ประสิทธิผลของนโยบายการเงินในโลกที่มีความเชื่อมโยงสูง

Globalization and Monetary Policy Effectiveness

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สัมมนาวิชาการประจำปี 2551

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สายนโยบายการเงิน

กันยายน 2551

ข้อคิดเห็นที่ปรากฏในบทความนี้เป็นความเห็นของผู้เขียน
ซึ่งไม่จำเป็นต้องสอดคล้องกับความเห็นของธนาคารแห่งประเทศไทย

บทคัดย่อ

บทความนี้มุ่งศึกษาความสัมพันธ์ระหว่างเศรษฐกิจไทยและประเทศอื่น ๆ ทั่วโลกโดยวัดผลการเปลี่ยนแปลงในความสัมพันธ์ดังกล่าวที่มีต่อตัวแปรทางเศรษฐกิจมหภาคในช่วงของการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อ (2543-2551) และวิเคราะห์ถึงผลกระทบของการปรับอัตราดอกเบี้ยนโยบายของธนาคารแห่งประเทศไทยต่อตัวแปรทางเศรษฐกิจภายในประเทศภายใต้สภาวะที่ปัจจัยจากต่างประเทศอาจมีอิทธิพลต่อเศรษฐกิจไทยเพิ่มขึ้นในช่วงที่ผ่านมา ซึ่งการศึกษาพบว่าปัจจัยด้านเศรษฐกิจและการเงินของโลกมีความสำคัญต่อพลวัตทางเศรษฐกิจและการเงินของไทย แต่ไม่สามารถสรุปได้ว่าความสำคัญนี้มีมากขึ้นต่อเศรษฐกิจไทยโดยรวม ยกเว้นตัวแปรทางเศรษฐกิจบางตัวที่มีความเชื่อมโยงกับต่างประเทศเพิ่มขึ้น นอกจากนี้ความเชื่อมโยงดังกล่าวยังมีการเปลี่ยนแปลงไปอย่างมีนัยสำคัญ สำหรับประสิทธิผลของนโยบายการเงิน พบว่ามีการเปลี่ยนแปลง ซึ่งน่าจะมีสาเหตุมาจากความสัมพันธ์ที่เปลี่ยนแปลงไประหว่างปัจจัยภายในประเทศเองมากกว่าที่จะมาจากอิทธิพลโดยตรงที่เกิดจากความเชื่อมโยงกับโลก ทั้งนี้ แม้ว่างานศึกษานี้อาจยังไม่มีข้อมูลเพียงพอที่จะได้ข้อสรุปที่ชัดเจนทางสถิติ แต่มีแนวโน้มว่าประสิทธิผลของนโยบายการเงินในการส่งผ่านไปยังภาคเศรษฐกิจต่าง ๆ ในปัจจุบันลดลงบ้างเมื่อเทียบกับอดีต โดยไม่ได้เป็นผลมาจากความเชื่อมโยงกับต่างประเทศที่เพิ่มขึ้น อย่างไรก็ตาม ในแง่ของความสามารถของธนาคารกลางในการดูแลรักษาเสถียรภาพของระดับราคาโดยรวมนั้น ยังคงเป็นไปได้ด้วยดี (largely intact)

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Globalization and Monetary Policy Effectiveness

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Abstract

We model relationships within as well as between two economic regions—Thailand and the rest of the world—and quantify changes in the spillover relationship between international forces and key Thai macroeconomic variables after the adoption of inflation targeting (2000-2008). Within the same framework, we measure the effect of an increase in the policy interest rate by the Bank of Thailand on key domestic economic variables over time, allowing for the possibility that global forces may matter more for Thai economic dynamics over the recent years. With some measure of confidence, we find that global macroeconomic and financial influence matters for Thailand's economic dynamics. Whether global forces have gained in importance is inconclusive for the overall economy, but that influence has intensified for several selected variables. We have also detected and identified statistically significant changes in the relationship between international forces and Thailand's economic dynamics over the past several years. Statistical evidence shows that recent changes in monetary policy effectiveness are not likely due to direct influence from globalization, but are mostly due to the change in the relationship among domestic variables themselves over time. Mindful that we may not have sufficient data to get a strong statistical conclusion, but monetary policy's ability to influence overall domestic events seems to have been somewhat diminished, with no evidence that this is due to globalization. The ability of the central bank to ensure long-term price stability, however, seems to have remained largely intact.

Keywords: Monetary policy, globalization, transmission mechanism, VAR, FAVAR

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บทสรุปผู้บริหาร

ในช่วงสองทศวรรษที่ผ่านมา เศรษฐกิจไทยมีความเชื่อมโยงกับเศรษฐกิจโลกมากขึ้นทั้งด้านการค้าและการเงิน โดยการค้าระหว่างประเทศของไทยขยายตัวอย่างรวดเร็วและสูงกว่าการขยายตัวทางเศรษฐกิจ ดังจะเห็นได้จากสัดส่วนมูลค่าการส่งออกและการนำเข้าต่อผลิตภัณฑ์มวลรวมภายในประเทศ (GDP) ที่เพิ่มขึ้นจากร้อยละ 75 ในปี 2533 เป็นร้อยละ 140 ในปี 2551 ขณะที่ความเชื่อมโยงทางการเงินก็มีมากขึ้น สะท้อนจากสัดส่วนยอดคงค้างสินทรัพย์และหนี้สินระหว่างประเทศต่อ GDP ที่โน้มสูงขึ้น ซึ่งสอดคล้องกับหลายๆ ประเทศทั้งในเอเชียตะวันออกและกลุ่มประเทศพัฒนาแล้วที่มีระดับการเปิดประเทศทางการเงินมากขึ้นเช่นกัน

ความเชื่อมโยงทางด้านการค้าและการเงินที่เพิ่มขึ้นนี้ อาจทำให้ความผันผวนที่เกิดขึ้นในประเทศหนึ่งส่งผลกระทบไปยังประเทศอื่นๆ ได้ง่ายกว่าในอดีต เศรษฐกิจไทยซึ่งเปิดกว้างและมีขนาดเล็ก ก็อาจได้รับผลกระทบจากปัจจัยภายนอกมากขึ้นเช่นกัน โดยในช่วงที่ผ่านมาพบว่าวัฏจักรเศรษฐกิจไทยมีความสอดคล้องกับวัฏจักรเศรษฐกิจโลกมากขึ้น ในขณะที่ภาวะการเงินในประเทศก็ได้รับอิทธิพลจากปัจจัยภายนอกมากขึ้นเช่นกัน ซึ่งอาจทำให้บทบาทของนโยบายการเงินที่มีต่อตัวแปรทางการเงินและภาคเศรษฐกิจจริงมีน้อยลง อย่างไรก็ดี ที่ผ่านมายังไม่เคยมีงานศึกษาใดที่ชี้ชัดว่าประสิทธิผลของนโยบายการเงินจะเพิ่มขึ้นหรือลดลงจากความเชื่อมโยงทางการเงินที่เพิ่มขึ้นดังกล่าว แต่มีข้อสันนิษฐานว่าตลาดการเงินที่มีประสิทธิภาพมากขึ้น น่าจะทำให้การดำเนินนโยบายการเงินมีประสิทธิผลมากขึ้น จากการตอบสนองที่รวดเร็วขึ้นของอัตราผลตอบแทนพันธบัตรที่มีต่อการส่งสัญญาณนโยบายการเงินของธนาคารกลาง

งานวิจัยนี้มุ่งทำการศึกษาในเชิงลึกถึงบทบาทของโลกาภิวัตน์ในการกำหนดพลวัตของตัวแปรทางเศรษฐกิจต่างๆ ของไทย รวมถึงวิเคราะห์ว่าความเชื่อมโยงกับเศรษฐกิจการเงินโลกที่สูงขึ้นได้ทำให้ความสามารถในการส่งผ่านนโยบายการเงินต่อตัวแปรทางเศรษฐกิจต่างๆ ลดน้อยลงหรือไม่

การวัดผลกระทบของความเชื่อมโยงทางการค้าและการเงินที่มีต่อเศรษฐกิจไทยเป็นเรื่องที่ยากและมีความซับซ้อน เพราะจะต้องวัดว่าการเปลี่ยนแปลงในพลวัตของเศรษฐกิจไทยนั้นเกิดจากการเปลี่ยนแปลงในความสัมพันธ์ระหว่างเศรษฐกิจในประเทศกับปัจจัยภายนอกหรือมาจากการเปลี่ยนแปลงของปัจจัยภายนอกเอง โดยเฉพาะเมื่อข้อมูลมีค่อนข้างน้อย (small sample) งานวิจัยนี้จึงพยายามให้คำนิยามสำหรับปัจจัยภายนอกและช่องทางที่ปัจจัยภายนอกอาจส่งผลกระทบต่อเศรษฐกิจไทยเพื่อให้สามารถวัดผลกระทบที่เกิดขึ้น ตลอดจนประเมินประสิทธิผลของการปรับอัตราดอกเบี้ยนโยบายของ ธปท. ที่มีต่อตัวแปรทางเศรษฐกิจต่างๆ ในช่วงเวลาที่ผ่านมา โดยคำนึงถึงความเป็นไปได้ที่ปัจจัยจากต่างประเทศอาจมีอิทธิพลต่อพลวัตของเศรษฐกิจไทยมากขึ้นในปัจจุบัน

งานวิจัยนี้ใช้แบบจำลอง Factor Augmented Vector Autoregression (FAVAR) ของ Bernanke, Boivin และ Eliasz (2005 หรือ BBE) ในการวิเคราะห์กลไกการส่งผ่านของนโยบายการเงิน โดยใช้ร่วมกับงานศึกษาของ Boivin และ Giannoni (2008 หรือ BG) ซึ่งได้นำวิธีการศึกษาของ BEE มาประยุกต์ใช้กับการวัดผลกระทบของโลกาภิวัตน์ต่อเศรษฐกิจสหรัฐฯ ซึ่งการนำแบบจำลอง FAVAR มาใช้จะช่วยให้สามารถวิเคราะห์ข้อมูลทางเศรษฐกิจและการเงินจำนวนมากได้

ผลการศึกษาสรุปได้ดังนี้ (1) ปัจจัยภายนอกมีความสำคัญอย่างมีนัยสำคัญต่อตัวแปรเศรษฐกิจในประเทศ และบทบาทของเศรษฐกิจการเงินโลกมีแนวโน้มเพิ่มขึ้นในการกำหนดตัวแปรเศรษฐกิจบางตัว (2) ความสัมพันธ์ระหว่างปัจจัยต่างประเทศและพลวัตของเศรษฐกิจไทยเปลี่ยนแปลงไปในช่วงที่ผ่านมา และ (3) ประสิทธิผลของนโยบายการเงินที่เปลี่ยนแปลงไปไม่ได้เกิดจากอิทธิพลของโลกาภิวัตน์โดยตรง แต่น่าจะเกิดจากการเปลี่ยนแปลงในเชิงโครงสร้างของเศรษฐกิจไทยเอง

ในช่วงที่ผ่านมา นโยบายการเงินของไทยดูเหมือนว่าจะยังคงไว้ซึ่งประสิทธิผลในการดูแลเงินเฟ้อ แม้ว่าผลการศึกษาจะชี้ว่านโยบายการเงินมีประสิทธิผลลดลงในส่วนที่เป็นการดูแลราคาในหมวดพลังงาน แต่นโยบายการเงินมีผลที่แน่นอน (predictable) มากขึ้น สะท้อนจากค่าความเบี่ยงเบน (standard error) ของการตอบสนองของตัวแปรเศรษฐกิจต่างๆ ที่ลดลง นอกจากนั้น ยังมีหลักฐานทางสถิติที่ชี้ให้เห็นว่าการที่ธนาคารแห่งประเทศไทยให้ความสำคัญกับการดูแลเงินเฟ้อที่แท้จริงในระยะยาว (underlying inflation) นั้น อาจมีส่วนช่วยลดผลลบต่อการขยายตัวทางเศรษฐกิจของการดูแลเงินเฟ้อ (short-run inflation-output tradeoff) ในระยะสั้นได้จริง ดังนั้น เมื่อมองในแง่นี้นโยบายการเงินดูเหมือนว่าจะมีประสิทธิภาพ (efficiency) ในการดูแลเงินเฟ้อมากขึ้น อย่างไรก็ตาม สาเหตุของความเปลี่ยนแปลงที่ศึกษาพบนี้ไม่น่าจะมาจากประสิทธิผลที่มากขึ้นของนโยบายการเงินที่กระทบภาคเศรษฐกิจ สินเชื่อ อัตราดอกเบี้ยระยะยาว หรืออัตราแลกเปลี่ยนโดยตรง แต่น่าจะมาจากความสามารถในการดูแลอัตราเงินเฟ้อคาดการณ์ของสาธารณชน (anchoring of public inflation expectation) ที่ดีขึ้นหรือการส่งผ่านจากตัวแปรเหล่านี้ไปยังระดับราคา (pass-through) ที่อาจสูงขึ้นด้วย

กล่าวโดยสรุป แม้ว่างานศึกษานี้อาจยังมีข้อมูลไม่เพียงพอที่จะให้ข้อสรุปที่ชัดเจนทางสถิติ แต่เบื้องต้นก็สามารถบ่งชี้ได้ว่าปัจจัยต่างประเทศมีผลต่อพลวัตของเศรษฐกิจไทยในช่วงที่ผ่านมา และแม้ความสามารถของนโยบายการเงินต่อภาคเศรษฐกิจจริงอาจมีแนวโน้มลดลงบ้าง แต่ก็ไม่ได้เป็นผลมาจากโลกาภิวัตน์โดยตรง และถึงกระนั้นธนาคารกลางก็ยังคงมีความสามารถในการรักษาเสถียรภาพด้านราคาในระยะยาวได้อย่างไม่ได้เสื่อมลง (largely intact)

Executive Summary

Over the past two decades, Thailand has become increasingly more integrated with the world in many aspects through the process that has become commonly known as globalization. International trade, as measured by the amount of goods and services imported and exported, has expanded more rapidly than GDP. Indeed, the ratio of trade volume to GDP almost doubles between 1990 and 2008, from 75 to around 140 per cent. Meanwhile, the Thai economy's financial linkage with the world, as measured by gross stock of international assets and liabilities to GDP, has also strengthened. The trend of deepening financial integration is also witnessed in East Asia, and is even more striking for advanced economies (see Figure 1).

