model

We start our VAR analysis with a small basic model which includes real output (GDP), the CPI (PRICE), and the 14-day repurchase rate (RP14).[14] The latter is our measure of the of monetary policy. In addition to a constant term, the VAR also contains the Baht/US exchange rate as an exogenous variable to control for the 1997 crisis.[15] The estimation is done using quarterly, seasonally-adjusted data from 1993Q1 to 2001Q4 with two lags. While the optimal lag length under various criteria (including the Akaike, Schwarz, and Hannan-Quinn criteria) appears to be one quarter, we feel that this is too short to capture the underlying dynamics of the system. At the same time, we quickly run into degree of freedom problems if we include too many lags. For this reason, the VARs estimated in this paper are quite parsimonious with the set of variables kept relatively small and lag length set to two quarters. In any case, the results are similar with only one lag.[16]

The VAR is identified using a 'recursive' Choleski decomposition with the ordering of variables as listed above.[17] The ordering is in part guided by the finding in Section 3.1 that movements in RP14 tends to lead changes in GDP. In particular, the assumption is that GDP is not affected contemporaneously by shocks to other variables in the system while RP14 responds to innovations in GDP and PRICE within the same period. This reflects an assumption about the speed with which the variables respond to shocks with output being the least responsive, followed by prices, and finally interest rates. This seems plausible and consistent with actual behavior of the economy since changing output and prices are time-consuming processes while monetary authorities set policy with at least some indication about contemporaneous developments in output and prices. In any case, the results are fairly robust to alternative ordering, including some radical ones such as completely reversing the order.

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[14] The VARs were also estimated using private demand (real GDP minus total government spending, which is primarily driven by fiscal policy) instead of GDP but the results are almost identical. Similarly, the results in this paper are robust to the inclusion of oil or world commodity prices to capture supply shocks, as well as to the inclusion of the Fed Funds Rate to reflect developments in world interest rates.

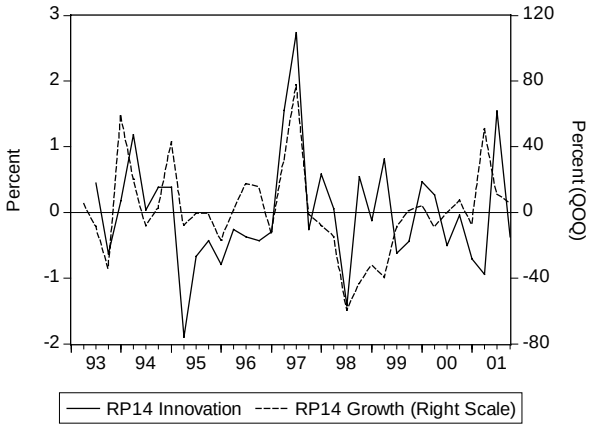
[15] This seems to be able to capture the large residuals associated with the crisis and is more satisfactory, from an economic point of view, than including a crisis dummy.

[16] Generally speaking, lag length criteria such as the Akaike and Schwartz statistic are not without shortcomings and should be used more as a guide than hard-fast rules. Ramaswamy and Sloek (1997) also used two lags in their cross-country comparison of monetary transmission in the EU, as did Morsink and Bayoumi (2001) in their analysis of Japan.

[17] See Appendix A for a description of alternative identifying schemes.

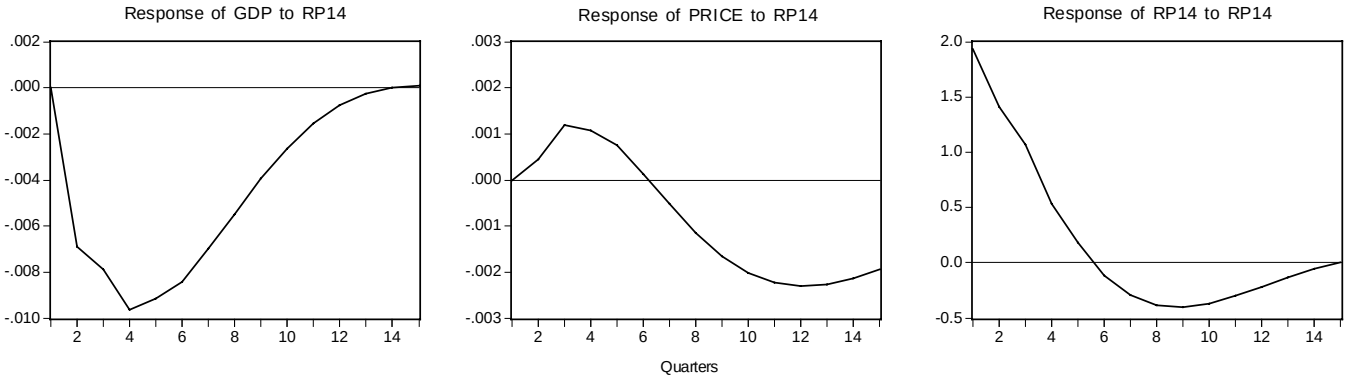
At the outset, it is useful to examine whether the monetary policy shocks identified by our VAR seem reasonable. Figure 3 plots the recovered structural RP14 innovations against the quarter-on-quarter growth of RP14, where positive innovations in RP14 are identified with monetary policy tightening while negative values represent episodes of loosening. The graph indeed shows that positive structural innovations are generally associated with increases in the RP14 rate while negative innovations with declines, as one would expect.

Figure 3: Structural Innovations



We now turn to the impulse response functions from the basic model, which are presented in Figure 4.[18] These basically traces out the implied dynamic paths of the endogenous variables in the system following a one-time shock to one of the innovations. They allow us to 'see' the monetary transmission mechanism unfolding by illustrating the response of the system to a shock in our measure of monetary policy. An unexpected tightening of monetary policy—corresponding approximately to a 2 percent rise in RP14—gives rise to a U-shaped output response which bottoms out after around 4-5 quarters (at 0.82 percent below baseline) and dissipates after 12 quarters. Prices don't begin to decline until about 6 quarters, and although the fall itself is quite small (around 0.23 percent below baseline at the maximum), it seems

Figure 4: Basic Model



[18] All impulse responses in this paper are based on one standard deviation innovations in the variable of interest.

quite persistent. Finally, the interest rate shock is also quite persistent, taking around 6 quarters to dissipate.[19]

The initial positive response of prices to a contractionary monetary policy shock seems somewhat contradictory, but is commonly found in the literature and has been dubbed the 'price puzzle'. A leading explanation is the failure to include a rich enough specification of the information available to policymakers. If policy makers can observe variables that contain useful information about future inflation, but those variables are left out of the model, then positive innovations in interest rates may be associated with higher prices because they partly reflect systematic policy responses to information indicating that inflation is on the way. As will be shown below, the inclusion of bank credit can effectively remove the price puzzle in the case of Thailand.

To get an idea of the share of the fluctuations in a given variable that are caused by different shocks, Table 8 presents variance decompositions for each variable at forecast horizons of one through four years. The columns give the percentage of the variance due to each shock, with each row adding up to 100. The results indicate that, after two years, interest rate shocks account for around 35 percent of the fluctuation in output, with own shocks accounting for most of the rest. This is similar to empirical results for the U.S. and indicate that interest rate innovations are an important determinant of fluctuations in economic activity.

