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ฟองสบู่และการดำเนินโยบายการเงิน
Asset Price Bubble and Monetary Policy: Identification and Policy Response Under Inflation Targeting

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บทสรุป

ข้อคิดเห็นที่ปรากฏในบทความนี้เป็นความเห็นของผู้เขียน ซึ่งไม่จำเป็นต้องสอดคล้องกับความเห็นของธนาคารแห่งประเทศไทย

บทวิจัยนี้มีวัตถุประสงค์เพื่อที่จะเตรียมแนวทางที่เหมาะสมของนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อในการรับมือหากภาวะฟองสบู่ก่อตัวขึ้น โดยแบ่งการศึกษาออกเป็น 3 ส่วนคือ (1) การศึกษาพฤติกรรมของวัฏจักรราคาสินทรัพย์รวมถึงความสัมพันธ์ระหว่างราคาสินทรัพย์กับการเจริญเติบโตทางเศรษฐกิจและเครื่องชี้ทางการเงินที่สำคัญ (2) วิธีการทั้งทางตรงและอ้อมที่อาจนำมาใช้เพื่อบ่งชี้ถึงการก่อตัวของภาวะฟองสบู่ (3) แนวทางที่เหมาะสมในการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อในการรับมือกับภาวะฟองสบู่ การศึกษาพบว่าราคาสินทรัพย์เป็นข้อมูลสำคัญที่เป็นประโยชน์ต่อการดำเนินนโยบายการเงิน จึงควรมีการติดตามอย่างใกล้ชิด อย่างไรก็ตามราคาสินทรัพย์นั้นผันผวนเกินกว่าที่จะนำมาเป็นเป้าหมายที่เหมาะสมของนโยบายการเงิน นอกจากนี้ นโยบายการเงินที่มีการมองไปข้างหน้าและมีเงินเฟ้อเป็นเป้าหมาย ย่อมจะช่วยลดความผันผวนของวัฏจักรราคาสินทรัพย์ได้ในระดับหนึ่งจากการที่ราคาสินทรัพย์โดยเฉพาะอย่างยิ่งราคาอสังหาริมทรัพย์ปรับตัวก่อนหน้าไปในทิศทางเดียวกันกับเงินเฟ้อ แต่การรับมือและบรรเทาผลกระทบที่อาจเกิดขึ้นจากภาวะฟองสบู่ที่ดีที่สุด คือการป้องกันโดยวิธีต่างๆ อาทิ การส่งเสริมหลักธรรมาภิบาล การกำกับดูแลสถาบันการเงินให้มีความเข้มแข็ง การพัฒนาตลาดทุนและเครื่องมือกระจายความเสี่ยง รวมทั้งการจัดทำและเผยแพร่ข้อมูลต่างๆเกี่ยวกับราคาสินทรัพย์ สิ่งเหล่านี้อาจช่วยทำให้ฟองสบู่มีขนาดลดลงและบรรเทาผลกระทบจากการแตกของฟองสบู่ให้น้อยลง

บทสรุปผู้บริหาร
ฟองสบู่และการดำเนินนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อ

เศรษฐกิจไทยที่ฟื้นตัวอย่างต่อเนื่องพร้อม ๆ กับแนวโน้มที่ดีขึ้นของราคาสินทรัพย์ เช่น หุ้น และอสังหาริมทรัพย์ ทำให้เกิดความกังวลว่าภาวะฟองสบู่เริ่มก่อตัวขึ้นในระบบเศรษฐกิจไทยหรือยัง ประสบการณ์ที่ผ่านมาในหลาย ๆ ประเทศชี้ให้เห็นว่าการเพิ่มขึ้นของราคาสินทรัพย์ที่เกินปัจจัยพื้นฐานสร้างความไม่สมดุลทางการเงิน อาทิ การก่อหนี้เกินตัวขึ้นได้ แม้ในยามที่เศรษฐกิจขยายตัวและอัตราเงินเฟ้อต่ำ ๆ