Intensifying world trade and financial integration should imply that economic or financial disturbances that occur in one economy have more chance of being transmitted or spilled over to another economy than before. As a small and increasingly open economy, it is often argued that macroeconomic developments in Thailand may increasingly be shaped by external forces. In fact, the economies of Thailand and the rest of the world tend to fluctuate together over time as the degree of integration rises. That is, the contemporaneous comovement between the business cycles of Thailand and a group of advanced economies as well as ASIA-8 tends to be higher over time. Meanwhile, domestic financial conditions may have been increasingly influenced by global financial conditions, which suggests that domestic monetary policy may have already lost the ability to influence financial conditions and through it, the rest of the economy. It is not clear a priori whether monetary policy effectiveness should grow or diminish as domestic financial markets are developed as a result of financial globalization. Arguments can also be made in support of the fact that a more efficient financial market can carry the policy interest rate signal forward along the yield curve more efficiently.

To what extent have international forces affected the determination of key macroeconomic variables in Thailand? Has globalization weakened the ability of Thai monetary policy to influence domestic financial and real variables? This paper investigates these two empirical questions in depth.

Measuring the influence of international integration in trade and finance on the Thai economy over time is no easy task. It is specifically the change in the spillover relationship between the economic dynamics of Thailand and those of the rest of the world as well as among the rest of the world themselves that we seek to capture. Given limited data, we explore a way to identify global forces and the channel through which they may affect Thailand's economic fluctuations. We then formally measure the effect of global forces on Thailand's economic dynamics. Within the same framework, we measure the effect of an increase in the policy interest rate by the Bank of Thailand on key domestic economic variables over time, allowing for the possibility that global forces may matter more for Thai economic dynamics over the recent years.

At the empirical level, we find the FAVAR framework introduced by Bernanke, Boivin and Eliasz (2005, or BBE) to evaluate US monetary transmission mechanism a natural empirical framework for our research questions. Recognizing that Thailand's economic

dynamic are influenced also by global forces, we apply the empirical strategy employed by Boivin and Giannoni (2008) (or BG), which extends the BBE's model to explicitly account for possible global influence on the US economy, to address these questions for Thailand. The FAVAR framework allows us to systematically exploit a large set of economic and financial data as well as information.

With some measure of confidence, our findings can be summarized thus: First, we find that global macroeconomic and financial influence on real and nominal variables in Thailand is significant. Whether global forces have gained in importance is inconclusive for the overall economy, but we find that that influence has intensified for several selected variables. Second, we have also detected and identified statistically significant changes in the relationship between international forces and Thailand's economic dynamics over the past several years.

Third, on the question of how much globalization enhances or tempers the effect of BOT's monetary policy on the Thai economy, we have found that the recent changes in monetary policy effectiveness are not likely due to direct influence from globalization, but are mostly due to the change in the relationship among domestic variables themselves over time.

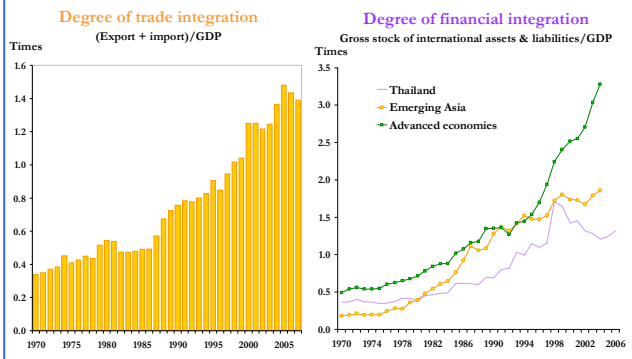
Over time, Thai monetary policy seems to have more or less maintained its effectiveness on the inflation path. While there is statistical evidence to point to the fact that monetary policy has been less effective in influencing the energy components in the consumer price inflation measure, the standard errors have also become smaller over time. Viewing impulse responses as a distribution of paths, we think that the explicit focus on long-term underlying inflation has contributed to lower inflation-output tradeoff over the past several years. Monetary policy, in short, seems to have become more efficient for this purpose. Evidence suggests that this improvement seems less likely to have come from the ability to impact on real variables, credit, long-term rates or the exchange rate, but more likely from higher pass-through from these variables to prices or better anchoring of the inflation expectation of the public.

In short, with a caveat that we may not have sufficient data to get a strong statistical conclusion, we have found evidence to the effect that international economic developments matter for the fluctuations of Thailand's macroeconomic variables. Monetary policy's ability to influence overall domestic events seems to have been somewhat diminished, with no evidence that this is mainly due to globalization. But the ability of the central bank to ensure long-term price stability seems to have remained largely intact.

1. Introduction

Over the past two decades, Thailand has become increasingly more integrated with the world in many aspects through the process that has become commonly known as globalization. International trade, as measured by the amount of goods and services imported and exported, has expanded more rapidly than GDP. Indeed, the ratio of trade volume to GDP almost doubles between 1990 and 2008, from 75 to around 140 per cent. Meanwhile, the Thai economy's financial linkage with the world, as measured by gross stock of international assets and liabilities to GDP, has also strengthened. The trend of deepening financial integration is also witnessed in East Asia, and is even more striking for advanced economies (see Figure 1).

Figure 1 Degree of economic integration



Intensifying world trade and financial integration should imply that economic or financial disturbances that occur in one economy have more chance of being transmitted or spilled over to another economy than before. As a small and increasingly open economy, it is often argued that macroeconomic developments in Thailand may increasingly be shaped by external forces. In fact, the economies of Thailand and the rest of the world tend to fluctuate together over time as the degree of integration rises. That is, the contemporaneous comovement between the business cycles of Thailand and a group of advanced economies as well as ASIA-8 tends to be higher over time (Table 1).[1] Meanwhile, domestic financial conditions may have been increasingly influenced by global financial conditions, which suggests that domestic monetary policy may have already lost the ability to influence financial conditions and through it, the rest of the economy.[2]

[1] This argument is consistent with several studies, which have suggested that greater openness to trade and financial flows have increased cross-border economic interdependence and resulted in the synchronization of business cycle fluctuations as well as the economic sensitivity to external shocks. For example, Stock and Watson (2005) suggests that high degree of output synchronization across countries in the 1970s may come from unusually strong common (oil) shocks. Nguyen (2007), using a Bayesian dynamic factor model to extract the world business cycle, finds that business cycles during 1960-2002 are highly synchronized in a subgroup of East Asian countries, which includes Korea, Hong Kong, Singapore, Malaysia, Indonesia and Thailand. On the other hand, globalization might not affect business cycle, as evidenced by the impressive growth of some emerging market economies such as China and India despite slowdowns in a number of industrial countries (Kose et al, 2008). The evidence on changes in business cycle synchronization among industrial countries has been mixed, however (see BG for brief review).

[2] It is not clear, ex ante, whether monetary policy effectiveness should grow or diminish as domestic financial markets are developed as a result of financial globalization. Arguments can also be made in support of the fact that a more efficient financial market can carry the policy interest rate signal forward along the yield curve more efficiently.

Table 1 Cross-correlations between Thai and foreign business cycles

Correlation at t=0	World	Advanced economies	Asia-8
1980s	0.42	0.35	0.59
1990s	0.73	0.52	0.67
2000 - 07	0.78	0.68	0.78

Source: Annual GDP growth data are from IMF's World Economic Outlook database. Correlation coefficients are from author's calculation.
Note: Cyclical components of real GDP are estimated from 'Band pass filter' introduced by Christiano-Fitzgerald (2003).

To what extent have international forces affected the determination of key macroeconomic variables in Thailand? Has globalization weakened the ability of Thai monetary policy to influence domestic financial and real variables? This paper investigates these two empirical questions in depth.

Measuring the influence of international integration in trade and finance on the Thai economy over time is no easy task. It is specifically the *change* in the spillover relationship between the economic dynamics of Thailand and those of the rest of the world as well as among the rest of the world themselves that we seek to capture. Given limited data, we explore a way to identify global forces and the channel through which they may affect Thailand's economic fluctuations. We then formally measure the effect of global forces on Thailand's economic dynamics. Within the same framework, we measure the effect of an increase in the policy interest rate by the Bank of Thailand on key domestic economic variables over time, allowing for the possibility that global forces may matter more for Thai economic dynamics over the recent years.

At the empirical level, we find the FAVAR framework introduced by Bernanke, Boivin and Eliasz (2005, or BBE) to evaluate US monetary transmission mechanism a natural empirical framework for our research questions. Recognizing that Thailand's economic dynamic are influenced also by global forces, we apply the empirical strategy employed by Boivin and Giannoni (2008) (or BG), which extends the BBE's model to explicitly account for possible global influence on the US economy, to address these questions for Thailand. The FAVAR framework allows us to systematically exploit a large set of economic and financial data as well as information.

With some measure of confidence, our findings can be summarized thus: First, we find that global macroeconomic and financial influence on real and nominal variables in Thailand is significant. Whether global forces have gained in importance is inconclusive for the overall economy, but we find that that influence has intensified for several selected variables. Second, we have also detected and identified statistically significant changes in the relationship between international forces and Thailand's economic dynamics over the past several years.

Third, on the question of how much globalization enhances or tempers the effect of BOT's monetary policy on the Thai economy, we have found that the recent changes in monetary policy effectiveness are not likely due to direct influence from globalization, but are mostly due to the change in the relationship among domestic variables themselves over time.

Over time, Thai monetary policy seems to have more or less maintained its effectiveness on the inflation path. While there is statistical evidence to point to the fact that monetary policy has been less effective in influencing the energy components in the consumer price inflation measure, the standard errors have also become smaller over time. Viewing impulse responses as a distribution of paths, we think that the explicit focus on long-term underlying inflation has contributed to lower inflation-output tradeoff over the past several years. Monetary policy, in short, seems to have become more efficient for this purpose. Evidence suggests that this improvement seems less likely to have come from the ability to impact on real variables, credit, long-term rates or the exchange rate, but more likely from higher pass-through from these variables to prices or better anchoring of the inflation expectation of the public.[3]

In short, with a caveat that we may not have sufficient data to get a strong statistical conclusion, we have found evidence to the effect that international economic developments matter for the fluctuations of Thailand's macroeconomic variables. Monetary policy's ability to influence overall domestic events seems to have been somewhat diminished, with no evidence that this is mainly due to globalization. But the ability of the central bank to ensure long-term price stability seems to have remained largely intact.

The paper is organized as follows: Section 2 briefly reviews the literature on globalization and monetary policy as well as previous empirical studies. Section 3 outlines the empirical methodology. Section 4 discusses our findings. Section 5 concludes with policy implications.

2. Globalization and monetary policy

2.1 Literature review

A growing discussion among central bankers and academics on the implication of globalization for monetary policy has 2 strands. Sparked during the Great Moderation period in global output fluctuation and inflation, the first strand of research concerns the effects that real globalization might have on the inflation process. Here the main questions are: (1) what role does globalization play in producing and maintaining low inflation?; and (2) are global factors becoming more important, relative to domestic factors, as determinants of domestic inflation? The second strand focuses on effect that financial globalization might have on the transmission mechanism of monetary policy.

Increasingly, a prominent view is that the forces of globalization have become the central drivers in domestic inflation trends. For instance, Rogoff (2004) argues that globalization may help support low inflation, even over the longer term when the developing world's integration into the global economy is no longer a surprise. In particular, globalization creates favorable environment for maintaining low inflation through greater

[3] For example, Poshyananda in BIS (2008) shows a slight increase in the exchange rate pass-through to core inflation in Thailand during 1995-2005 from 1993-2001. However, recent evidence from industrialized countries tends to point to a decline in the pass-through from exchange rate to domestic prices (Campa, Goldberg and Minguez, 2007 and Campa and Goldberg, 2008).

competition that weakens the power of domestic monopolies and labor unions. Greater competition contributes to greater price and wage flexibility, and diminishes the output gains from expansionary monetary policy for any given inflation impulse. Since rigid wages and prices are much harder to sustain in a highly competitive environment, one would expect the globalization effect to dominate over the longer run. Moreover, globalization could alter the behavior of domestic monetary policymakers (Rogoff, 2006). This way, globalization might help instill more monetary discipline as the impulse provided by monetary shocks on the real economy is reduced. Finally, positive supply shocks could well enhance the credibility of central banks, especially if continuing low prices are assumed by an undiscriminating public to be the results of good monetary policies. As a result, globalization may allow central banks to target a lower level of inflation, or more easily tolerate mild levels of disinflation (BIS, 2006).