Table 8: Variance Decomposition for the Basic Model

Variance Decomposition of GDP			
Period	GDP	PRICE	RP14
4	73.30	5.15	21.56
8	58.23	5.91	35.86
12	56.10	8.05	35.85
16	55.90	8.47	35.63
Variance Decomposition of PRICE			
Period	GDP	PRICE	RP14
4	12.19	82.91	4.90
8	55.87	40.20	3.93
12	59.35	28.60	12.05
16	54.80	26.98	18.22
Variance Decomposition of RP14			
Period	GDP	PRICE	RP14
4	30.30	14.49	55.20
8	38.81	16.31	44.88
12	38.14	15.90	45.96
16	38.77	15.83	45.40

Finally, it is important to note that when the VAR was re-estimated using data up to only 1999Q1, the output and price response is larger. In response to an interest shock of roughly the same size, trough output is 1.2 percent below baseline after 4 quarters, while prices decline by 0.28 percent at the maximum. This gives an indication of the extent to which the effectiveness of monetary policy has been reduced in recent

[19] Using the same recursive identification scheme adopted in this paper, Ramaswamy and Sloek (1997) find that transmission of monetary policy shocks in the EU countries fall into two main groups. In one group (Austria, Belgium, Finland, Germany, the Netherlands, and the UK) output bottoms out approximately 11 to 12 quarters following a contractionary monetary shock, with the decline in output amounting to around 0.7 to 0.9 percent from the baseline. In the other group (Denmark, France, Italy, Portugal, Spain, and Sweden) output typically bottoms out about 5 to 6 quarters following a contractionary impulse, with the decline in output being in the range of 0.4 to 0.6 percent from baseline. In all cases, the monetary shock corresponds approximately to a 1 percentage point shock to the interest rate.

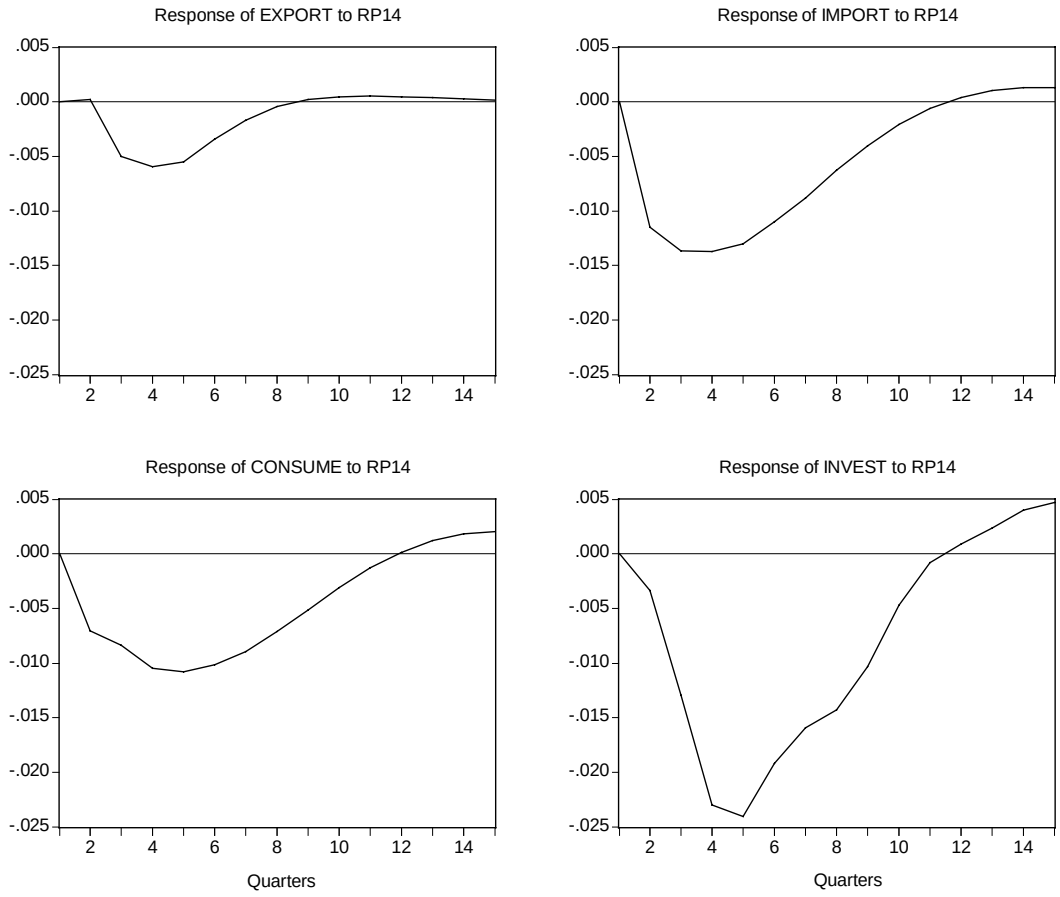
years by structural problems relating particularly to difficulties in the banking and corporate sectors. We will revisit this issue in more detail below in our analysis of the different channels of monetary transmission.

3.3. Components of Aggregate Demand

The basic VAR is now extended to examine which components (private consumption, investment, exports, and imports) of real GDP are most affected by monetary policy. This is accomplished by re-estimating the basic model with real GDP split into the particular component being examined and the remainder. For example, to analyze the response of exports, the VAR includes GDP less exports, exports, PRICE, and RP14. Figure 5 shows the response of the individual components of GDP to an RP14 shock. The graphs are plotted on the same scale and in all cases, the monetary shock amounts to roughly a 1.7 percent rise in the RP14 rate.

The results indicate that monetary policy operates on the real economy largely through its impact on investment. A typical innovation in the RP14 lowers investment quite steeply, bottoming out after 5 quarters at around 2.5 percent below baseline. By contrast, at its trough, consumption is only slightly over 1 percent lower than baseline

Figure 5: Components of Aggregate Demand



after 5 quarters.[20] The response of imports largely mirrors those of consumption and while exports do decline eventually, in line with an exchange rate channel story, the effect is quite small and dissipates quickly. The latter is not entirely unexpected given that for much of the sample, Thailand was operating under a fixed-exchange rate regime. While the importance of investment is consistent with the traditional channel of monetary transmission—higher interest rate leading to lower investment demand—it is also suggestive of the presence of a significant bank lending channel since investment in Thailand has historically relied heavily on bank credit, at least at the margin. It is directly to these issues that we now turn.

3.4. Channels of Monetary Transmission

We gauge the strength of each channel by first appending the basic model with a variable that captures the particular channel of interest and calculating two sets of impulse responses: one with the variable treated as endogenous in the VAR and another where it is included as an exogenous variable. The latter procedure generates a VAR identical to the former (with identical orthogonalized innovations), except that it effectively blocks off any responses within the VAR that passes through the variable of interest. Comparison of the output responses of the two models thus provides a measure of the importance of that particular channel in acting as a conduit for monetary policy to the real economy.[21]

Before turning to the results, we should note that to really get a good grip on the importance of each channel of transmission, one would have to study each in detail, ideally making use of micro-data (for example as in Kashyap and Stein, 1997, for the US) such as corporate flow of funds data. Given the data constraints for Thailand and the focus on documenting stylized facts about monetary transmission, this paper adapts the VAR methodology to obtain rough indications of the relative importance of each channel. Once the picture becomes clearer and key elements of the 'black box' identified, further research can be conducted to more systematically uncover the factors responsible for making one channel more important than the other in the case of Thailand.

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[20] The larger response of investment relative to consumption is even more pronounced in light of the fact that the RP14 innovation is actually somewhat larger in the consumption VAR. Barran et.al. (1996) also find for the EU countries that monetary shocks affect aggregate demand primarily through its impact on investment.