ทั้งนี้ตัวอย่างที่เห็นได้ในระยะไม่กี่ปีที่ผ่านมา คือการที่ฟองสบู่ของหุ้นเทคโนโลยีในสหรัฐฯแตก และความกังวลเกี่ยวกับภาวะราคาอสังหาริมทรัพย์ใน สหรัฐฯ อังกฤษ และออสเตรเลีย เป็นสาเหตุของการถกเถียงกันอย่างกว้างขวางในบรรดาผู้บริหารธนาคารกลางและนักเศรษฐศาสตร์ชั้นนำทั่วโลก เกี่ยวกับนโยบายการเงินที่เน้นการรักษาเงินเฟ้อให้อยู่ในระดับต่ำ ว่ามีความเพียงพอหรือไม่ต่อการรักษาเสถียรภาพทางการเงิน และควรที่จะนำนโยบายการเงินมาใช้ในการป้องกันและแก้ไขปัญหาฟองสบู่หรือไม่และอย่างไร

บทวิจัยนี้เป็นมีวัตถุประสงค์เพื่อที่จะหาวิธีที่จะบ่งชี้ภาวะฟองสบู่ และเตรียมแนวทางที่เหมาะสมของนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อ ในการรับมือหากภาวะฟองสบู่ก่อตัวขึ้น

ภาวะฟองสบู่คืออะไร

ในทางทฤษฎีแล้ว ภาวะฟองสบู่เกิดขึ้นเมื่อราคาสินทรัพย์ในตลาดสูงขึ้นเกินราคาสินทรัพย์ตามปัจจัยพื้นฐาน ดังนั้นการจะบ่งชี้ว่ามีภาวะฟองสบู่เกิดขึ้นในขณะใดขณะหนึ่งหรือไม่ จึงขึ้นอยู่กับความสามารถในการคำนวณหาราคาสินทรัพย์ตามปัจจัยพื้นฐาน ซึ่งมีข้อถกเถียงกันอย่างมากว่าจะหาราคาดังกล่าวได้อย่างไรจึงจะถูกต้องเพื่อให้สามารถบ่งชี้ภาวะฟองสบู่ได้อย่างทันท่วงที ดังนั้นในทางปฏิบัติจึงมีการนิยามภาวะฟองสบู่ว่าเป็นสถานการณ์ที่ราคาสินทรัพย์เพิ่มขึ้น(ลดลง) อย่างต่อเนื่องเป็นเวลานาน และติดตามมาด้วยการลดลง(เพิ่มขึ้น)อย่างรวดเร็วและรุนแรง นิยามนี้มีข้อดีที่เข้าใจได้ง่ายและนำไปใช้วัดขนาดของการเพิ่มและลดของราคาได้ อย่างไรก็ตามต้องระวังว่าการเพิ่มขึ้นและการลดลงของราคาสินทรัพย์อาจปรับตัวตามปัจจัยพื้นฐานและไม่เกี่ยวข้องกับภาวะฟองสบู่เลยก็ได้ รวมทั้งจะไม่สามารถบ่งชี้ภาวะฟองสบู่ได้ล่วงหน้า

การศึกษานี้ได้ใช้ทั้งสองนิยามข้างต้นประกอบกันในการบ่งชี้ภาวะฟองสบู่ คำนิยามแรกเน้นให้เกิดความเข้าใจถึงปัจจัยพื้นฐานที่เป็นตัวกำหนดราคาสินทรัพย์ ส่วนคำนิยามที่สองมีประโยชน์ในการชี้วัดภาวะฟองสบู่ด้วยข้อมูลทางสถิติในอดีต และชี้ให้เห็นถึงความสัมพันธ์ของราคาสินทรัพย์ในวัฏจักรราคาสินทรัพย์กับตัวแปรทางเศรษฐกิจมหภาคอื่นๆ

ข้อสังเกตเกี่ยวกับราคาสินทรัพย์และความสัมพันธ์กับตัวแปรทางเศรษฐกิจและการเงิน [1]