Along a similar thread, measures of "global slack" are also shown to be statistically significant, over and above domestic output gap, in driving domestic inflation in a number of countries (Borio and Filardo, 2007). Pain et al (2006) also finds that import prices, presumably driven by foreign slack, have played a growing role in explaining domestic inflation in OECD economies in recent years. Meanwhile, estimates of standard Phillips curves for 11 industrial countries do not seem to support the hypothesis that foreign output gap plays an active role in determining domestic inflation (Ihrig et al, 2007).

At the other end of this debate, Ball (2006) argues that structural changes engendered by globalization can affect only the relative prices of goods and services; in contrast, inflation—the rate of change of the overall price level—must ultimately be determined solely by monetary policy. For example, the opening of trade with emerging-market economies that have low labor costs may reduce the relative prices of imported manufactured goods, but if the long-run inflation objective of the central bank is held constant, then the ultimate effect of the lower import prices on inflation will be insignificant as changes in other prices offset the effect of import prices. In effect, globalization may affect the parameters of central banks' models, but independent central banks still control their own "inflation destinies" (Kohn, 2006).

Aside from a few concerns raised here and there, there is little work on the effect of financial globalization on monetary policy transmission in a small open economy. Policy makers in New Zealand and Iceland, for example, seem to be increasingly concerned that the interest rate channel of monetary policy may have been weakened as the countries become more financially integrated to the world financial market (Gudmundsson, 2007). Evidence suggests that while asset prices react most strongly to other domestic asset prices, there are substantial international spillovers, both within and across asset classes between the US and the euro area (Ehrmann, Fratzscher and Rigobon, 2005).

2.2 Related empirical work on globalization and monetary policy effectiveness

While a large literature has developed on measuring the effects of monetary policy shocks over the last two decades, empirical studies on the impact of international interconnectedness and monetary policy transmission mechanism are sparse, partly owing to

the recent nature of the problem. In fact, we are hard put to find an empirical study of the issue on emerging markets or small open economies.

Methodologically speaking, vector autoregressions (VARs) have become a standard framework to study the effects of monetary policy shocks on macroeconomic variables. With few exceptions, VAR models employed in the literature are fairly small to save degrees of freedom. Typical monetary VARs include a measure of output, a measure of inflation, the policy interest rate and a few other variables. The small number of variables used in such studies, however, is at odd with the information set actually available to and used by central banks in deliberating monetary policy. In fact, existing econometric approaches fail to treat the huge amount of data central banks consider when deciding their actions (Sims, 2002). Sims (2002), in an essay on the way data relate to policy making at central banks, also emphasizes the need to be able to model "30 or 40 variables *jointly* in real time [Italic ours]," and take into account disaggregated or sectoral variables in policy decision. Typical VARs are short to this task. Failure to account for the appropriate information set available to the policymaker in real-time is generally problematic given that monetary policy shocks can be mis-measured.

As a result, recent research has attempted to incorporate larger information sets in VAR models. Bernanke and Boivin (2003) and Bernanke, Boivin and Eliasz (2005) were first to combine VAR models with factor analysis to measure the effects of monetary policy in what is a "data-rich" environment through the use of Factor-Augmented VARs (FAVARs), in which common factors are added to a standard VAR specification. FAVAR, however, allow a better identification of the monetary policy shock, since they condition on a more realistic information set. In addition, while VAR impulse responses can be derived only for the few included variables, FAVAR permit to observe the impulse responses to shocks for all the economic series included in the construction of the factors. The main drawback of the approach is the inability to assign explicit economic interpretation to the factors.

Mumtaz and Surico (2007) and Boivin and Giannoni (2008) are among the first to apply the FAVAR in an open economy context to study the impact of globalization on monetary policy transmission mechanism. The former finds that the dynamic effects on the UK economy following an unanticipated fall of short-term interest rates in the rest of the world are real house price inflation, rises in investment, GDP and consumption growth (peaking after one year) followed by the peak in wages, CPI and GDP deflator. The latter estimates a FAVAR on a large set of US and international data series and finds no strong evidence of a change in the transmission mechanism of US monetary policy due to global forces. Boivin, Giannoni and Mojon (2008) uses FAVAR to measure the change in the monetary transmission after the introduction of the euro and finds that the creation of the euro has contributed to a greater homogeneity of the transmission mechanism across countries and an overall reduction in the effects of monetary shocks.

3. Empirical framework and strategy

Measuring the influence of international integration in trade and finance on the Thai economy over time is an exceedingly difficult task, particularly with limited data. We consider our contribution to be an exploration of the issue from an empirical point of view. Following some insights we will have gained about how the important relationships work and how they change over time, more fundamental research can then begin to advance our understanding of the issue, possibly through dynamic stochastic general equilibrium modeling technique.[4]

The objectives of this study are twofold: To evaluate the importance of global macroeconomic and financial influence on real and nominal variables in Thailand as well as the transmission of the Bank of Thailand's monetary policy. Specifically, to what extent do global forces enhance or temper the effect of BOT's monetary policy on the Thai economy? And how has this changed over the recent years?

At the empirical level, we find the FAVAR framework introduced by Bernanke, Boivin and Eliasz (2005, or BBE) to evaluate US monetary transmission mechanism a natural empirical framework for our research questions. Recognizing that Thailand's economic dynamic are influenced also by global forces, we apply the empirical strategy employed by Boivin and Giannoni (2008) (or BG), which extends the BBE's model to explicitly account for possible global influence on the US economy, to address these questions for Thailand.

The framework is based on the recognition that not all relevant concepts are perfectly observed in macroeconomics. Some concepts are measured with error or, as theory suggests, they can be fundamentally latent. For instance, the concepts of potential output, inflation, natural rate of interest are difficult to measure directly. In the nutshell, one hopes to be able to extract from a large data set the most important components driving the fluctuations in the economy.[5] To the extent that we extract the correct number of common components from the data set of noisy indicators, these common components should constitute relevant set of factors underlying the dynamic of that noisy data set. Each common component may not represent one single economic concept, but in the form of factors, each is a summary measure (or statistic) of many features of the state of the economy at each date. In short, the game is to extract the common "factors" (denoted by C's below) that together linearly span the space of the economic data set representing the economies of Thailand and the rest of the world (denoted by X's below).

The important reason we do not wish to restrict ourselves to measures typically used in VARs (e.g., inflation, output) is because we recognize that policy makers and financial market participants exploit large information sets in practice. Indeed the central argument by proponents of FAVAR is predicated on the fact that we should be able to identify monetary policy shock better by using a large set of data available than through the use of standard

[4] Since the first order conditions of a DSGE model can be represented in VAR form, our result (summarized by various impulse responses) will be useful for DSGE model calibration or estimation through moments or impulse response matching.

[5] Stock and Watson's research program on forecasting with a lot of data provides the backbone for this empirical approach.

VARs, which permit only small data sets. Equally important, from the data point of view, and in recognition of reality, it allows us to include a variety of measures of prices and real activity without being limited to a selected few. These forces are treated as latent common components. Moreover, we can construct an impulse response function and trace out the effect of monetary policy shocks through time on any *individual* economic variables included in the data set. The FAVAR framework, in this sense, accommodates our task of identifying the effect globalization has on the transmission of monetary policy on a wide array of individual economic time series; particularly with short economic time series limiting the usefulness of structural VARs.

In this section, we describe the FAVAR model, our estimation approach, the data used and how we treat them, as well as characterize the transmission of monetary policy under globalization.

3.1 Description of FAVAR (BG)

In this paper, we consider two regions: Thailand and the rest of the world, denoted with *. In each region, we measure the state of the economy with large vectors of macroeconomic indicators, denoted by a $N \times 1$ vector X_t for Thailand and a $N^* \times 1$ vector X_t^* for the rest of the world. We assume that the state of the economy, possibly unobserved, can be summarized by a $K \times 1$ vector C_t in Thailand and a $K^* \times 1$ vector C_t^* for the rest of the world. The number of these common factors are assumed to be small relative to the number of indicators, i.e., $K < N$ and $K^* < N^*$, and relate to the state of the economy according to the measurement (or observation) equations

$$X_t = \Lambda C_t + e_t \tag{3.1}$$

$$X_t^* = \Lambda^* C_t^* + e_t^* \tag{3.2}$$

where Λ and Λ^* are $N \times K$ and $N^* \times K^*$ matrices of factor loadings while e_t, e_t^* are the $N \times 1$ and $N^* \times 1$ vectors of series-specific components that are uncorrelated with the C's, but can be serially correlated and weakly correlated across indicators.

In this framework, the C_t and C_t^* can be understood as two distinct sets of (unobserved) components common to all (observed) data *in the respective region*, which can be correlated across regions. Equations (3.1)-(3.2) the common factors represent forces that drive the common dynamics of the economy as represented by the data. Moreover, they are summary statistics of the state of the economy in the respective region at each date. Alternatively, the variables in the two X's are noisy measures of the underlying unobserved factors, the C's.[6]

The dynamics of the common factors are modeled as a typical structural VAR according to the state equation

[6] In principle, C_t can always capture arbitrary lags of some factors; so it is not uncommon to assume that X_t depends only on the current values of the factors.

$$\Phi_0 \begin{bmatrix} C_t^* \\ C_t \end{bmatrix} = \Phi(L) \begin{bmatrix} C_{t-1}^* \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} v_t^* \\ v_t \end{bmatrix} \tag{3.3}$$

where Φ_0 is a matrix of appropriate dimension on which we can later impose restrictions, $\Phi(L)$ is a conformable lag polynomial of finite order, whereas the structural shocks v_t, v_t^* are assumed to be i.i.d. with mean zero and diagonal covariance matrix Q and Q^* respectively. The off-diagonal elements of Φ_0 and $\Phi(L)$ allow the shocks to affect the common factors of the other region both contemporaneously and over time. We can write a reduced-form representation of this state equation by premultiplying on both sides of (3.3) by Φ_0^{-1} thus:

$$\begin{bmatrix} C_t^* \\ C_t \end{bmatrix} = \begin{bmatrix} \Psi_{11}(L)\Psi_{12}(L) \\ \Psi_{21}(L)\Psi_{22}(L) \end{bmatrix} \begin{bmatrix} C_{t-1}^* \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} u_t^* \\ u_t \end{bmatrix} \tag{3.4}$$

where the reduced form innovations u_t, u_t^* are cross-correlated.

We write

$$C_t = \begin{bmatrix} F_t \\ R_t \end{bmatrix} \tag{3.5}$$

where F_t is a vector of latent macroeconomic factors summarizing the behavior of the Thai economy and R_t is the BOT's policy interest rate. Writing the policy interest rate as an observed common component of all Thai data series means that we allow the BOT's policy instrument to have pervasive effect on the Thai economy. It allows us to identify and characterize the effect of monetary policy on the economy.

The dynamic (empirical) model just laid out consists of the measurement and the state equations. The former, (3.1)-(3.2), links a large set of observable indicators—central banks are likely to pay attention to them—to a small set of common components. For instance, (3.1) combined with (3.5) specifies that indicators of Thai economic activities, real and nominal, are driven by domestic latent factors F_t, the BOT's policy interest rate R_t, and a component that is specific to each individual series e_t, which accounts for measurement error or other idiosyncrasies. The state equation (3.3) or (3.4) specifies how these common components evolve over time. These unobserved (common) factors should reflect general region-specific economic conditions or concepts generally *not* captured by a few time series, but rather by a wide array of economic indicators, such as economic activities, the price pressure, financial market conditions, the cost of capital (captured by key features in the term structure of the interest rates).

The factors summarizing economic conditions in Thailand and the rest of the world, C_t and C_t^*, may be affected by their own region-specific shocks and by global shocks. In fact, since the reduced form innovations u_t, u_t^* are cross-correlated, they can be interpreted

as the sum of a component that is common to both Thailand and the rest of the world, driven by some global shocks and a component that is exclusively region-specific.[7]

The matrix polynomials $\Psi_{12}(L)$ and $\Psi_{21}(L)$ determine the magnitude of the spillover or feedback between the economic variables of Thailand and the rest of the world. For instance, when $\Psi_{21}(L) = 0,$ the rest of the world has no influence or spillover on the Thai economy, i.e. fluctuations in international (foreign) economic variables do not have information to help forecast (or "Granger cause") any fluctuations in Thai economic variables. Indeed, following a surprise BOT monetary policy move, $\Psi_{21}(L)$ measures the degree to which the rest of the world enhances or mitigates the transmission of Thailand's monetary policy *domestically*. To evaluate that feedback and its influence on the working of Thailand's monetary policy, $\Psi_{21}(L)$ has to be identifiable.

3.2 Estimation

While our model setup is identical to that of BG's, we depart from BG in our estimation approach in two fundamental ways: 1. we standardize our data series like BBE and other principal component studies before it; and 2. we remove the policy rate from the space covered by the principal components along the line of BBE. We refer to these papers for detailed description, and briefly outline the steps as follows:

The first step consists of extracting the principal components from X_t and X_t^* to obtain consistent estimates of the common factors C_t and C_t^*. In the second step, we add the policy interest rate to the estimated factors and estimate the VAR in (3.4).

Like BBE, we assume that the policy interest rate is one of the domestic common components and should be captured by the principal components. To "remove" the policy interest rate from the space spanned by the principal components, we perform a transformation of the principal components exploiting the behavior of "slow moving" trend variables and "fast moving" variables.[8]

After estimating the factors C_t and C_t^* and the factor loadings Λ and Λ^*, we estimate the VAR (3.4).