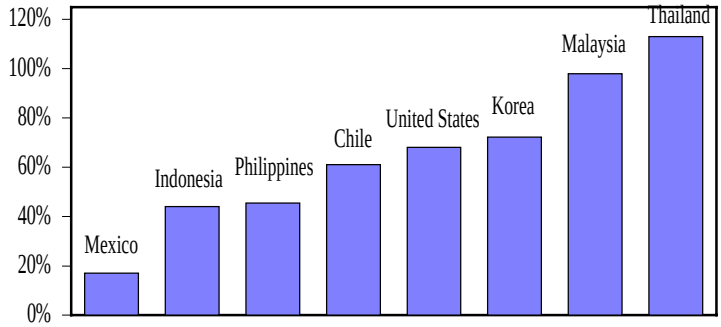
[21] Bayoumi and Morsink (2001) applied a similar method in their analysis of the Japanese monetary transmission mechanism.

3.4.1. Bank Lending Channel

We begin by examining the role of bank credit. The so called 'bank lending channel' operates through the fall in bank reserves brought on by a contractionary monetary policy, implying a lower supply of loanable funds that can be used to finance investment and consumption. In contrast to the traditional 'money view', bank loans and bonds are considered imperfect substitutes. Monetary policy may have amplified effects on aggregate demand by modifying the availability or the terms of new loans. The lending channel presumes that small and medium-sized firms, facing informational frictions in financial markets, rely primarily on bank loans for external finance because it is prohibitively expensive for these borrowers to issue securities in the open market. The importance of this channel thus depends on two factors: i) the degree to which the central bank can affect the supply of bank loans; and ii) the dependence of borrowers on bank loans. These factors are clearly influenced by the structure of the financial system and its regulation.

The key point here is that the real effects of higher interest rates may be amplified through the lending channel *beyond* what would be predicted were policy transmitted solely through the traditional interest rate (cost of capital) channel. As market interest rates rise subsequent to monetary tightening, business investment falls not only because the cost of capital is higher, but also because the supply of bank loans—mostly to small and medium-sized firms—is reduced.

Figure 6: Private Credit to GDP Ratio (Average for 1995-2000)

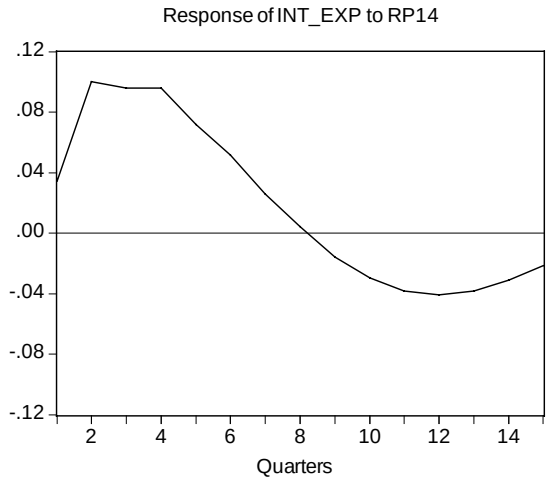


Historically, firms in Thailand have relied heavily—perhaps excessively—on bank lending. This is reflected in Figure 6, which shows that Thailand's credit to GDP ratio is high by emerging market standards. The bias towards bank debt-financing not only makes firms more dependent on bank lending, but also increases the sensitivity of firms' balance sheets to interest rate movements. An indication of monetary policy's impact on firms' balance sheets is presented in Figure 7, which shows the response of the ratio of interest expenses to total assets of Thai firms to a contractionary monetary shock.[22] Evidently, a rise in the RP14 immediately

[22] The ratios are size-weighted averages across non-financial firms that are listed in the SET. Source: SET and IMF estimates.

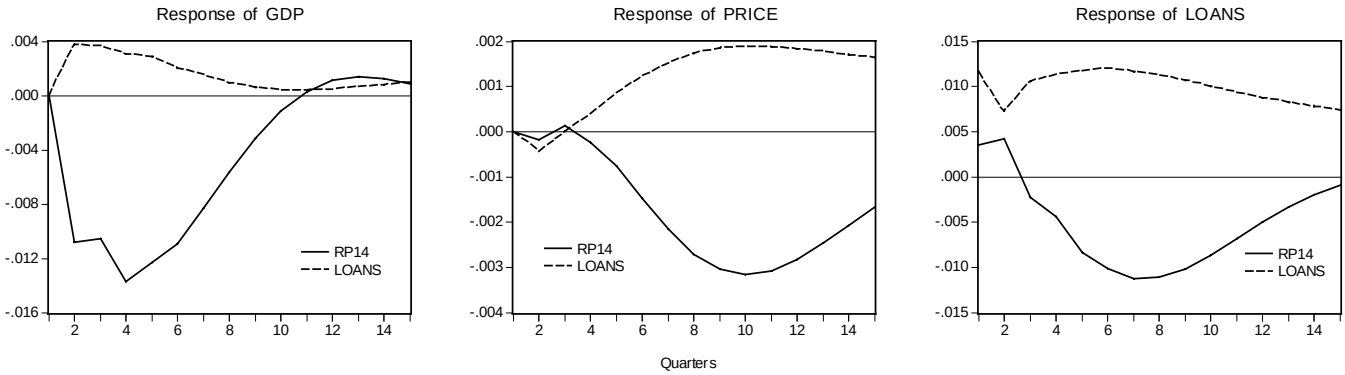
translates into higher interest expenses for firms as a ratio of total assets, which peaks after 2 quarters.[23]

Figure 7: Adjustment of Firms' Interest Expense



To examine the role of bank loans in the transmission mechanism, we append the basic VAR model with the log of bank credit (LOANS).[24] The VAR thus comprises of GDP, PRICE, RP14, and LOANS. Figure 8 shows the impulse responses of GDP, bank credit, and prices to innovations in RP14 and bank credit.[25] Two things are directly noticeable. First, the output response to RP14 shocks (of roughly 2 percent) is now larger than in the basic model but the effects dissipate faster. Second, the 'price puzzle' has disappeared with prices hardly moving until about a year then declining to a bottom after roughly 10 quarters. In addition, GDP and prices respond positively to innovations in bank lending, while loans eventually falls following a monetary shock with the maximum response occurring after about 7 quarters. The latter is consistent with what one would expect since loans are quasi-contractual commitments whose stock is difficult to change quickly and also with the evidence for the US economy (see Bernanke and Blinder, 1992). Finally, a variance decomposition (not shown) reveals that the share of output

Figure 8: Bank Lending Model

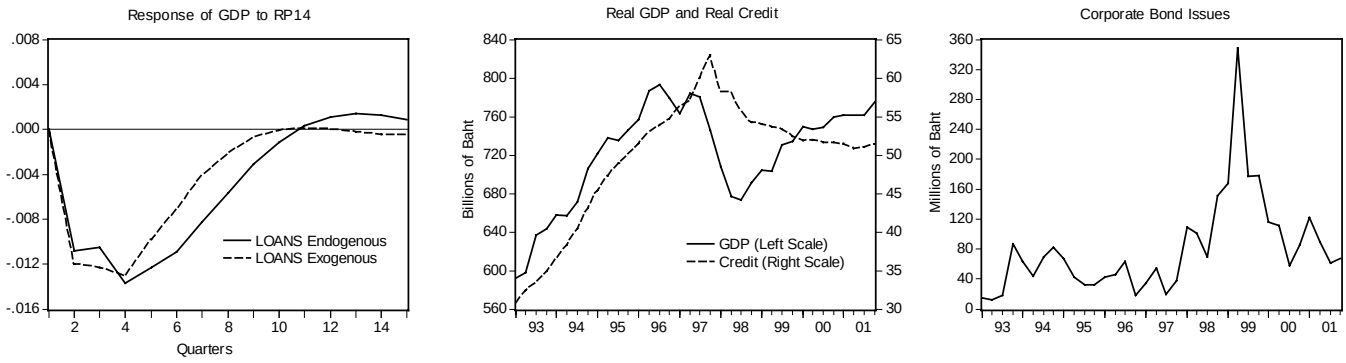


[23] To the extent that the resulting deterioration in firms' balance sheets worsens the information asymmetry problems, firms may find it more difficult to raise funds and the toal decline in real activity may be larger due to this 'balance sheet' channel.