1) โดยปกติของวัฏจักรราคาสินทรัพย์แล้ว ราคาในช่วงขาขึ้นมักจะเพิ่มขึ้นอย่างค่อยเป็นค่อยไป แต่หากต่อเนื่องเป็นระยะเวลานาน ราคาในช่วงขาลงมักจะลดลงอย่างรวดเร็วและรุนแรง

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[1] ในบทวิจัยนี้ราคาสินทรัพย์จะครอบคลุมราคาอสังหาริมทรัพย์และราคาหุ้น และในการหาข้อสรุปในส่วนนี้ ได้ใช้ข้อมูลของไทยประกอบกับข้อมูลของต่างประเทศ เนื่องจากความไม่สมบูรณ์ของข้อมูลของราคาอสังหาริมทรัพย์ไทย

2) มีโอกาสประมาณร้อยละ 25 (ร้อยละ 40) ที่การเพิ่มขึ้นอย่างต่อเนื่องของดัชนีราคาหุ้น (ดัชนีราคาอสังหาริมทรัพย์) จะตามมาด้วยการลดลงอย่างรุนแรง

3) ในกรณีที่ราคาสินทรัพย์มีการปรับตัวอย่างรุนแรง ดัชนีราคาหุ้น (ดัชนีราคาอสังหาริมทรัพย์) จะลดลงประมาณร้อยละ 45 (ร้อยละ 30) โดยการปรับตัวจากจุดสูงสุดถึงจุดต่ำสุดจะกินเวลาประมาณ 10 ไตรมาส (4 ปี)

4) ดัชนีราคาหุ้นมักจะผันผวนไปกับรายได้ประชาชาติที่แท้จริงและองค์ประกอบ แต่จะเคลื่อนไหวนำประมาณ 1 ปี ส่วนดัชนีราคาอสังหาริมทรัพย์มักจะหดตัวพร้อมๆ กันกับการหดตัวของรายได้ประชาชาติ โดยที่ผลกระทบต่อรายได้ประชาชาติโดยรวมจะมีความรุนแรงกว่า

5) โดยปกติราคาสินทรัพย์จะผันผวนไปในทิศทางเดียวกันกับสินเชื่อภาคเอกชน แต่จะนำหน้าประมาณหนึ่งถึงสองปี

6) ดัชนีราคาหุ้นปรับตัวนำทั้งดัชนีราคาสินค้าอุปโภคบริโภคทั่วไปและพื้นฐานประมาณ 3 ปี

7) ผลกระทบของภาวะที่ฟองสบู่แตกจะต่างกันในแต่ละประเทศตามโครงสร้างระบบการเงิน โดยหากประเทศอิงระบบธนาคารในการระดมทุน การลดลงของราคาอสังหาริมทรัพย์ (ราคาดัชนีหลักทรัพย์) จะมีผลกระทบรุนแรงมากกว่า (น้อยกว่า) ประเทศที่อาศัยตลาดทุนในการระดมทุน

เหตุใดราคาสินทรัพย์จึงเป็นวัฏจักร

โดยทั่วไปในตลาดการเงินจะมีทั้งนักลงทุนที่มีลักษณะ Rational และ Irrational ซึ่งทำให้นักเศรษฐศาสตร์ได้มีความคิดเห็นแตกต่างกันเกี่ยวกับสาเหตุที่ก่อทำให้เกิดการขึ้นและลงของราคาสินทรัพย์ในวัฏจักรราคาสินทรัพย์และแบ่งออกได้เป็นสองกลุ่ม คือกลุ่ม “Fundamentalist” และกลุ่ม “Behavioralist” โดยกลุ่มแรกเชื่อว่าการที่ลักษณะการเปลี่ยนแปลงราคาสินทรัพย์ในช่วงขาขึ้นแตกต่างไปจากช่วงขาลง ตามข้อสังเกตที่ (1) นั้น เกิดจากผลของ technological shocks และจากการที่นักลงทุนมีข้อมูลไม่เท่าเทียมกัน นักเศรษฐศาสตร์กลุ่มนี้เห็นว่าการเปลี่ยนแปลงของราคาสินทรัพย์ในวัฏจักรราคาสินทรัพย์นั้นเป็นไปตามพฤติกรรมของนักลงทุนที่มีลักษณะ rational และกลไกตลาดมีประสิทธิภาพ