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[7] They can be written as $\begin{bmatrix} u_t^* \\ u_t \end{bmatrix} = \begin{bmatrix} \Gamma_1 \\ \Gamma_2 \end{bmatrix} g_t + \begin{bmatrix} \varepsilon_t^* \\ \varepsilon_t \end{bmatrix}$, where g_t is a vector of global exogenous shocks and ε_t and ε_t^* are disturbances specific to each region and are uncorrelated across regions, i.e. $E_t(\varepsilon_t' \varepsilon_t^*) = 0$. It is important to note here that we do not attempt to identify the world-wide global shocks g_t in this study. It is not necessary, however, to identify such world-wide global shocks in order to quantify the effects of international factors on the monetary transmission mechanism of the BOT.

[8] Another approach may be to impose the constraint that the policy interest rate is one of the factors in the estimation during the first step. BG, for example, imposes that constraint and perform iterative regression to tease out the first $K-1$ principal components of X_t and the factor loading for R_t. We have reasons to believe that our factor and factor loading estimation results may not be robust to this particular method.

Note that the matrix polynomial (the VAR coefficient) $\Psi_{21}(L)$, which captures the effects of international factors on Thai variables, will be crucial to our analysis and identification of global influence on BOT monetary policy effectiveness. The following conditions suffice for this matrix polynomial to be identified: 1. C_t^* "Granger causes" C_t and 2. C_t does not constitute sufficient statistics to uncover the dynamics of the Thai economy. In other words, we need international factors to bring additional statistical information, or else we cannot separate their influence on the Thai economy from other forces. As the estimate of $\Psi_{21}(L)$ relies on the presence of independent variation originating in the rest of the world, we will show that we have sufficient such variation in the data from the Granger causality (or predictability) tests reported below.

3.3 Description of the data

In our application of the FAVAR methodology, the set of information variables consists of a balanced panel of 182 monthly macroeconomic time series that are tabulated in Appendix A. The bilateral repurchase interest rate and its corresponding short-term money market rates that the BOT used as signal for monetary policy is interpreted as the monetary policy instrument and considered to have pervasive effects on the economy.

The data span the period from January 2000 – June 2008. The choice of starting period is based on data availability at monthly frequency and the practice of inflation targeting in Thailand. The estimation period is also well after the 1997 Thai financial crisis and so the dynamics of our results are not affected by structural break from the crisis and the exchange rate regime shift.

As described in the Appendix, the data are divided into two blocks; domestic and international. Domestic block consists of 123 Thai indicators and covers a wide set of real economy and financial variables. These include components of manufacturing production index (MPI), private consumption indicator (PCI), private investment indicator (PII), balance of payment, export, import, employment, as well as various indicators of prices, interest rates and money aggregates. Variables that contain expectation of future outcomes, other than the financial variables, such as Business Sentiment Index (BSI) and Consumer Confidence Index (CCI) are also included. International block which consists of 59 international indicators comprises world commodity prices and the data of other 12 foreign countries which recognized as Thailand's major trading partners, including US, Euro area, Japan, China, Hong Kong, UK, Indonesia, Korea, Malaysia, Philippines, Singapore and Taiwan. The data are selected to represent the real activity, consumer price index, financial market and interest rate in those foreign countries. All series are taken from various sources, both private and public databases. In addition, when it is appropriate, the series are seasonally adjusted and transformed to induce stationarity before using in estimation in the next step. However, to remain consistent with the literature and to have a common treatment across similar variables in the data set, we analyze variables in levels in our FAVAR results.

3.4 FAVAR model specification

In selecting our preferred model, there is one important issue to consider. The sample size (number of observation) we have to work with puts a restrictive constraint on the dimension of our model. Like most studies of this nature, the number of lags in the VAR can be limited, especially when the number of factors becomes large.

Akaike information criteria for selecting the number of factors and lags may be inadequate for our purpose, as we are more concerned with bias than efficiency. Indeed, the literature and our experience show that the Akaike information criterion (AIC) tends to overestimate the number of lag length while the Bayesian information Criteria (BIC), such as the Schwartz and the Hannan-Quinn (HQC), tend to be parsimonious, restricting the number of lags to a very minimum.[9] These information criteria require large samples to be precise, a luxury macroeconomic research does not generally enjoy. For small sample sizes, Kilian and Ivanov (2005) suggests that HQC is best for quarterly and monthly data.

In practice, we have to balance between having sufficient number of lags to ensure adequate dynamic in the model and a large number of factors to ensure that the data set is sufficiently spanned (i.e., the variation in the data is adequately explained by the common factors). Our approach to model selection therefore is to experiment with as many domestic and international factors as the degree of freedom allows. Our experience has shown that when the number of factors is large relative to the number of observation, we do not find that varying the number of factors changes substantially the dynamic response of the economy to monetary policy, but the uncertainty surrounding the estimates increases with more factors. Our experience also shows that adding factors seem to mitigate the "price puzzle", as is corroborated by BG and Pongpaichet (2008). We also find that having at least 5 or 6 domestic latent factors does not change the result in any meaningful way; this includes improving on the "price puzzle".

Regardless of the number of factors we include, the BIC selects 1 lag in (3.4) over the entire sample. In fact, we find that the BIC tends to choose models that are parsimonious, as it heavily penalizes on complexity. In any case, model dynamic, as captured in the impulse responses of important economic variables to a surprise change in the policy interest rate, shows a degree of robustness at 2 and 3 lags in (3.4).

After robustness check for different model specifications and practical consideration, our preferred specification admits 5 domestic latent factors (in addition to the policy interest rate), 3 international factors and the state equation (3.4) has 1 lag.

3.5 Characterization of monetary policy transmission under globalization

We characterize the transmission mechanism of monetary policy by computing the response of selected macroeconomic variables to an identified monetary policy shock. In order to do that, we need to ensure that the only shock that enters the system comes from innovations in the policy interest rate shock in (3.3) or (3.4). Moreover, to identify monetary

[9] For detailed argument, see Canova (2007).

policy shocks, which are surprise changes in the policy interest rate (possibly deviation from some understood monetary policy rule), we make a standard assumption that other variables in the VAR, which in our case are the international factors C_t^* and the domestic latent factors F_t, cannot respond to innovations in R_t in the period of the shock. The policy interest rate can, however, respond to contemporaneous fluctuations in the other factors. Also recall that the ordering between factors within the two sets of common components C_t and C_t^* (excluding the policy interest rate) does not matter to our result, as they are all principal components or, by design, an orthogonal linear combination of the data. Taking into account the fact that domestic latent factors should not influence global factors contemporaneously, we order our VAR as follows: international factors, domestic factors, and policy interest rates. We impose the standard Cholesky restriction accordingly on the matrix in Φ_0 in (3.3).

To measure the extent to which globalization impacts on the transmission mechanism of Thailand's monetary policy, our strategy is to trace out the impact of monetary policy shocks on selected domestic economic variables for different values of $\Psi_{21}(L)$ and compare them. While we would be able to explore directly the importance of the endogenous response of the rest of the world in the BOT transmission of monetary policy in principle, it may not be that fruitful an exercise because Thailand is small relatively to the rest of the world. But, we would be able to explore the following questions: *What would the impulse responses be like if there is a possibility that global spillover into domestic variables has singularly increased (or simply changed) over the years on account of intensified globalization in trade and finance, as many believe?* While there is a possibility that the relationship between global and domestic variables may have changed over time, has globalization reduced the ability of Thailand's monetary policy to influence domestic variables?

We implement this strategy by allowing for the possibility that the international factors may affect domestic variables differently after 2003M6. The short sample leaves us little room to pick the "break date." Indeed, since the process of globalization has only been characterized as monotonically intensifying, without loss of generality, we should pick a break date that maximizes the use of our sample for the benefit of accuracy in estimation. We follow BG and expand the VAR system of our FAVAR to include a dummy variable interacted with all the lags of the international factors. We estimate the following system:

$$\begin{bmatrix} C_t^* \\ C_t \end{bmatrix} = \begin{bmatrix} \Psi_{11}(L)\Psi_{12}(L) \\ \Psi_{21}(L)\Psi_{22}(L) \end{bmatrix} \begin{bmatrix} C_{t-1}^* \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} \Psi_{11}^d(L) \\ \Psi_{21}^d(L) \end{bmatrix} d_t C_{t-1}^* + \begin{bmatrix} u_t^* \\ u_t \end{bmatrix}, \tag{3.6}$$

where $d_t = 0$ during the period 2000M2-2003M6 and $d_t = 1$ afterward. We estimate over two sample periods, 2000M2-2003M6 and the entire sample period 2000M2-2008M6 with the interactive dummy turned on. Then we study the impulse responses—or functions of the parameters estimated for the whole period (with the dummy turned on) and those that are functions of all the parameters estimated for the whole sample, except for the $\Psi_{21}(L)$, which we will substitute with the value estimated during the first subsample (naturally, setting $\Psi_{21}^d(L)$ equal to zero). By comparing the two sets of impulse responses, we can gauge the effects on the monetary policy transmission of the *changes* in the feedback relationship from

the international factors to the Thai factors, most likely to be due to globalization. In fact, the only relationships that are allowed to change over time and are captured by the two sets of impulse responses are those which describe the final effect of international factors on Thai data. By following this strategy, we also maximize the use of our short sample, mitigate the small sample bias in our estimation, and allow for a change in the role of international factors over time. We pick 2003M7 as our break date. Here, we note that our results are substantially robust to the choice of break dates to approximately 6 months around that date.

4. Findings

4.1 Comovements between international factors and Thai economic dynamics

In order to explore how much international factors can explain *business cycle fluctuations* in various Thai macroeconomic variables with information *not* contained in Thai factors, we study the fraction of volatility in the series listed in the first column of Table 2 that is explained by the 6 Thai factors (including the policy interest rate), the 3 international factors, and all factors taken jointly. Table 2 reports the adjusted-R^2 statistics obtained by regressing the cyclical components of these variables on the cyclical components[10] of the two set of factors over the entire sample period 2000M2-2008M6. Since the Thai and international factors are allowed to be correlated, the sum of the fractions of the variance in any given variable explained by the Thai factors and by the international factors do not necessarily have to be equal to the fraction of the variance explained jointly by these two sets of factors; i.e. the second and third columns do not have to add up to the fourth column.[11] Note that the R^2 reported in this table may seem low because they are adjusted-R^2 that are collected from regressing cyclical components of each variable on the cyclical components of the factors at business cycle frequency. Using monthly growth rates of some of these variables (e.g., real activities) instead of the cyclical components (at business cycle frequency) will give more high-frequency variability than what is reported here. We have also experimented with up to 20 domestic factors and 10 international factors and find that while the adjusted-R^2 rise as a result of additional factors, the shapes of the rolling R^2 reported in Figure 2 and therefore the conclusion drawn below are substantially unchanged.

Recall that we are investigating the *additional* power of explanation international factors can provide for the dynamics of important Thai variables. Table 2 reveals some interesting observations.

1. The entire Thai data set X_t is quite correlated with the (joint) common factors. On average, all factors explain 34 per cent of the variance of the Thai economy, as represented by X_t. The corresponding figure reported in BG for US data set, collected from regression using unfiltered data, is 45 per cent. The domestic factors explain Thailand's economic fluctuations slightly better than the international factors do, as the adjusted-R^2's for these factors are 0.22 and 0.17, respectively. Adding international factors does help to increase the power of explanation by as much as 12 percentage points.

[10] Cyclical components are estimated as the deviation from Hodrick-Prescott filtered trend.
[11] In fact, the difference between the fourth column and the sum of the second and third columns may give a rough sense of how the *determinants* of these variables may be correlated across countries.

At the level of selected Thai indicators, we find:

2. Real economic activities, such as MPI, PCI and PII, display some correlation with the Thai factors over the entire sample. Both MPI and PCI are as correlated with international factors as they are correlated with Thai factors, while adding international factors raise the explanatory power by roughly 10 percentage points. PII are slightly better explained by the Thai factors than by the international factors, and adding international factors raises the power of explanation by roughly 20 percentage points. In short, the additional explanatory power the international factors bring is quite substantial relative to the adjusted-R^2 obtained solely with the Thai factors.

Not surprisingly, Thai real exports of goods are more correlated with the international factors. The addition of international factors more than doubles the explanatory power of domestic factors alone. Thai real imports of goods are as correlated with domestic as they are with the international factors, but adding international factors can raise the adjusted-R^2 by 9 percentage points.

We can see that these international factors contain substantial information not already contained in the Thai factors, and which are correlated with MPI, PCI, PII, real exports, and to some extent real imports.

3. For sentiment indices, the international factors roughly double the adjusted-R^2 for both the consumer confidence index and its 3-month-ahead value. As for the business sentiment index, the domestic factors have approximately equal explanatory power as the international factors.

4. On average over the sample, the variance of the cyclical components of Thai price variables are uniformly better explained by the domestic factors, although adding the international factors raises that power of explanation by a substantial degree for most price indicators, such as CPI, PPI, export price and energy price. What is striking is that the international factors can explain the variance of the cyclical components in energy and core price inflation as well as the domestic factors can. This reflects the fact that Thai and international factors which can explain these inflation measures well may be correlated, and is consistent with the argument that important components of consumer price inflation may be shared globally.

The low correlation between international factors and Thai raw food price on average helps explain why the consumer price index is not as strongly correlated with the international factors as it is with domestic factors. Nevertheless, the international factors are found to help increase the adjusted-R^2 for CPI by 12 percentage points.