[24] The credit series is the BOT's add-back series which adjusts for debt write-offs and transfers to AMCs to minimize accounting effects on the data.

[25] The orthogonal shocks to credit can be considered as shocks to credit supply since changes in credit attributable to demand effects is already captured, to a large extent, by lagged and contemporaneous changes in GDP.

Figure 9: The Bank Lending Channel



variance accounted for by RP14 is now larger at around 50 percent after two years reflecting the more prominent role of monetary policy in the augmented model.

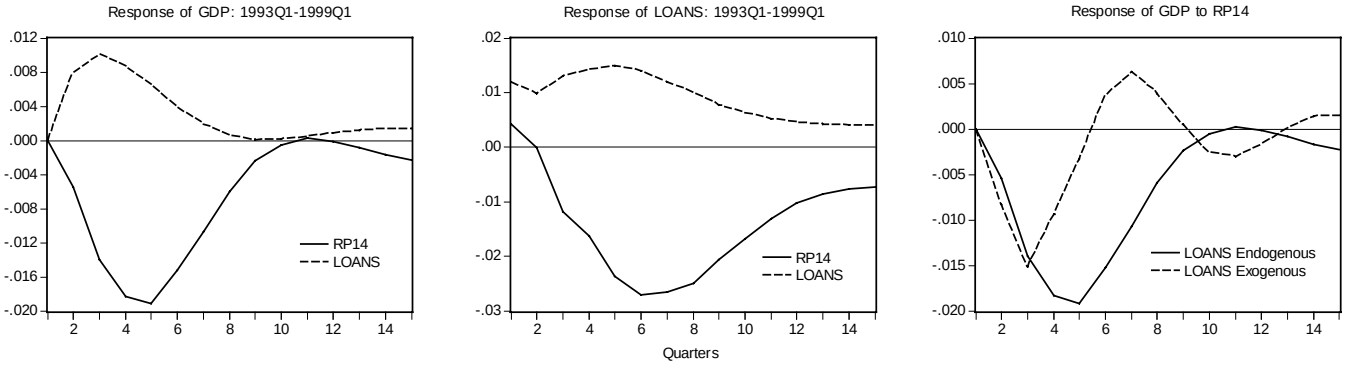
The importance of banks in transmitting monetary shocks to the real economy can be gauged by exogenizing bank loans in the calculation of the impulse responses. As shown in the left-hand panel of Figure 9, the output responses to an RP14 shock with and without LOANS exogenized are quite similar for the first 4 quarters but the former dissipates more quickly thereafter. But while the output response is certainly dampened when the role of bank credit is blocked off, the difference is not very pronounced indicating the existence of a bank lending channel that is not very strong. Indeed, after two years, the accumulated response of output is only around 16 percent lower when this channel is blocked off.

This may seem surprising given the importance of banks in the Thai financial system. A possible explanation is that in the aftermath of the crisis, the role of banks in financing real activity has been hampered by structural problems relating to non-performing loans and a weakened capital base. Indeed the (temporary) decline in banks' intermediary role is evident in the middle panel of Figure 9 which shows that before and immediately after the 1997 crisis, real activity and real bank loans tracked each other quite closely. However, since 1999 real output has recovered while real credit has continued to decline (until very recently). This decline in the credit-intensity of production suggests that firms have increasingly turned to other sources of non-bank financing, such as retained earnings and corporate bond issues. Indeed, the right-hand panel of Figure 9 shows that corporate bond issues have risen sharply as GDP began to recover in 1999 and remains above past levels.

To verify whether these casual observations stand up to more rigorous analysis, we re-estimate the VAR using data only up to the first quarter of 1999. The differences are stark. The first two panels of Figure 10 display the responses of GDP and bank credit to innovations in RP14 and LOANS estimated using the truncated sample. Compared to the results in Figure 8, it is evident that the impact on output and bank credit of a similarly sized monetary policy shock is significantly more pronounced in the model estimated using data only up to 1999Q1.[26] Similarly, innovation in bank

[26] Trough output response is about 1.3 percent below baseline in the full model compared to around 2 percent in the model estimated over the sub-sample. Similarly, loans bottoms out at

Figure 10: Pre-Crisis Bank Lending Channel



credit unrelated to interest rates increases output by more in the sub-sample. This suggests not only that the effectiveness of monetary policy has declined since 1999 but also that this decline has been associated with a weaker bank lending channel. Indeed the right-hand panel of Figure 10 confirms that the degree with which the response of output to monetary shocks is dampened when bank loans are exogenized is considerably larger over the sample from 1993Q1 to 1999Q1. After 4 quarters, nearly half of the direct impact of a change in the RP14 rate on GDP comes through bank loans. The weakening of the bank lending channel recently has apparently been driven by a smaller sensitivity of both bank loans to monetary policy and of output to bank loans.

To summarize, the key findings in this section are: i) a monetary tightening leads to a fall in bank credit, with about a 3 quarter lag; ii) the impulse responses of GDP to interest rate shocks are reduced when bank loans are exogenized, suggesting that bank loans are an important transmission channel; and iii) the importance of bank loans and relevance of the bank lending channel has declined since 1999, weakening the impact of monetary policy on output. Overall, the contribution of the credit channel seems to be more noteworthy over longer horizons, where its principal contribution appears to be that of extending the effect of a monetary shock on output rather than deepening the output response. This appears to be due to the slow moving nature of credit in response to changes in monetary policy rather than to the lagged reaction of output to changes in credit.

Looking forward, there are two sets of opposing forces that will determine the strength of the bank lending channel. On the one hand, resolution of remaining banking sector problems and continued expansion of consumer credit should alleviate supply side constraints and increase the importance of bank loans in the economy. On the other hand, reliance on bank-finance should decline as capital markets become more developed, while banks are likely to strengthen their ability to cushion any fall in bank reserves and retail deposits associated with a tightening of policy, thereby reducing the sensitivity of loans supply to monetary shocks. Nonetheless, given that

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around 2.7 percent below baseline in the shorter-sample model compared to 1 percent in the full-sample model.

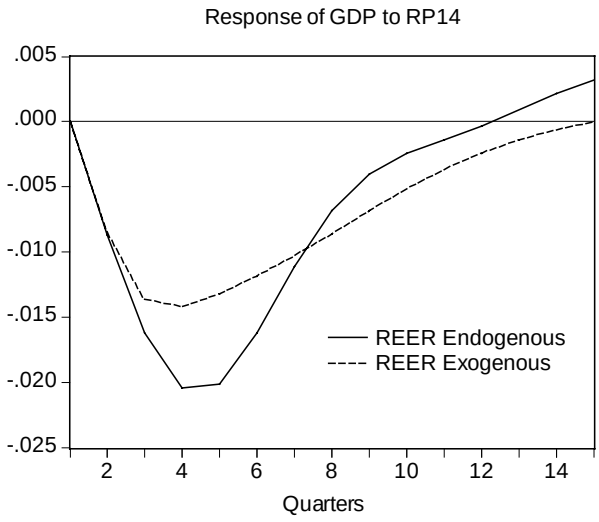
fundamental capital market development tends to take place gradually and the continued importance of small firms in Thailand, the overall effect in the medium term should be an increase in the significance of the bank-lending channel.