นักเศรษฐศาสตร์กลุ่ม “Behavioralist” เห็นว่าในตลาดอาจมีฟองสบู่และมีพฤติกรรมที่ Irrational ปรากฏอยู่ โดยที่ นักลงทุนกลุ่มที่ Rational ไม่สามารถร่วมมือกันทำการซื้อขายในตลาดพร้อมๆกันเพื่อพลักดันให้ราคาสินทรัพย์ เป็นไปตามปัจจัยพื้นฐานได้ในช่วงตลาดขาขึ้น (โดยส่วนหนึ่งอาจมีสาเหตุจากข้อจำกัดในการทำ short-sale) และบางส่วนมีแรงจูงใจที่มุ่งจะหาผลตอบแทนในระยะสั้นตามกระแส ทำให้ภาวะฟองสบู่นั้นเกิดขึ้นต่อเนื่อง

การบ่งชี้ภาวะฟองสบู่

โดยทั่วไปการบ่งชี้ภาวะฟองสบู่โดยตรงจากการหาราคาสินทรัพย์ตามปัจจัยพื้นฐานนั้นมีอยู่หลายวิธี บทวิจัยนี้ได้เลือกใช้ 2 วิธีกล่าวคือการเปรียบเทียบสัดส่วนของราคาต่อกำไร (Price/Earning Ratio) กับในอดีต และการประเมินราคาสินทรัพย์จากกระแสเงินปันผล (Dividend Cash-flow Model) วิธีการเหล่านี้แม้อาจจะใช้เป็นสัญญาณที่บ่งชี้ว่าเกิดภาวะฟองสบู่ได้บ้าง แต่ก็มีข้อจำกัดมาก เพราะต้องอาศัยการคาดการณ์ของตัวแปรในอนาคตซึ่งมีความไม่แน่นอนสูงและอ่อนไหวสูงต่อความเชื่อมั่นของนักลงทุน นอกจากนั้นการเปรียบเทียบกับข้อมูลในอดีตอาจไม่ถูกต้องหากมีการเปลี่ยนแปลงของผลิตภาพ (productivity) และโครงสร้างตลาด

จากข้อจำกัดข้างต้น บทวิจัยนี้จึงได้นำวิธีการบ่งชี้ทางอ้อมมาใช้เสริม โดยวิเคราะห์ผ่านความไม่สมดุลทางการเงินซึ่งมักจะเกิดขึ้นพร้อมกันกับการเพิ่มขึ้นของราคาสินทรัพย์ พบว่าเครื่องชี้อัตราแลกเปลี่ยนที่แท้จริง สัดส่วนสินเชื่อต่อ GDP และราคาหุ้นที่แท้จริง สามารถช่วยคาดการณ์วิกฤตการณ์ทางเศรษฐกิจในปี 2540 ได้สองปีล่วงหน้า ดังนั้นเครื่องชี้ดังกล่าวจึงควรนำใช้เป็นตัวแปรส่วนหนึ่งของระบบเตือนภัยทางเศรษฐกิจ (Early Warning Indicators)

นอกจากนี้บทวิจัยนี้ยังได้นำแบบจำลองในการวิเคราะห์การหาแนวโน้มของราคาสินทรัพย์ตามปัจจัยพื้นฐานที่เปลี่ยนแปลงตาม ภาษีประเภทต่างๆ ประสิทธิภาพการผลิตและโครงสร้างประชากร มาใช้ประกอบกับวิธีการข้างต้น วิธีการนี้แม้จะมีหลักการไม่ต่างไปจากการประเมินราคาสินทรัพย์จากกระแสเงินปันผล แต่การประเมินราคาหุ้นตามปัจจัยพื้นฐานนั้น จะคำนวณจาก มูลค่าของ Tangible และ intangible capital แล้วปรับด้วยภาษี จึงมีข้อดีที่ไม่ต้องใช้ตัวแปรเกี่ยวกับการคาดการณ์ในอนาคต จากการวิเคราะห์โดยวิธีนี้พบว่าราคาหุ้นจะมีแนวโน้มเปลี่ยนแปลงไปในทางตรงกันข้ามกับ ภาษีเงินปันผล ภาษี Capital gains ภาษีรายได้นิติบุคล Investment tax credit และส่วนต่างของค่าเสื่อมทางบัญชีกับค่าเสื่อมทางเศรษฐศาสตร์ นอกจากนี้ การเปลี่ยนแปลงของผลิตภาพการผลิต (productivity) จะมีผลต่อราคาหุ้นในระยะสั้น แต่จะไม่มีผลในระยะยาว