5. The THB/USD exchange rate is much more strongly correlated with the international factors than with the Thai factors, while the nominal effective exchange rate is also more strongly correlated with the international factors. Moreover, the price of the risk-reversal (25-delta) option strategy, which contains market information about the probability of 12-month-ahead movements in the bilateral THB/USD exchange rate, is not correlated with the Thai factors on average over the sample; instead it is quite well correlated with the international factors. Contrary to the case of a large and relatively closed economy like the

US (studied by BG), the international factors bring substantially large amount of additional information to help explain the fluctuations around the trends of Thailand's exchange rates, which themselves contain expectation on various economic indicators including their own future values.

Table 2 Adjusted R^2 for regressions of cyclical components of selected Thai series on cyclical components of various sets of factors (sample 2000M2-2008M6)

	Domestic factors	International factors	All factors
All Thai data X_t (average over all Thai data)	0.22	0.17	0.34
Selected Thai indicators			
Policy rate	1.00	0.71	1.00
Minimum lending rate (MLR)	0.72	0.44	0.74
14Y bond yield	0.05	0.14	0.21
Spread (14Y-2Y)	0.40	0.42	0.45
Thai baht risk reversal (25 Delta)	0.01	0.36	0.42
Exchange rate (THB/USD)	0.14	0.52	0.69
Nominal effective exchange rate (NEER)	0.16	0.23	0.56
SET index	0.13	0.26	0.28
Credit outstanding	0.21	0.03	0.40
Manufacturing production index (MPI)	0.17	0.18	0.28
Capacity utilization (CAPU)	0.08	0.30	0.33
Private consumption indicator (PCI)	0.17	0.13	0.27
Car sales	0.13	0.06	0.19
Private investment indicator (PII)	0.24	0.21	0.43
Export quantity index (QX)	0.12	0.20	0.27
Import quantity index (QM)	0.16	0.14	0.25
Imports of capital goods	0.14	0.07	0.24
Headline consumer price index (CPI)	0.49	0.25	0.61
Core CPI	0.64	0.64	0.76
Raw food CPI	0.18	0.02	0.23
Energy CPI	0.32	0.28	0.58
Producer price index (PPI)	0.41	0.10	0.53
Export price index	0.37	0.27	0.58
Import price index	0.55	0.02	0.65
Consumer Confidence Index (CCI)	0.18	0.32	0.37
CCI expected	0.18	0.27	0.33
Business Sentiment Index (BSI)	0.11	0.14	0.21
BSI expected	0.00	0.06	0.08

6. While domestic factors are certainly key in explaining the variance in the cyclical component of Thai commercial bank credit outstanding, the international factors almost doubles the explanatory power. On the contrary, fluctuation in the SET index is dominated by the international factors.

7. Finally for nominal interest rates, even though the policy interest rate is a Thai factor by assumption, it is highly correlated with the international factors. Long-term Thai interest rates are more strongly correlated with the international factors than with the Thai factors, although the adjusted-R^2 is quite low. The floating MLR interest rate, however, displays high correlation with the international factors, although the Thai factors dominate. Both the policy interest rate and MLR do not benefit from the little additional information brought in by the international factors. They are quite obviously determined domestically while remaining highly correlated with global developments.

Using an exclusively financial FAVAR (at daily frequency), we also find that the Thai domestic financial market variables, such as the stock market, the THB/USD exchange rate and 10-year long-term bonds, are strongly correlated with both international financial factors and other domestic financial indicators.[12] (Adjusted-R^2 statistics are mostly over 0.60 in both cases.) The overall result suggests the importance of international as well as domestic spillovers across Thai financial assets. In this context, the international financial market factors appear to be generally more significant in explaining the variance of Thai financial market variables.[13]

In summary, most of the indicators associated with real GDP, prices and interest rates, with the exclusion of real exports and long-term bond yield, are more correlated with the Thai factors and to a lesser extent with the international factors. The opposite is true for the exchange rate and stock market indicators. Nevertheless, we find that the international factors matter for the dynamics of the Thai economy.

The evidence discussed so far can only provide a *prima facie* case for considering the international factors as a joint set of explanatory variables when modeling fluctuations in the Thai economy. This evidence suggests that we can make the case that the international factors do bring additional statistical information. As will be shown in the following pages, we can separate their influence on the Thai economy from other forces and identify the matrix polynomial $\Psi_{21}(L)$ in our model. In fact, the low correlation with the international factors is deceptive because it is subject to considerable instability over the sample.

Have international forces and Thai economic fluctuations become more strongly entwined? A formal empirical analysis of the recent changes due to greater international integration in trade and finance is exceedingly difficult even without the limits on short data samples. Nevertheless, we want to explore the comovement between Thai variables and the

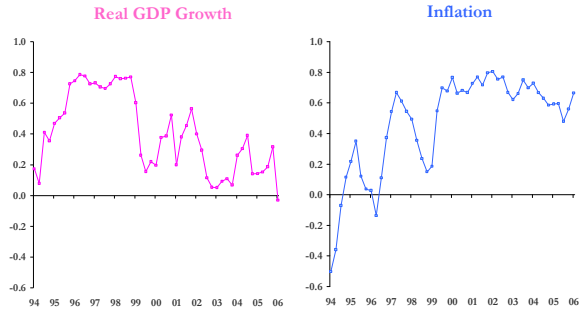
[12] Specifically, to be able to give a more specific economic interpretation, we partition our global financial variables so that each variable is grouped according to the following factors: Short-term interest rate factor, bond market factor, foreign exchange market factor and stock market factor. These factors are extracted from a set of 62 daily financial market indicators during 4 January 2000 - 11 July 2008 and covers financial variables of Thailand as well as 12 other countries, namely US, euro area, Japan, China, Hong Kong, UK, Indonesia, Korea, Malaysia, Philippines, Singapore and Taiwan. Domestic financial variables include domestic stock market index, the 1-day repurchase rate, THB/USD exchange rate and 10-year bond yield. Foreign variables are analogous counterparts. The variables used are transformed into a log form with the exception of short-term interest rate and bond yield.

[13] The stock market, for example, is largely explained by movements in international financial factors (88%). The exchange rate is also strongly correlated to international factors (77%). Moreover, the Thai bond market appears to be the least correlated with the global financial market.

international factors over time. We start by showing some evidence on GDP growth and inflation synchronization over a short period between 2000 and 2008. Then we follow up on the comovements between key economic and financial variables.

Figure 2 Correlations between Thai and underlying global growth*

(Computed over a 3-year moving window)



Remark: *Kalman filtering method is used for extracting dynamic common factors, as suggested by Moneta and Ruffer (2006), where selected countries are US, Euro(12), Japan, China, Hong Kong, Korea, Taiwan, Singapore, Malaysia, Indonesia, and Philippines. Shown dates in figures are mid point of rolling period.

Source : BOT, MOC and NESDB

Assuming no spillover between countries for simplicity's sake, we follow Moneta et al (2006) and estimate a dynamic common factor model of underlying world economic growth[14]. We find that the correlation between Thailand's GDP growth rate and the common (world) growth rate, another measure of output synchronization between Thailand and global economy, has been declining slightly between 2000 and 2008 (Figure 2 - left panel), in line with the decline in the explanatory power of global factors for some domestic-driven indicators shown below.

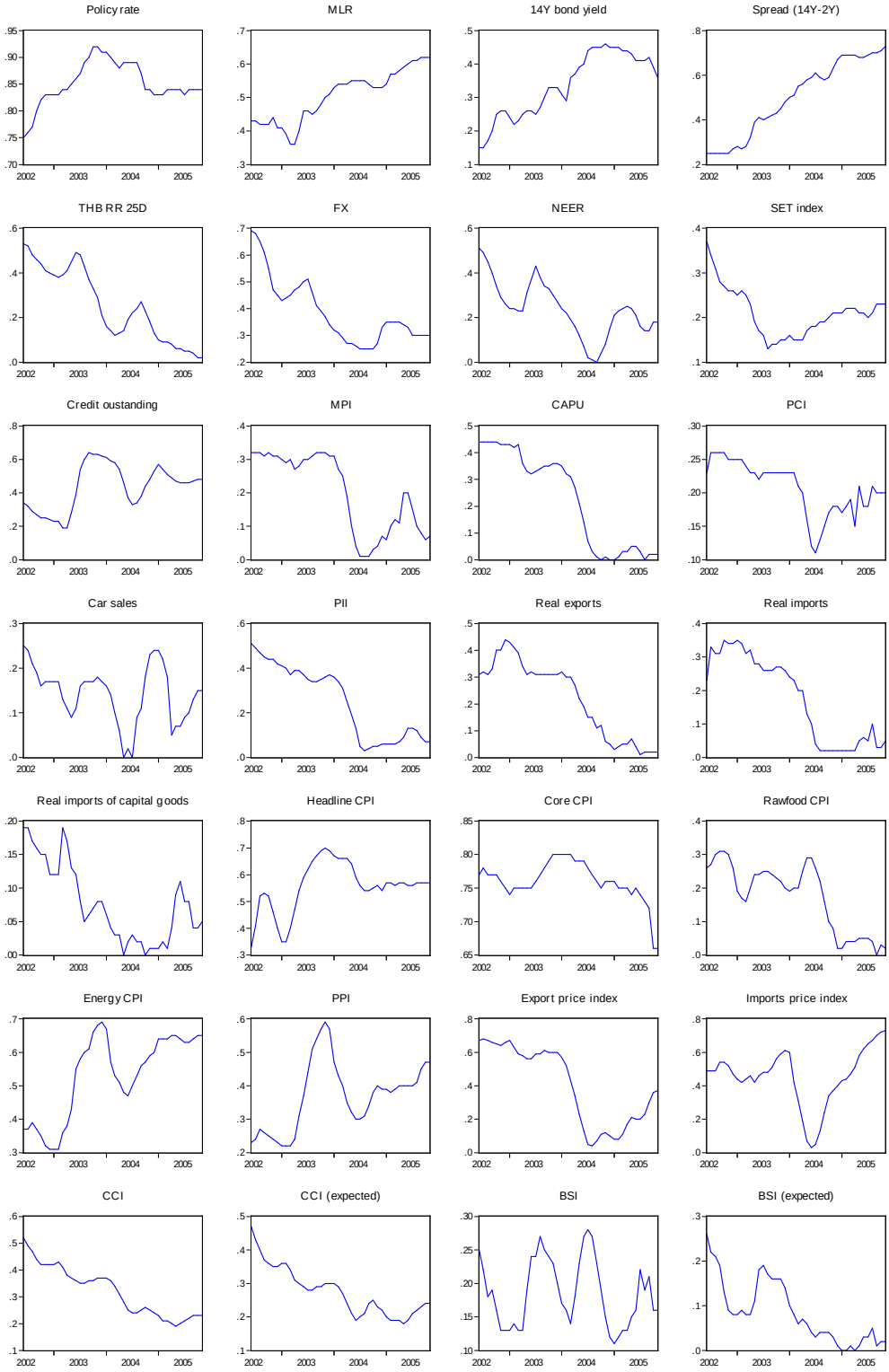
For Thailand, explanation behind the lower degree of business cycle comovement could derive from our own domestic factors and the structure of economy highly depend on domestic demand (share of domestic demand in GDP is higher than external demand).[15] For example, domestic demand picked up during 2002-2004 from fiscal and monetary stimulus, whereas the export sector and the global economy were experiencing a downturn in global electronics cycle. During the past 2 years, however, domestic demand has been affected by (idiosyncratic) domestic political uncertainty while export growth rate has remained robust.

For synchronization of inflation rates with the rest of the world, we find a different story. Right panel of Figure 2 shows that the correlation between Thailand's inflation rate and the underlying world inflation trend has increased over time. Many candidate explanations exist, and they tend to be based on stories of common shocks such as the positive global supply shock during the Great Moderation, convergence of central bank policy in many countries to focus on maintaining price stability, as well as the recent upward trend of world commodity prices, which play important role in price synchronizing across countries (White, 2008 and Yellen, 2008).

[14] The model consists of 2 equations: $Y_{i,t} = a_i Y_{i,t-1} + b_i Z_t + \varepsilon_{i,t}$ and $Z_t = dZ_{t-1} + \eta_t$, where $Y_{i,t}$ is real GDP growth of country i, Z_t denotes the common factor, ε and η are independent Gaussian white noise terms. We use Kalman filter to estimate the parsimonious version of the model, i.e., assuming that there are no spillover effects among countries. We do this for simplicity's sake since Moneta et al (2006) finds that the spillover effects across countries explain only a small part of the co-movement in the ASEAN region.

[15] Moneta et al (2006) finds the decline in the synchronization of output growth among ASEAN countries after the Asian crisis and reports that the synchronization appears to reflect a strong common export phenomenon rather than common consumption or investment dynamics.

Figure 3 The comovement or the fraction of the variability in Thai variables that can be explained by the international factors



Note: Adjusted R-squared from 42 months rolling regressions since 2000M2-2008M6. Dates in figures are mid points of rolling periods.

Next we report the results on the comovements between Thai variables with international fluctuations. Figure 3 shows the comovement or the fraction of the variability in Thai variables that can be explained by the international factors. The reported adjusted-R^2's come from the estimation using 42-month rolling windows. The dates on the horizontal axis correspond to the mid-point of that window.

These figures display interesting results. The comovements between selected Thai macroeconomic variables and the estimated international factors have varied over the past several years. Short sample may have contributed to the fluctuation in the correlation measure. Nevertheless, the comovements seem to have declined recently for indicators of real economic activity, including MPI, manufacturing capacity utilization rate (CAPU), PCI, PII and import volume, in accordance with indicators of economic sentiments, namely CCI and BSI. These variables' correlation with the international factors may have diminished as cyclical components of domestic demand are out of synch with the development in the rest of the world toward the end of the sample.