3.4.2. Exchange Rate Channel

For small open economies, a potentially important channel through which monetary policy may affect real activity is through its effects on the exchange rate. Specifically, a nominal depreciation brought on by monetary easing, combined with sticky prices, results in a depreciation of the real exchange rate in the short-run and thus higher net exports. The strength of the exchange rate channel depends on the responsiveness of the exchange rate to monetary shocks, the degree of openness of the economy, and the sensitivity of net exports to exchange rate variations. However, substantial unanticipated exchange rate depreciations can actually reduce output when a significant share of debt in the economy is foreign currency denominated.[27]

To examine the role of exchange rates in the Thai monetary transmission mechanism, we add the log of the real effective exchange rate (REER) to our basic VAR model.[28] Figure 11 shows the response of output to innovations in RP14 with and without the real exchange rate exogenized. With the exchange rate channel blocked off, we do find that the output response is dampened somewhat with the trough output being around 0.5 percent of baseline higher than the case with the exchange rate endogenous. In terms of accumulated responses, the total impact on output with this channel blocked off is around 19 percent lower after 2 years.[29]

Figure 11: The Exchange Rate Channel



[27] Disyatat (2001) presents a model which highlights this trade-off and relates the output effects of a depreciation to the health of the banking system.

[28] Note that we exclude the Baht/US exchange rate from the VAR in this section since most of the information is already contained in the real exchange rate index.

[29] Clements et.al. (2001) also find that the exchange rate channel in the euro-area countries is relatively small and attribute the result to weak responses of output to movements in the effective exchange rate.

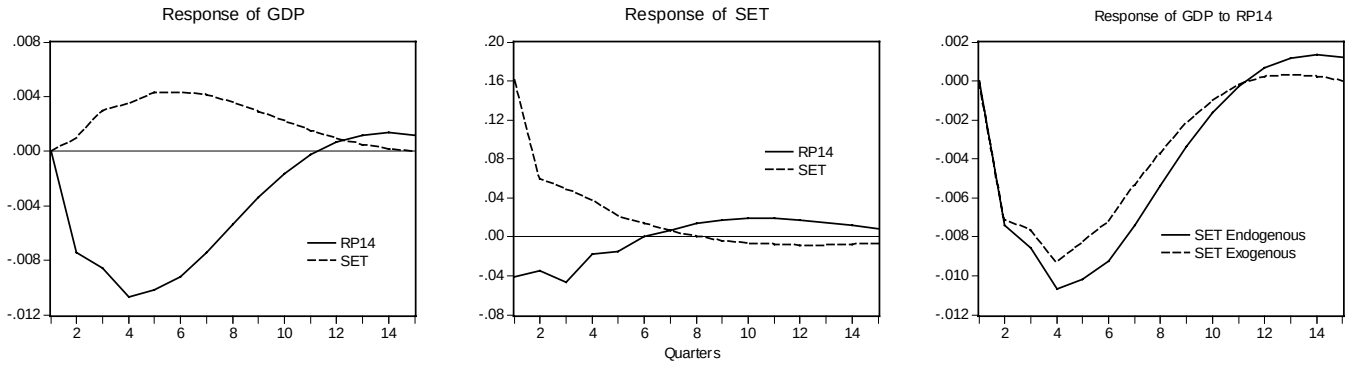
These results should be viewed with some caution, however, since the exchange rate regime was modified during the sample period and also because the regime switch was associated with substantial non-linear movements in the exchange rate. Looking forward, the exchange rate channel may become more prominent as the flexible exchange rate regime becomes fully entrenched and a more accurate estimation can be obtained once data from the flexible exchange rate period is accumulated.

3.4.3. Asset Price Channel

Another potential conduit of monetary policy shocks are fluctuations in asset prices. A monetary easing can boost equity prices by making equity relatively more attractive to bonds (since interest rates fall) as well as improving the earnings outlook for firms (since household spending rises). Higher equity prices, in turn, can propagate monetary impulses in two main ways. First, higher equity prices increases the market value of firms relative to the replacement cost of capital, also known as Tobin's *q*, spurring investment. Secondly, increases in stock prices translates into higher financial wealth of households and therefore higher consumption. In addition, to the extent that higher equity prices raises the net worth of firms and households and improve their access to funds, the effects captured would partly reflect the 'balance sheet channel' of monetary policy as well. Note that the notion of equity here can also be expanded to encompass a broader range of assets, such as real estate. However, due to data limitations we will limit our attention only to stock market equity, keeping in mind that these may serve as a proxy for a broader range of assets as well.

To examine the role of asset prices in the Thai monetary transmission mechanism, we add the log of the SET index to our basic VAR model. Figure 12 shows that a monetary tightening (corresponding to a rise in the RP14 rate of around 2 percent) results in an immediate but small fall in equity prices of approximately 4 percent that lasts for about 6 quarters, while innovations in asset prices boost output as expected. The latter effect is relatively small, however, with a 16 percent innovation in stock prices boosting output by only at most 0.4 percent from the baseline. Not

Figure 12: Asset Price Channel



surprisingly, exogenizing the stock index dampens the response of GDP only slightly as depicted in the right-hand panel of Figure 12. Comparing the accumulated responses indicates that movements in equity prices accounts for only around 17 percent of the total impact on output after 2 years.

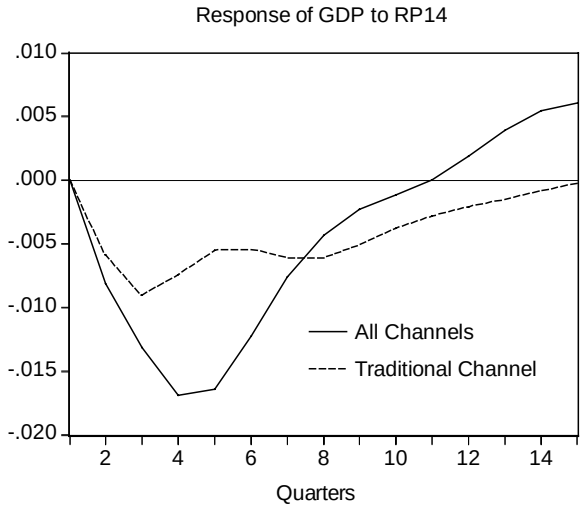
The relative unimportance of asset prices in transmitting monetary shocks is not entirely surprising given that share ownership is not yet very pervasive in Thailand, and that firms' reliance on equity financing has not been very significant compared to bank credit. No doubt the role of asset prices in the transmission mechanism should increase into the future in line with continued developments in capital markets that both increases investment opportunities for households, as well as financing options for firms.

3.4.4. Direct Interest Rate Channel

Having discussed more sophisticated ways in which monetary policy affects real activity, we now go back to basics and examine the direct interest rate effects of monetary shocks. This traditional channel of monetary transmission associates a monetary easing with falls in real interest rates (since prices are sticky in the short-run), that causes interest-sensitive components of aggregate demand, such as investment spending, to rise which ultimately results in higher output. With the relatively high degree of leverage in Thailand and much of bank debt at floating rates, our prior is that the interest channel should be quite important.