Price indices show a mixed change. Headline CPI has become slightly more correlated with the global factors, thanks in large part to the energy components and the floating of domestic retail oil prices as well as larger oil price swing in the recent period. However, core CPI has almost displayed no change in the correlation until the very end of the sample period. We suspect that this relatively constant comovement has several underlying reasons, one of which could be due to monetary policy. The comovement for import price, on the other hand, tends to fluctuate, and rises toward the end of the period, coinciding with the correlation reported for CPI energy, as oil prices picked up and Thailand is dependent on oil imports. Export price (in dollar terms) has become less correlated with the international factors, suggesting that Thai exporters may have some ability to set prices more or less despite the vicissitude of the global economy.

Every measure of the exchange value of the Thai baht has become less correlated with the international factors, including the price of the risk-reversal 25-delta strategy, which summarizes the 12-month-ahead view of the direction of THB/USD. In fact, the ability of the international factors to explain fluctuations in the Thai baht exchange rate has consistently declined over time.

Interest rates, namely the yield on 14-year government bonds, have become increasingly more correlated with the international factors. The pickup in the comovement may have been due to higher degree of participation of non-residents in the bond market. Market information suggests that prices of long-term bond in the international markets are highly correlated due to synchronization of global economic cycle during the recent periods. Nominal interest rates, including the policy interest rate and commercial bank lending rate (MLR), have displayed higher correlation with the international factors despite the fact that they are much more correlated with the Thai factors. We suspect that monetary policy has become more synchronized across the world over the business cycle, as output has become more synchronized during the period of interest. Lending rates tend to follow the policy rate at business cycle frequency.

4.2 How relevant are global factors for Thai economic fluctuations?

From the statistical viewpoint, can we identify the spillover from the rest of the world to the Thai economy necessary for an identification of the feedback measure $\Psi_{21}(L)$? We check for the relevance of global fluctuations for the dynamic of the Thai economy by testing whether past values of the common international factors C_t^* have information to help forecast the current values of Thai latent factors F_t and the policy interest rate. In short, we test whether international factors jointly "Granger cause" Thai factors.[16]

Table 3 reports results of these Granger predictability tests. The null hypothesis that international factors have no predictive power can be rejected for all but 3 Thai factors (including the policy interest rate) at 10% level over the entire sample. Evidently, the inability to reject the null hypothesis over the subsamples (and over the entire sample) in some cases might just reflect the low power of the test over these small samples. We note that for the quarterly sample that extends back to 1995Q1 also confirms that international factors have sufficient information to forecast Thai fluctuations over the entire sample. These results identify the feedback from the rest of the world to the Thai economy through $\Psi_{21}(L)$.

Table 3 Granger-causality test for international factors affecting Thai factors

	Full sample	00M2-03M6	03M7-08M6
Factor 1	0.06	0.01	0.60
Factor 2	0.07	0.52	0.14
Factor 3	0.44	0.55	0.22
Factor 4	0.01	0.02	0.00
Factor 5	0.18	0.57	0.19
Policy rate	0.29	0.01	0.01

Note: Table reports p-values to reject the null hypothesis that the reporting Thai factors or policy rate is not jointly Granger-caused by international factors.

The ever increasing intensity of global interconnectedness and the evidence that Thailand's relationship with the world has become more intertwined suggest that the feedback relationship from global to domestic variables may not be stable over the sample. To test for the stability of the Granger predictability relationships, we employ the standard Quandt-Andrews (likelihood-ratio) stability test. We apply the test jointly to all international factors.[17] Evidence reported in Table 4 suggests that such "feedback" relationship is likely

[16] To be sure, Granger "causality" is not economic causality. We limit ourselves to identify $\Psi_{21}(L)$. We are not claiming economic causality; that task is best left for an optimization model with micro-foundation.
[17] The Quandt-Andrews test has an asymptotic distribution, which requires large sample size for accuracy. Like other studies with small time series sample, but which have estimates from large cross section of data, we ignore the uncertainty in the factor estimates in this case, the cross section of our indicators, the X's, being large enough that the uncertainty in the factor estimates declines toward negligibility asymptotically.

not stable over time. Indeed, we can reject stability at 95% confidence level in every case, except for Factor 2.

Table 4 Stability tests for breakpoint in coefficients of international factors jointly affecting Thai factors

	QLR statistics	p-value
Factor 1	9.92	0.01
Factor 2	3.30	0.58
Factor 3	10.36	0.01
Factor 4	10.50	0.01
Factor 5	17.48	0.00
Policy rate	149.68	0.00

Note: Table reports average Quandt-Andrews LR statistics and p-value under the null hypothesis that there is no breakpoint within 15% trimmed data.

In terms of financial variables, the chow-test for stability in the relationship between domestic financial variables and foreign financial factors in the financial FAVAR mentioned earlier also suggests that there is statistically significant change in the relationship between international financial factors and domestic financial variables at around 2003M7. We reject "stability" at the 5% level in all cases (Table 5).

Table 5 Chow test for stability of international financial factors affecting Thai financial markets

	Joint-global
Foreign exchange	0.00
Stock market	0.00
Bond market	0.00

Note: Table reports p-values.

These results imply that despite a short sample, the tests contain sufficient information to allow us to detect statistically significant changes in the relationship. The following section investigates whether these changes have been economically important for Thailand's monetary policy transmission and for its policy strategy.

4.3 Globalization and monetary policy effectiveness

We find little to no evidence that international developments have had an economically important effect on Thailand's monetary transmission mechanism over the last 8 years. The responses of Thai macroeconomic variables to changes in the policy interest rate of the BOT have been little affected by global forces.

Figure 4 Impulse response of selected Thai economic variables to a monetary policy shock

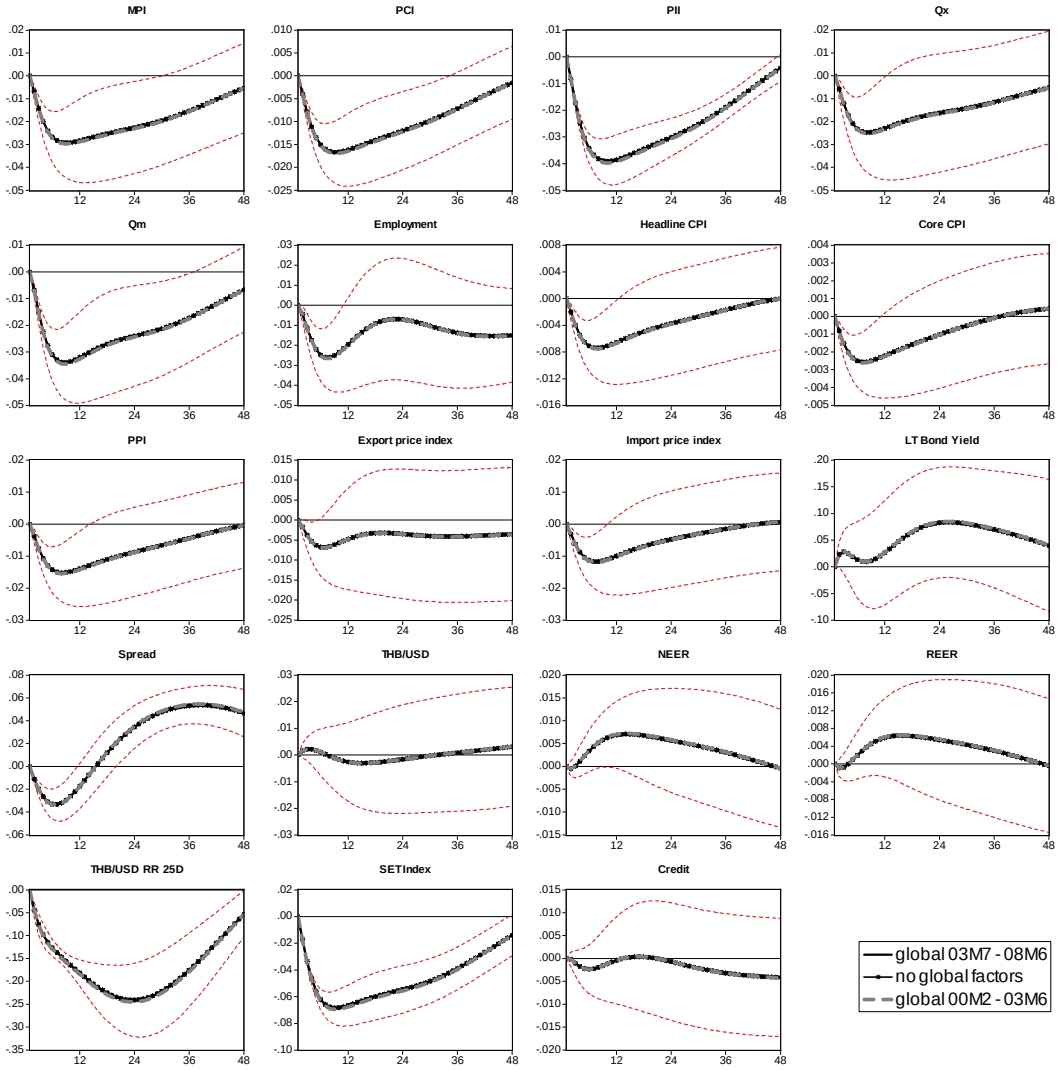


Figure 4 shows the estimated impulse responses of a set of macroeconomic indicators to a tightening of monetary policy corresponding to an unexpected increase in the policy interest rate of 25 basis points. The black-solid lines display the responses computed with the relationship between the Thai factors and the international factors as estimated over 2000M2 to 2008M6 according to the FAVAR system in (3.1)-(3.2) and (3.6). The gray-dashed lines represent the responses computed using *the same* FAVAR, but the relationship between the Thai factors and the international factors is estimated over the 2000M2 to 2003M6, along with the 2 standard deviation confidence bands.

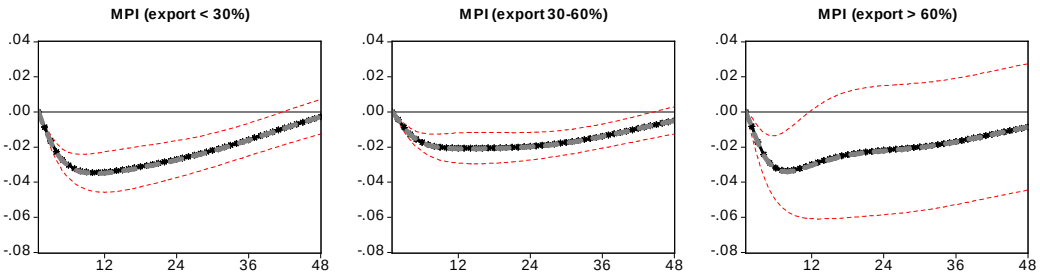
Since the other parameters are assumed to be constant over the entire sample, the only difference between the black-solid and the gray-dashed impulse response lines comes from different relationship between the international factors and the Thai factors, captured by different $\Psi_{21}(L)$'s.

An immediately apparent observation is that the two sets of impulse responses are largely similar for every variable we are interested in. Results from the quarterly data confirm this observation, although slight difference can be found, most likely on account of the fact that the data extended far back into the 1995. Indeed, what these results suggest is that by varying the $\Psi_{21}(L)$ according to the estimates we obtain over time, international forces seem not to make any quantifiable economic difference to the transmission of monetary policy in Thailand. We will revisit this point below.

Since this is not a micro-founded structural model, we should resist the temptation to offer a causal explanation; after all the model's important relationships are purely backward-looking and is based on Granger "causality". The impulse responses based on the effects of international factors estimated for the 2000M2-2003M6 sample and those based on the effects of international factors estimated for the entire sample period, allowing for the possibility of change in their influence on Thai factors can be summarized thus:

Following an unexpected 25 basis point increase in the policy interest rate, we observe a gradual decline in MPI, which proxies for real GDP (in this case because real GDP data do not exist in monthly format). The MPI tends to revert back to the original level after about 4 years. Another interesting observation is that, on average, monetary policy tightening tends to affect production of firms that are more concentrated in the domestic market and firms that export most of their production roughly equally. As show in Figure 5, the response of domestic-oriented firms is less uncertain than that of export-heavy firms. This result is consistent with the high uncertainty surrounding the impact of a surprise rate hike on the exchange value of the Thai baht.[18] Consistent with the case found for Israel in Ber, et al. (2002), Thai firms that depend on both domestic and foreign markets seem to more able to adjust to the domestic monetary conditions.

Figure 5 Impulse response of MPI by sector to a monetary policy shock



Other indicators for components of aggregate demand, namely PCI and PII show similar response, declining gradually and reverting back to the original level within approximately 4 years. PCI gradually declines, although the decline is smaller than that of MPI. The pace of the decline of PII is roughly similar to that of PCI, although it falls much

[18] Ber, et al (2002), using firm-level data, observes that monetary policy tightening tends to be less effective on the production of exporting firms. They suggest that these firms have better access to foreign credit markets and therefore rely less on domestic borrowing.

more.[19] This finding is consistent with the idea that private investment is more interest-sensitive than aggregate consumption. Import volume (real imports) falls slightly, together with indicators of domestic demand, in response to an interest rate increase. Around 8 months after the shock, the fall in imports seems to be arrested, plausibly following the mean-reversion of domestic demand and consistent with the apparent NEER appreciation. Export volume falls less than MPI and reverts as well as reaches the original level at roughly the same time.

We notice consistent movements between real exports and imports and the exchange values of the Thai baht following the monetary policy shock: The fall and the reversion to the original level in import volume is consistent with the slight appreciation in the NEER, as does the fall in real exports.

Notice that the risk reversal 25-delta option strategy, which is a market indicator of the direction of change in the bilateral exchange rate 12-month ahead, reveals that market participants expect THB/USD to appreciate more than to depreciate one year after a rate hike and the effect can last for some time. But the degree of uncertainty in the estimate of the impulse response of the bilateral THB/USD exchange rate is large. While the standard error bands surrounding a few other variables are wide, they tend to fall and rise with the mean estimates. For this exchange rate indicator, however, not only are the mean impulse responses close to zero throughout the forecast period, but the standard error bands also suggest that the response of the Thai baht could be anything (appreciation or depreciation against the US dollar) after the increase in the policy interest rate. This observation is consistent with the empirical fact that the uncovered interest parity relationship does not hold in the short run, i.e., the link between short-term interest rate and the exchange rate is tenuous at best (barring an anticipated series of interest rate movement). Market may expect the THB/USD to appreciate after a rate hike, but the ex-post evidence may or may not follow this expectation.

All price indices, here reported in levels, show modest response on impact, but falls gradually over the following 3-4 years following the monetary tightening, much like that found for the US (see BG). Core consumer price level is less responsive than headline consumer price level, and it reverts to the original level roughly 1 year faster than headline.

Financial variables such as the SET Index tends to mimic the response of aggregate demand components, while private credit's response is highly uncertain with mean estimates treading close to zero after the surprise monetary tightening.

The price responses reported in this paper are qualitatively similar to those found in the earlier VAR literature for Thailand (see Disyatat and Vongsinsirikul, 2002 and Charoensang and Manakit, 2007), but without the initial "price puzzle". Our results are qualitatively similar to Pongpaichet (2008), which estimates Thai-only FAVAR, for the following variables: SET Index, government bond yield, THB/USD exchange rate and employment. Pongpaichet's (2008) mean responses of MPI and core CPI to monetary tightening take longer than 60 months to revert to the original levels and there is detectable

[19] The sensitivity of private investment to interest rate shocks is also captured by Disyatat and Vongsinsirikul (2002).

"price puzzle" in PPI. We differ also in out interpretation of the exchange rate response to interest rate shocks.

The results above suggest that *while the relationship between the international factors and the Thai factors has changed over the sample due to globalization of trade and finance, the impact of that change on the transmission of monetary policy has most likely been insignificant.*

Upon further investigation, we find that any change in the transmission mechanism of monetary policy during 2000-2008 is more likely to have come from changing relationships among *Thai* factors not attributed directly to globalization, rather than through the changing response of international factors to Thai monetary policy shocks.

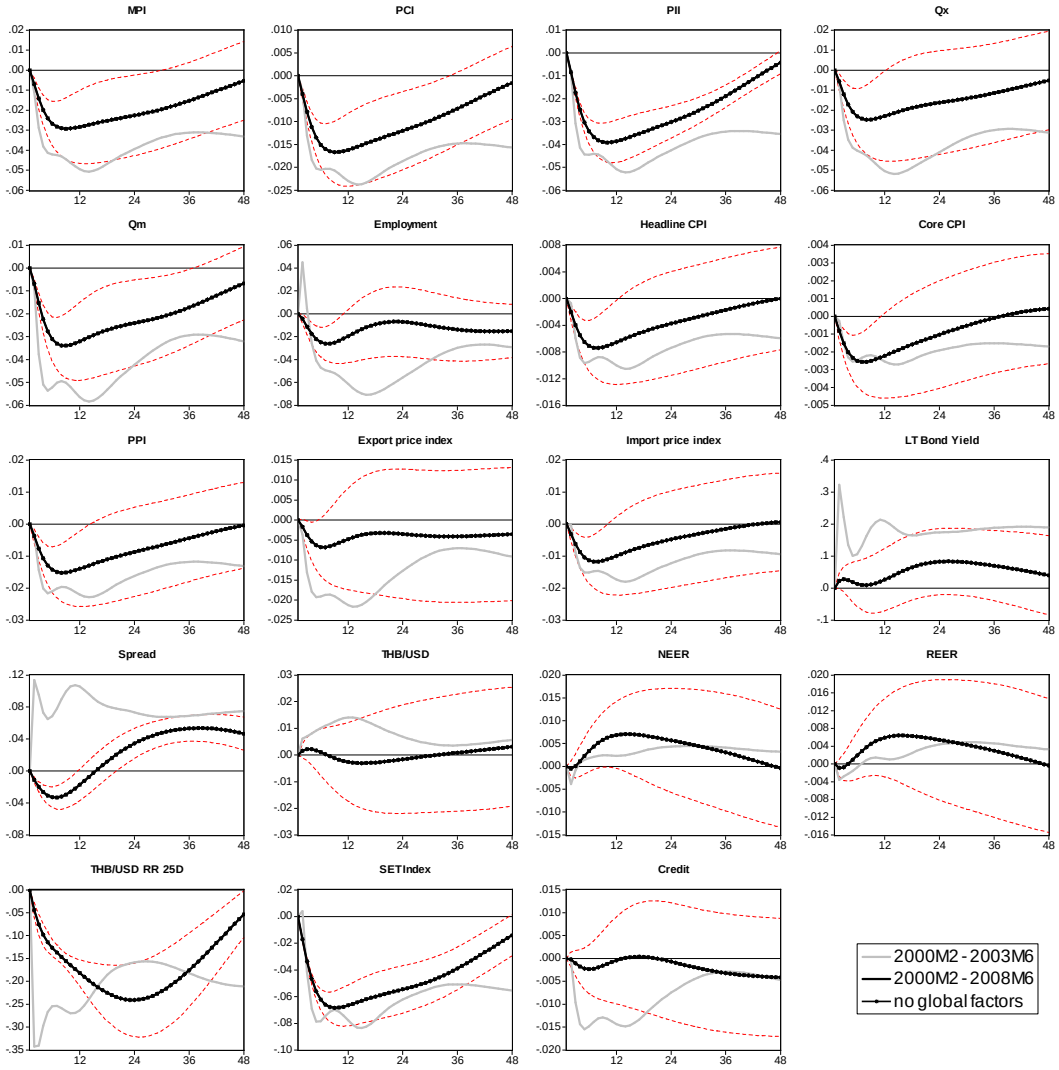
Figure 6 shows the estimated impulse responses of a set of macroeconomic indicators to a tightening of monetary policy corresponding to an unexpected increase in the policy interest rate of 25 basis points. The gray-solid lines represent the responses computed from the FAVAR that is estimated over the 2000M2 to 2003M6. The black-solid lines display the responses using the FAVAR as estimated (with the interactive dummy turned on) over the 2000M2 to 2008M6 along with the 2 standard deviation confidence bands. Note that these two lines are estimated over different periods.

A rough approximation to gauge the role of globalization in the transmission of Thai monetary policy is to show the impulse responses, assuming that the Thai factors do not respond to the international factors at all. The gray-dotted lines (in Appendix B) and black-dotted lines are these impulse responses; the former set comes from setting $\Psi_{21}(L)$ to zero and the FAVAR is estimated over the first subsample; and the latter set comes from setting $\Psi_{21}(L)$ and $\Psi_{21}^{d}(L)$ to zero, and estimated the FAVAR over the entire sample.

There are 3 key observations from the evidence presented in Figure 6: 1. The impulse responses estimated from the model with dummy using the whole data sample are perceptibly different from those estimated for the first subsample (2000M2-2003M6). 2. The distance between the impulse responses when the feedback parameter $\Psi_{21}(L)$ is restricted to zero and those with estimated $\Psi_{21}(L)$ is negligible (for the first subsample) during 2000M2 to 2003M6. 3. The distance between the impulse responses when the feedback parameters $\Psi_{21}(L)$ and $\Psi_{21}^{d}(L)$ are both restricted to zero and those with estimated $\Psi_{21}(L)$ and $\Psi_{21}^{d}(L)$ is negligible (for the whole sample) during 2000M2 to 2008M6.

Observations 2 and 3 suggest that, *within* each sample, the responses of Thai variables to BOT monetary policy shock assuming that the Thai factors do not respond to the international factors (setting the matrix polynomials $\Psi_{21}(L)$ and $\Psi_{21}^{d}(L)$ to zero to abstract from international factors), are *no* different from allowing the Thai factors to respond to the international factors as estimated. As other parameters are taken as constant *within* sample, this means that globalization does not seem to have more than a marginal impact, if any at all, on the transmission of monetary policy *in either period*, both the first subsample and the entire sample under study. Considering that Thailand is small relative to the rest of the world, these two observations should come as a confirmation that BOT monetary policy shocks should not influence Thai variables through its influence on the international factors.

Figure 6 Impulse response of selected Thai economic variables to a monetary policy shock before and after 2003M7



However, observation 1 suggests that monetary policy transmission mechanism has indeed changed *over time*. Since (a) the change in $\Psi_{21}(L)$, statistically significant according to the instability test presented in the earlier section, does not contribute to changes in impulse response *across* samples as shown above[20], and (b) the contribution of the matrix polynomial describing the feedback from the Thai factors to the international factors $\Psi_{12}(L)$ should be nearly negligible over the entire sample—as Thailand is small compared to the rest of the world—the change in the impulse responses across periods can only have come from changes in $\Psi_{11}(L)$ and $\Psi_{22}(L)$. This means that the driving force behind the change in BOT monetary policy effectiveness over the past 8 years are more likely to be Thai-specific than spillover effects from global forces onto the Thai factors and macroeconomic variables.

[20] Recall that each variable's impulse response is a function of the state equation's parameters, summarized in the matrix polynomials $\Psi_{11}(L), \Psi_{12}(L), \Psi_{21}(L), \Psi_{22}(L)$.

On average, monetary policy seems to have less impact on domestic demand components, especially on MPI and real exports (possibly due to long-running global expansion and the link between MPI and exports). Consistent with that, employment decline also moderates over the years to almost negligible after a surprise rate hike. While monetary policy tightening has milder impact on overall aggregate demand and slightly more modest impact on headline CPI, it retains its effectiveness over core CPI. Meanwhile, the mean response of forward-looking asset prices, represented here by the SET index, is still material over the years and the change is marginal.

We find that the short-term output-inflation tradeoff seems to have reduced over the years, when core inflation, which has been the target of the BOT since May 2000, is taken to the definition of price inflation. This observation coupled with the facts that the ability to influence long-term bond yields, credit conditions and the THB/USD exchange rate has been lessened over the years (although the response of the exchange rate carries with it vast uncertainty in any case) leads us to think that the ability to influence core inflation and achieve the inflation target, which has not been degraded, may likely to have come from higher pass-through from these variables to prices, itself a structural change; or through the expectation channel of monetary transmission mechanism. This result highlights the plausibility that the influence on public inflation expectation may have gained in importance for BOT's ability to maintain low and stable aggregate price inflation over the years.

Table 6 24-month average standard error of impulse response functions

Variable	MPI	PCI	PII	QX	QM	CPI	Core
2000M2 – 2003M6	0.10	0.04	0.07	0.12	0.11	0.03	0.01
2000M2 – 2008M6	0.03	0.01	0.01	0.04	0.03	0.01	0.00

Variable	14Y	14Y-2Y	THB/USD	NEER	SET	Credits	RP
2000M2 – 2003M6	0.49	0.13	0.07	0.03	0.09	0.05	0.25
2000M2 – 2008M6	0.17	0.03	0.03	0.01	0.03	0.02	0.19

Another observation is that the impact of monetary policy on Thai macroeconomic variables may have become more predictable in the recent years. Table 6 reports 24-month average standard errors around the mean responses of selected Thai macroeconomic variables to surprise monetary tightening. It can be seen that the standard errors have declined during the 2000M2-2008M6 compared to those estimated during 2000M2-2003M6.[21]

From the empirical evidence reported thus far, we are left to conclude that if there was any effect of global influence on BOT monetary policy transmission mechanism during its inflation targeting years spanning 2000-2008, we cannot find it. Whatever changes occur

[21] It is hard to know for certain as this might simply be the artifact of small sample bias for the first subsample.

to the monetary policy transmission is more likely to have come from changes in the structure of the Thai economy, as captured by $\Psi_{22}(L)$. This change could have occurred at the structural level, be it different persistence of inflation from firms' price-setting behavior, changing forms of firms' financing, etc. The structural change in the Thai economy captured by the FAVAR could have come from increasing integration with the world economy, but we cannot tell for sure under this framework.

We have managed to measure the change in Thai monetary policy transmission and focus the search for explanation of these changes on the relationships among domestic factors themselves, which may not necessarily have to do with global influence. This is so because Thai macroeconomic variables respond to BOT monetary policy changes directly and not through international developments.

It is important to keep in mind that VAR impulse responses are functions of the VAR coefficients and the covariance matrix of the shocks. We have to be careful about the lessons learned for the following reasons: The results are conditional on the nature of the shocks, namely our framework is based on the shock process having constant variance, i.e. no stochastic volatility. Even with no large shocks over the past 8 years, except for the recent oil shocks, we have no way to tell for sure if our results are robust to this assumption used under our framework. Moreover, insofar as the dynamic of some macroeconomic variables depends on the process that determines expectations about future domestic variables *through greater economic integration*, our results are also subject to changes in such process. In short, as in other econometric study, we assume that the model is a structural description of the truth. Because short sample would not permit extra parameters needed to account for changes in complicated structural relationship, we may have to revisit this question in a different—and likely more complicated—dynamic stochastic general equilibrium framework.