The interest rate channel can be proxied by the residual output effects after blocking off each of the other channels respectively. As a preliminary estimate, our previous results indicate that in terms of accumulated responses, the three channels (bank lending, exchange rate, asset price) together account for around half of the output response after two years, leaving the remaining half to be explained by the interest rate channel. To obtain a more direct measure, we augment our basic VAR by including bank loans, the real exchange rate index, and the SET index and compare the output responses with and without these variables exogenized. The results in Figure 13 generally confirms our initial estimate, indicating that the traditional channel accounts for roughly half of the output effect after 4 quarters, and moreover that variations in the other three variables play a role in hastening the dissipation of monetary policy shocks.

Figure 13: The Traditional Interest Rate Channel



3.5. Summary Model

Taking stock of our findings, we now construct a single VAR that summarizes the key aspects of the monetary transmission mechanism in Thailand, namely the importance of bank lending, and the particular sensitivity of investment and consumption (relative to other components of aggregate demand) to monetary shocks. The summary VAR thus contains investment, consumption, prices, RP14, and bank credit (in that order). The impulse responses are displayed in Figure 14.

Monetary shocks, equivalent to an increase in the RP14 of approximately 1.8 percent, lead to substantial declines in investment which bottoms out after 4 quarters at around 3.3 percent below baseline. In contrast, the consumption response is smaller and reaches its trough much quicker, 1.2 percent below baseline after 2 quarters. Consumption appears, however, to remain near its trough for longer. The finding that investment responds more gradually is consistent with the idea that planning processes for investment are longer than for consumption. The response of prices is quite slow, declining only after about a year and reaching a trough after 10 quarters at around 0.3 percent below baseline. The gradual and relatively small response of prices is consistent with evidence from other countries (see Christiano et. al., 1998; Mojon and

Figure 14: Summary Model

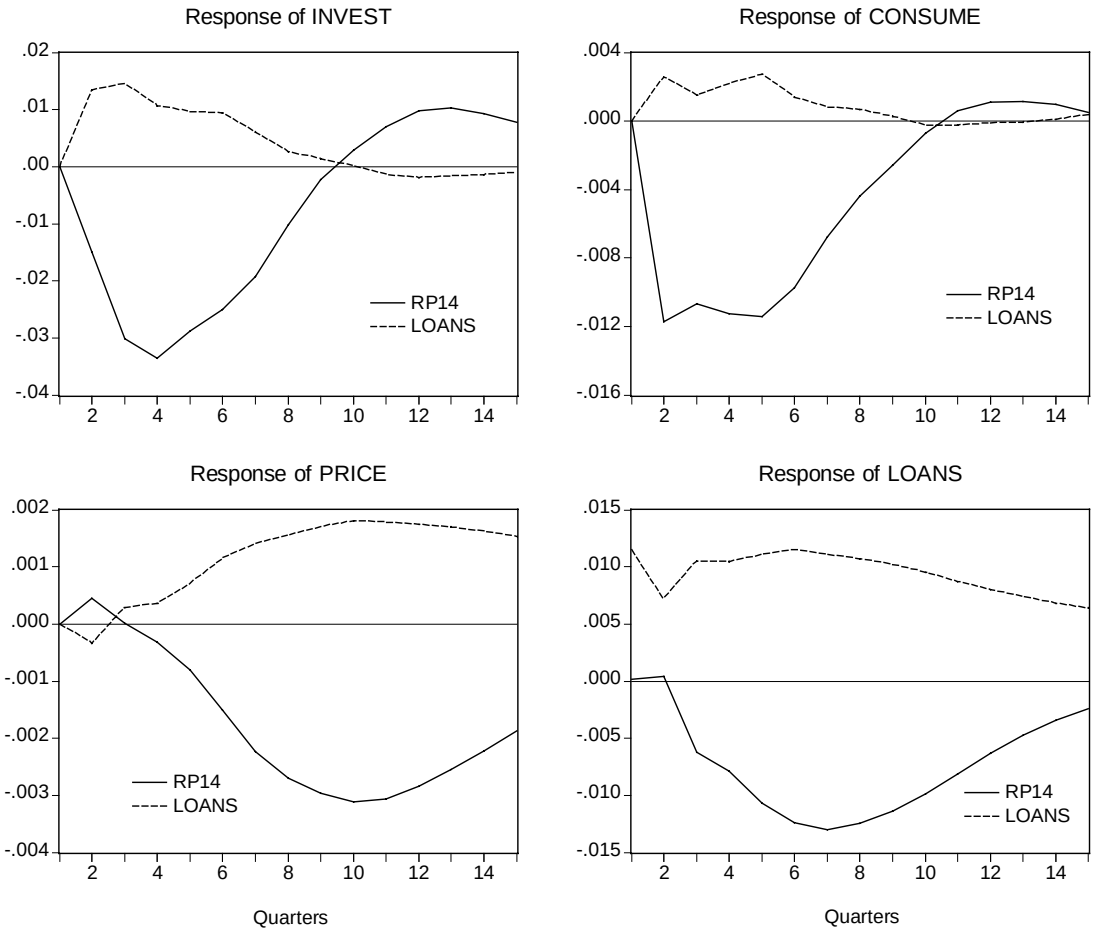
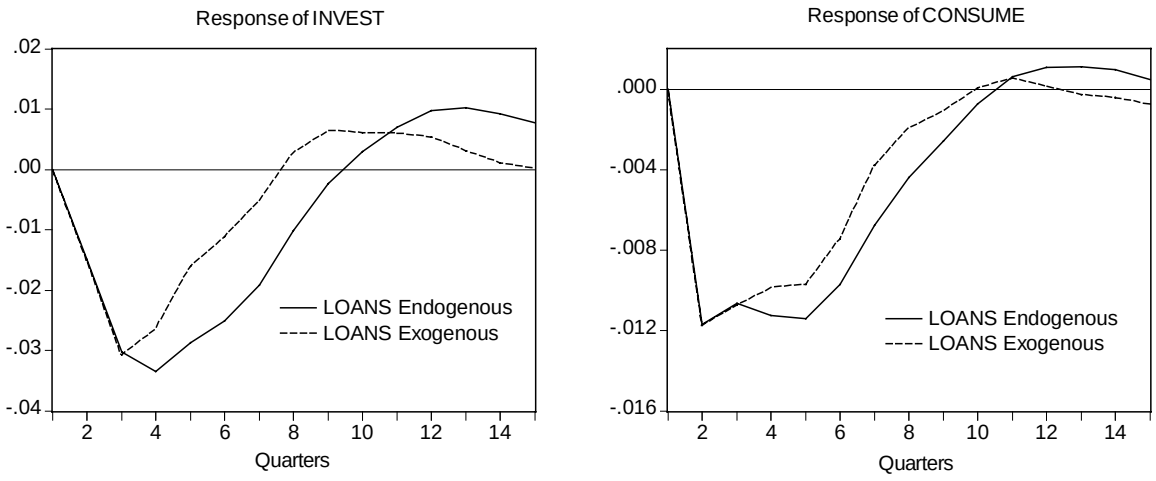


Figure 15: Bank Lending Channel – Summary Model

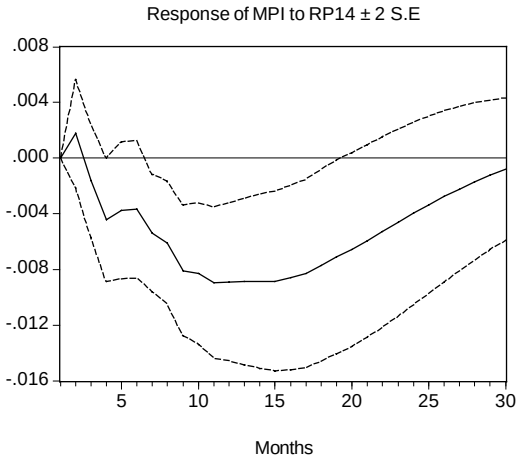


Peersman, 2001). In line with the existence of a bank lending channel, bank loans decline after 3 quarters to a trough of 1.3 percent below baseline after 7 quarters. In addition, shocks to bank credit raises investment but has only a negligible impact on consumption, suggesting that the bank-lending channel works mainly by constraining investment rather than consumption. This is confirmed in Figure 15, which shows that exogenizing bank loans does indeed have more of an impact on the response of investment than consumption.[30] The latter partly reflects the lack of development of the consumer credit sector with Thai households being relatively under-leveraged.

3.6. Specification Issues and Robustness

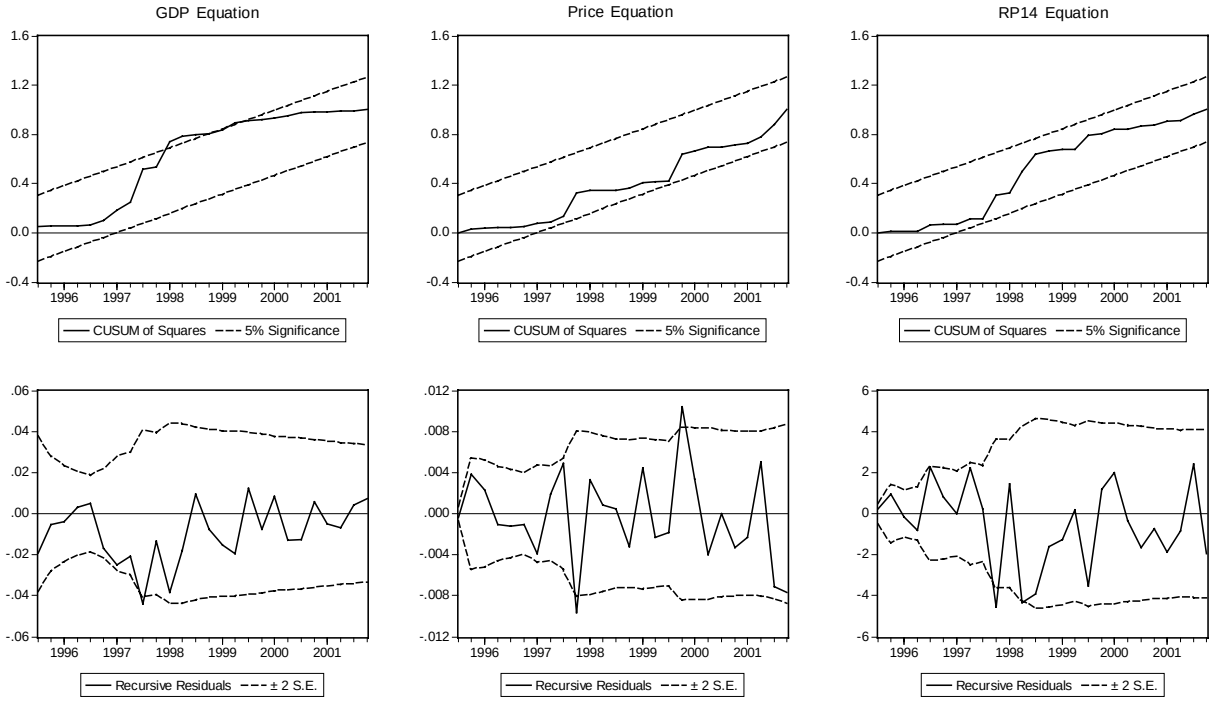
Given that our sample space is not that long and includes some turbulent periods, it is important to check our results for robustness and also look for evidence of structural breaks and other misspecification problems in the VAR. First, given the relatively small number of observations, we checked the robustness of our results by running the VAR on monthly data from 1989M1 to 2001M12 using the manufacturing production index (MPI) as our proxy for real GDP and found not only that the shape, but also the timing, of the impulse responses were broadly similar. Figure 16 shows the response of MPI to an RP14 innovation in a model that includes MPI, CPI, RP14, and bank credit estimated using six lags. A contractionary monetary

Figure 16: Monthly Data



[30] While the magnitudes are not very different, loans seem to play a role in prolonging the output effect by drawing out the investment response.

Figure 17: Stability Tests



policy leads to declines in the MPI, which bottoms out after around 12 months and dissipates after 30 months.

In terms of stability, Figure 17 shows the cumulative sum of squares (CUSUM) tests for parameter stability as well as the recursive residuals for each equation of the VAR in the basic model. The results indicate that despite some minor episodes of instability, the residual variance of each equation is generally stable (the test statistics remain within the 5 percent critical band). Moreover, the inverse roots of the characteristic polynomial all have modulus less than one and lie inside the unit circle indicating that the estimated VAR is stable (stationary). We also carried out the multivariate LM test for residual serial correlation up to 4 lags and could not reject the null of no serial correlation for all cases.

Finally, given that some of the variables in the model are likely to be non-stationary, there is a trade-off between estimating the VAR in levels versus in first differences. The trade-off is between the loss of efficiency (when the VAR is estimated in levels) and the loss of information about long-run relationships (when the VAR is estimated in first differences). In particular, a VAR in first differences provides no information on the relationships between levels of the variables in the VAR, and it is this aspect on which economic theory is usually most informative. Moreover, while estimation in levels may incur some efficiency losses, this comes at no cost in terms of consistency of estimators. Most of the empirical literature on VARs have tended to estimate VARs that are unrestricted in levels. We have done the same here.

4. Conclusion

The goal of this paper has been to enhance our understanding of the monetary transmission mechanism in Thailand. In light of data constraints and the limited number of studies on the subject, our goal has been relatively modest but at the same time focused. Specifically, we have attempted to quantify the lags associated with monetary policy shocks and investigate the channels through which these shocks are propagated. In doing so, we have unearthed a set of key findings that can be summarized by the following *stylized facts* about the response of the economy to a tightening of monetary policy:

Stylized fact 1: The aggregate price level initially responds very little, but starts to decline after about a year and quite persistently so.

Stylized fact 2: Output follows a U-shaped response, bottoming out after around 4-5 quarters and dissipating after approximately 11 quarters.

Stylized fact 3: Investment appears to be the most sensitive component of GDP to monetary policy shocks.

These observations are generally consistent with findings in other countries, using similar methodology, including the US and European countries.

Moreover, in addition to the traditional interest rate channel, the results in this paper point to a transmission mechanism in which banks play an important role. The exchange rate and asset price channels have been less significant by comparison. Together with our finding that interest rate pass-through in Thailand is generally lower than those in developed countries, the results suggests that banks partly respond to changing liquidity conditions through the adjustment of both the *price and quantity* of loans (ie. credit rationing). In this respect, and in light of our finding that M1 is a good predictor of real activity—even after taking into account the information contained in interest rates, it appears that interest rates alone do not adequately reflect the links between financial markets and the rest of the economy. Rather, developments in quantity variables, such as credit and money supply, contain useful information about output trends that should be monitored closely.