5. Conclusion and implication for monetary policy

Measuring the impact of globalization in trade and finance on the Thai economy over time is a highly complicated task, especially given short data, which are representation of the truth. Indeed, identifying "globalization" is a difficult task. We consider our contribution to be an exploration of the issue from an empirical point of view. The insights gained into how effective monetary policy is and how the underlying relationships between international and Thai factors change over time can contribute to our understanding of the how small open economy's monetary policy works in an ever more integrating world.

With some measure of confidence, we have found that global macroeconomic and financial influence on real and nominal variables in Thailand is significant. Whether global forces have gained in importance is inconclusive for the overall economy, but we find that that influence has intensified for several selected variables. We have also detected and identified statistically significant changes in the relationship between international forces and Thailand's economic dynamics over the past several years.

On the question of how much globalization enhances or tempers the effect of BOT's monetary policy on the Thai economy, we have found the answer to depend on the ability of Thai monetary policy to influence Thai variables through international variables. Presently, the change in monetary policy effectiveness is not likely due to direct influence from globalization, but is mostly due to the change in the relationship among domestic variables themselves over time. It would therefore be interesting to see research on monetary policy effectiveness focusing on how the relationship between domestic factors changes over time.

In any case, as Thailand grows in size and importance relative to the rest of the world or the region, we may start to see the role of globalization or "regionalization" in the ability of our monetary policy to influence events in Thailand.

Over time, Thai monetary policy seems to have more or less maintained its effectiveness when it comes to influencing the inflation path. While the mean response of headline inflation has been slightly weaker, suggesting lower monetary policy effectiveness in influencing the energy components in the consumer price inflation measure, the standard errors have also become smaller over time. Viewing impulse responses as a distribution of paths, we think that the explicit focus on long-term underlying inflation has contributed to lower inflation-output tradeoff over the past several years. Monetary policy, in short, seems to have become more efficient for this purpose. Evidence suggests that this improvement seems less likely to have come from the ability to impact on real variables, credit, long-term rates or the exchange rate, but more likely from higher pass-through from these variables to prices, a structural change, or better anchoring of public inflation expectation.

Since the correlation between international forces and core inflation has remained rather constant so far, the monetary authority should not have to respond to the change in core inflation differently in terms of basis-point change in the policy interest rate. With reasons to believe that global forces increasingly influence the dynamic of headline consumer price inflation in Thailand, should the monetary authority choose to target headline inflation, it may need to respond with more policy rate change than before.

With a caveat that we may not have sufficient data to get a strong statistical conclusion, we have found evidence to the effect that international economic developments matter for the fluctuations of Thailand's macroeconomic variables. Monetary policy's ability to influence overall domestic events seems to have been somewhat diminished, with no evidence that this is due to globalization. But the ability of the central bank to ensure long-term price stability seems to have remained largely intact.

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Appendix A – Data description

Format contains series description, unit, sources of the data, and transformation code. All data span monthly from January 2000 - June 2008. The transformation codes are: 1 - Seasonal adjustment, first difference of log; 2 - First difference of logarithm (no seasonal); 3 - First difference; 4 – No transformation. An asterisk, '*', next to the mnemonic/name denotes a variable assumed to be "slow-moving" in the estimation.

Monthly data (2000M1 – 2008M6)

1. Domestic block

Consumption			
Private Consumption Index (PCI)*	Index	BOT	1
PCI: Car*	Index	BOT	1
PCI: Fuel*	Index	BOT	1
PCI: Electricity*	Index	BOT	1
PCI: Imports of consumer goods*	Index	BOT	1
PCI: VAT*	Index	BOT	1
Investment			
Private Investment Index (PII) *	Index	BOT	1
PII: Construction area*	Index	BOT	1
PII: Cement sales*	Index	BOT	1
PII: Import of capital goods*	Index	BOT	1
PII: Domestic machinery sales*	Index	BOT	1
PII: Commercial car sales*	Index	BOT	1
Government			
Government revenue	Billion baht	MOF	1
Government expenditure	Billion baht	MOF	1
Budgetary balance	Billion baht	MOF	4
Non-budgetary balance	Billion baht	MOF	4
Cash balance	Billion baht	MOF	4
External			
Export price index	Index	MOC	1
Export quantity index	Index	MOC	1
Agriculture export price index	Index	MOC	1
Agriculture export quantity index	Index	MOC	1
Fishery export price index	Index	MOC	1
Fishery export quantity index	Index	MOC	1
Industrial export price index	Index	MOC	1
Industrial export quantity index	Index	MOC	1
Labor-intensive export price index	Index	MOC	1

Labor-intensive export quantity index	Index	MOC	1
Hi-tech export price index	Index	MOC	1
Hi-tech export quantity index	Index	MOC	1
Resource-based export price index	Index	MOC	1
Resource-based export quantity index	Index	MOC	1
Import price index	Index	MOC	1
Import quantity index	Index	MOC	1
Consumer goods import price index	Index	MOC	1
Consumer goods quantity index	Index	MOC	1
Material goods import price index	Index	MOC	1
Material goods quantity index	Index	MOC	1
Capital goods import price index	Index	MOC	1
Capital goods quantity index	Index	MOC	1
Oil import price index	Index	MOC	1
Oil import quantity index	Index	MOC	1
Trade balance	Billion baht	BOT	4
Service balance	Billion baht	BOT	4
Current account balance	Billion baht	BOT	4
Capital and financial account balance	Billion baht	BOT	4
Balance of payment	Billion baht	BOT	4
Net foreign direct investment (FDI)	Billion baht	BOT	4
Net portfolio investment	Billion baht	BOT	4
Net international reserve	Billion baht	BOT	2
Labour market			
Registered applicants	Persons	MOL	1
Job vacancies	No. of positions	MOL	1
Job placements	No. of positions	MOL	1
Number of closed firms	No. of firms	MOL	1
Number of employees laid-off	Persons	MOL	1
Price indices			
Headline consumer price index (HCPI)*	Index	MOC	1
HCPI: Core*	Index	MOC	1
HCPI: Raw food*	Index	MOC	1
HCPI: Energy*	Index	MOC	1
Producer price index (PPI)*	Index	MOC	1
PPI: Agriculture*	Index	MOC	1
PPI: Mining*	Index	MOC	1
PPI: Industrial*	Index	MOC	1
PPI: Petroleum*	Index	MOC	1
PPI: Food*	Index	MOC	1
Farm price index*	Index	MOC	1

Production			
Crop production index*	Index	BOT	1
Manufacturing production index (MPI)*	Index	MOI	1
MPI: Food*	Index	MOI	1
MPI: Beverage*	Index	MOI	1
MPI: Textiles & textile products*	Index	MOI	1
MPI: Products of leather & leather*	Index	MOI	1
MPI: Footwear*	Index	MOI	1
MPI: Pulp & paper products*	Index	MOI	1
MPI: Chemical products*	Index	MOI	1
MPI: Cleaning preparation*	Index	MOI	1
MPI: Rubber & rubber products*	Index	MOI	1
MPI: Construction material*	Index	MOI	1
MPI: Iron & steel products*	Index	MOI	1
MPI: Vehicles and equipments*	Index	MOI	1
MPI: Electronic & electrical products	Index	MOI	1
MPI: Electrical appliance	Index	MOI	1
MPI: Furniture and fixtures	Index	MOI	1
MPI: Others	Index	MOI	1
MPI: Exports less than 30%	Index	BOT	1
MPI: Exports between 30-60%	Index	BOT	1
MPI: Exports more than 60%	Index	BOT	1
Manufacturing capacity utilization rate*	Index	BOT	1
Interest rates			
Policy interest rate	% per annum	BOT	3
Minimum lending rate (MLR)	% per annum	BOT	3
3-month deposit rate	% per annum	BOT	3
Government bond yield 2Y	% per annum	BOT	3
Government bond yield 5Y	% per annum	BOT	3
Government bond yield 7Y	% per annum	BOT	3
Government bond yield 10Y	% per annum	BOT	3
Government bond yield 14Y	% per annum	BOT	3
Spread 14Y-2Y	% per annum	BOT	3
Spread 5Y-2Y	% per annum	BOT	3
Exchange rates			
Thai baht per US dollar	per USD	BOT	2
Nominal effective exchange rate (NEER)	Index	BOT	2
Real effective exchange rate (REER)	Index	BOT	2
Money and credit quantity aggregates			
Reserve money	Billion baht	BOT	1
Quasi money	Billion baht	BOT	1
Broad money	Billion baht	BOT	1

Deposit at commercial banks	Billion baht	BOT	1
Credit to corporate	Billion baht	BOT	1
Excess liquidity at commercial bank	Billion baht	BOT	3
Stock index			
Stock Exchange of Thailand index (SET)	Index	SET	2
Expectations			
Thai baht strangle	basis points	JP Morgan	3
Thai baht risk reversal	basis points	JP Morgan	3
Consumer Confidence Index (CCI) *	Index	UTCC	2
CCI: Expectation overall	Index	UTCC	2
CCI: Expectation on economy	Index	UTCC	2
CCI: Expectation on job situation	Index	UTCC	2
CCI: Expectation on income	Index	UTCC	2
Business Sentiment Index (BSI)	Index	BOT	2
BSI: Profitability	Index	BOT	2
BSI: Order	Index	BOT	2
BSI: Investment	Index	BOT	2
BSI: Employment	Index	BOT	2
BSI: Cost	Index	BOT	2
BSI: 3-month ahead	Index	BOT	2
2. International block			
Real activities			
Manufacturing production index (MPI)			
MPI: US	Index	CEIC	1
MPI: Japan	Index	CEIC	1
MPI: EU-12	Index	CEIC	1
MPI: United Kingdom	Index	CEIC	1
MPI: Hong Kong	Index	CEIC	1
MPI: Taiwan	Index	CEIC	1
MPI: South Korea	Index	CEIC	1
MPI: Singapore	Index	CEIC	1
MPI: Malaysia	Index	CEIC	1
MPI: Indonesia	Index	CEIC	1
MPI: Philippines	Index	CEIC	1
US Non-mfg business index	Index	CEIC	1
Short term interest rates			
US Fed Funds	% per annum	Bloomberg	3
JP rate	% per annum	Bloomberg	3
EU rate	% per annum	Bloomberg	3
UK rate	% per annum	Bloomberg	3

CN rate	% per annum	Bloomberg	3
Hong Kong base rate	% per annum	Bloomberg	3
Taiwan overnight call rate	% per annum	Bloomberg	3
South Korea overnight call rate	% per annum	Bloomberg	3
MY rate	% per annum	Bloomberg	3
ID rate	% per annum	Bloomberg	3
PH rate	% per annum	Bloomberg	3
Price indices			
Consumer price index (CPI)			
CPI: US	Index	Bloomberg	1
CPI: Japan	Index	Bloomberg	1
CPI: EU-12	Index	Bloomberg	1
CPI: United Kingdom	Index	Bloomberg	1
CPI: Hong Kong	Index	Bloomberg	1
CPI: Taiwan	Index	Bloomberg	1
CPI: South Korea	Index	Bloomberg	1
CPI: Singapore	Index	Bloomberg	1
CPI: Malaysia	Index	Bloomberg	1
CPI: Indonesia	Index	Bloomberg	1
CPI: Philippines	Index	Bloomberg	1
CPI: China	% yoy	Bloomberg	3
Exchange rates			
US Trade-weighted exchange rate (broad)	Index	Bloomberg	2
Japan exchange rate	USD/JPY	Bloomberg	2
Eurozone exchange rate	EUR/USD	Bloomberg	2
United Kingdom exchange rate	GBP/USD	Bloomberg	2
China exchange rate	USD/CNY	Bloomberg	2
Hong Kong exchange rate	USD/HKD	Bloomberg	2
Taiwan exchange rate	USD/TWD	Bloomberg	2
South Korea exchange rate	USD/KRW	Bloomberg	2
Singapore exchange rate	USD/SGD	Bloomberg	2
Malaysia exchange rate	USD/MYR	Bloomberg	2
Indonesia exchange rate	USD/IDR	Bloomberg	2
Philippines exchange rate	USD/PHP	Bloomberg	2
Stock indices			
US Stock	Index	Bloomberg	2
Japan stock	Index	Bloomberg	2
France stock	Index	Bloomberg	2
Germany stock	Index	Bloomberg	2
UK stock	Index	Bloomberg	2
Hong Kong's Hang Seng Stock Exchange	Index	Bloomberg	2
Taiwan stock	Index	Bloomberg	2

Korea stock	Index	Bloomberg	2
Singapore stock	Index	Bloomberg	2
Malaysia stock	Index	Bloomberg	2
Indonesian Jakarta Stock Exchange	Index	Bloomberg	2
Philippines stock	Index	Bloomberg	2
Oil and commodities			
Dubai crude oil price	USD per Barrel	Bloomberg	2
Global commodity price index	Index	Reuters' CRB	1

Data source abbreviation

BOT	= Bank of Thailand
MOC	= Ministry of Commerce, Thailand
MOF	= Ministry of Finance, Thailand
MOI	= Ministry of Industry, Thailand
MOL	= Ministry of Labour, Thailand
Reuters' CRB	= Reuters's Commodity Research Bureau
SET	= Stock Exchange of Thailand
UTCC	= University of Thai Chamber of Commerce

Appendix B– Impulse response function of selected Thai variables, comparing between 2000M2-2003M6 and 2000M2-2008M6, with s.e. band covering the estimates of 2000M2 – 2003M6