Nevertheless, the role of bank lending appears to have declined in the past 3 years along with the sensitivity of retail rates to money market rates. This has taken place in conjunction with the rise in prominence of non-bank sources of finance and continued weaknesses in the banking sector. To the extent that the latter has acted as a constraint on new bank credit, it would have tended to offset the impact of monetary easing. In addition, by effectively limiting investment demand, excess capacity and balance sheet weaknesses in the corporate sector have also blunted both the bank lending and traditional interest rate channels.

Overall, the picture that emerges is one in which a monetary easing leads first to a pick up domestic demand, primarily investment demand financed by bank

lending, which translates into a gradual build up of price pressures that eventually moves the overall price level with a significant lag. These observations have a direct bearing on the conduct of monetary policy. With monetary policy in Thailand firmly focused on inflation, the results highlight the forward-looking nature of policy formulation which such a framework necessarily entails and underscores the importance of having accurate forecast of main economic variables in the conduct of monetary policy. Moreover, the long and variable lags involved in monetary transmission underlie the fact that monetary policy can not be used to fine-tune the economy but should act more as an anchor for the medium to long-term objective of price stability, while minimizing the output volatility that may occur in response to unforeseen shocks.

Looking forward, restoration of the banking system to full health and effective de-leveraging of corporate sector balance sheets are essential steps in unclogging the wheels of the transmission mechanism and improving the effectiveness of monetary policy. At the same time, retail rates that are more sensitive to money market conditions would remove an important impediment in the financial system. Moreover, as households diversify their portfolios more towards bonds and equities, the asset price channel of monetary transmission should strengthen as wealth effects become more important

Finally, two key developments should also help to strengthen the monetary transmission mechanism in the near future. First, the BOT's Financial Master Plan, scheduled to be completed by the end of 2002, will form a solid basis for improving general access to credit and reducing existing liquidity constraints for both firms and households. As the debt levels of firms and consumers rise, economic activity should become more sensitive to interest rate changes. Second, the recent plan to fiscalize the losses of the FIDF will help to increase the operational independence of the BOT and improve flexibility in the conduct of open market operations by removing a key distortion in the repurchase market, and—combined with the withdrawal of the BOT from acting as a central counter-party—facilitating the development of a private repurchase market. The latter would help to strengthen the policy transmission channels by allowing the full play of market forces at the short-end of the yield curve. Finally, passage of the revised BOT Act would help to boost the credibility of inflation targeting by institutionalizing central bank autonomy and operational independence.

5. Appendix

5.1. Appendix A: VAR Methodology

VARs are dynamic systems of equations in which the current level of each variable in the system depends on past movements in that variable and all other variables in the system. In contrast to other macro-econometric models (including the BOT's model), VARs make few assumptions about the underlying structure of the economy and instead focus entirely on obtaining a good statistical representation of the past interactions between economic variables, letting the data determine the model. However, VARs are not completely devoid of assumptions since the choice of variables, lag length, and identification scheme can have important implications on the outcome. Nevertheless, VARs attempt to characterize the economy making a *minimum* number of *a priori* assumptions.

The basic premise is that the economy is described by a linear, stochastic dynamic system of the following form

$$Y_t = B_0 Y_t + B_1 Y_{t-1} + ... + B_p Y_{t-p} + \varepsilon_t, \qquad \text{(A1)}$$

where Y_t is an $n \times 1$ vector of variables in the system at time t, B_i for $i = 0,..., p$, are $n \times n$ matrix of coefficients, and ε_t an $n \times 1$ vector of structural shocks with a variance-covariance matrix of $E(\varepsilon_t \varepsilon_t') = I$. The VAR estimates (A1) in the reduced form

$$Y_t = A_1 Y_{t-1} + ... + A_p Y_{t-p} + u_t, \qquad \text{(A2)}$$

where u_t is the $n \times 1$ vector of residuals with variance-covariance matrix $E(u_t u_t') = \Omega$.

Defining $A_0 = (I - B_0)^{-1}$, implies that $A_i = A_0 B_i$ for $i = 1,..., p$. The structural shocks and the reduced-form residuals are thus related by

$$u_t = A_0 \varepsilon_t, \qquad \text{(A3)}$$

so that

$$\Omega = A_0 A_0'. \qquad \text{(A4)}$$

To obtain the impulse response functions, write (A1) and (A2) in MA form respectively as

$$Y_t = [I - B(L)]^{-1} \varepsilon_t \qquad \text{(A5)}$$

and

$$Y_t = [I - A(L)]^{-1} u_t. \qquad \text{(A6)}$$

From (3) and (6), the impulse response to structural shocks can be obtained from (A6) using the relation

$$[I - B(L)]^{-1} = [I - A(L)]^{-1} A_0. \qquad \text{(A7)}$$

While the elements of $A(L)$ can be obtained directly from the regression, not all of the n^2 elements of A_0 are identified without the imposition of further assumptions. These so called 'identifying assumptions' are necessary to recover the structural shocks, ε_t, from the reduced-form residuals, u_t. The variance-covariance matrix obtained from the estimation provides, through (A4), $n(n+1)/2$ restrictions on A_0, leaving $n(n-1)/2$ additional restrictions required for full identification. There are four general approaches that have been used in the literature to obtain identification, namely: i) restrictions on the contemporaneous effects of shocks through A_0; ii) restrictions on the contemporaneous relations of variables through B_0; iii) long-run restrictions through $A(1)$ or $B(1)$; and iv) some combination of these three identification schemes.

The literature has not yet converged on a particular set of assumptions for identifying the shocks although there is broad agreement about the qualitative effects of monetary policy shocks as the results appear robust across a large subset of identification schemes.[31] This paper adopts the standard and widely used recursive identification scheme which corresponds to assuming that A_0 is lower triangular and is implemented through the Choleski decomposition of the matrix Ω. The recursivity assumption translates into assumptions about the contemporaneous effects of shocks implicit in the ordering of the variables in the VAR. Specifically, the variable that comes first is most exogenous in the sense that it does not react to contemporaneous shocks to the other variables in the system while the variable ordered last responds to not only own shocks but also shocks to every other variable in the system. After the contemporaneous period is over, the response is again unrestricted.

5.2. Appendix B: Dynamic Multiplier Calculations

The dynamic multiplier model involves estimating

$$i_t = \sum_{j=1}^{n} \alpha_j i_{t-j} + \sum_{j=1}^{m} \beta_j m_{t-j} + u_t, \qquad \text{(B1)}$$

where i_t and m_t are the relevant retail and money market rate, respectively. Using the lag operator, (B1) can be written as

$$(1 - \alpha_1 L - \alpha_2 L^2 - ... - \alpha_n L^n) i_t = (\beta_0 + \beta_1 L + \beta_2 L^2 + ... + \beta_p L^p) m_t + u_t,$$

or

$$i_i = \frac{B(L)}{A(L)} m_t + \frac{u_t}{A(L)}.$$

[31] Christiano et.al. (1998) provides a nice overview of the extensive VAR literature and the various identification schemes employed.

The effect on i_{t+j} of changes in m_t is given by

$$\delta_j = \sum_{i=1}^{\min(j,n)} \alpha_i \delta_{j-i} + \beta_j \qquad \text{for} \qquad 1 \le j \le m$$

$$\delta_j = \sum_{i=1}^{\min(j,n)} \alpha_i \delta_{j-i} \qquad \text{for} \qquad j > m$$

The *impact multiplier* is then given by $\delta_0 = \beta_0$.

The *interim multiplier* by $\sum_{j=0}^{J} \delta_j$ for $j = 0,1,2,\ldots$.

The *long run multiplier* by $\sum_{j=0}^{\infty} \delta_j = \frac{B(1)}{A(1)}$.

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