ข้อเสนอแนะทางนโยบาย

บทวิจัยนี้เห็นว่า การเตรียมการรับมือและบรรเทาผลกระทบที่จะเกิดขึ้นกับฟองสบู่ที่ดีที่สุดคือการใช้มาตราการระดับจุลภาคช่วยป้องกันแต่ต้น อาทิ โดยการให้ความสำคัญกับหลักธรรมาภิบาล การกำกับดูแลสถาบันการเงินให้มีความเข้มแข็ง การพัฒนาตลาดทุนและเครื่องมือกระจายความเสี่ยง รวมทั้งการจัดทำและเผยแพร่ข้อมูลต่างๆ ที่มีคุณภาพเกี่ยวกับราคาสินทรัพย์โดยเฉพาะอย่างยิ่งข้อมูลตลาดอสังหาริมทรัพย์ เพื่อช่วยให้ลดความผันผวนวัฏจักรราคาสินทรัพย์และ ช่วยให้ของระบบเศรษฐกิจมีความยืดหยุ่นและสามารถปรับตัวได้หากราคาสินทรัพย์ปรับตัวอย่างรุนแรง

เป้าหมายของนโยบายการเงินคือการรักษาเสถียรภาพราคา ซึ่งจะทำให้อัตราดอกเบี้ยในระยะยาวจะได้มีเสถียรภาพเพื่อเอื้อต่อการลงทุน และทำให้หน่วยเศรษฐกิจสามารถดำเนินกิจกรรมทางเศรษฐกิจที่จะส่งผลต่อการจ้างงานและความเจริญเติบโตของเศรษฐกิจที่ยั่งยืน นโยบายการเงินที่เน้นการรักษาเสถียรภาพราคานั้นมีส่วนช่วยในการรักษาเสถียรภาพของสถาบันการเงินในตัวเอง จากการที่ราคาสินทรัพย์โดยเฉพาะอย่างยิ่งราคาอสังหาริมทรัพย์ปรับตัวก่อนหน้าไปในทิศทางเดียวกันกับเงินเฟ้อและเป็นส่วนหนึ่งของช่องทางการส่งผ่านของอัตราดอกเบี้ยนโยบาย นโยบายการเงินที่มีการมองไปข้างหน้าและมีเงินเฟ้อเป็นเป้าหมาย ย่อมจะช่วยลดความผันผวนของวัฏจักรราคาสินทรัพย์ได้ในระดับหนึ่ง นอกจากนั้นอัตราแลกเปลี่ยนแบบลอยตัวก็ช่วยลดความไม่สมดุลด้านต่างประเทศไปในตัว

ในการดำเนินนโยบายการเงิน ธนาคารกลางจำเป็นต้องติดตามการเปลี่ยนแปลงของราคาสินทรัพย์อย่างสม่ำเสมอ เพราะจะให้ข้อมูลที่รวดเร็วและสะท้อนถึงสภาวะเศรษฐกิจการเงินและแนวโน้มของเงินเฟ้อ อย่างไรก็ตามการกำหนดนโยบายการเงินไม่ควรมุ่งไปที่ราคาสินทรัพย์โดยตรงเนื่องจากราคาสินทรัพย์มีความผันผวนมาก แต่หากการเปลี่ยนแปลงของราคาสินทรัพย์ได้ส่งผลกระทบต่อเศรษฐกิจและการคาดการณ์ของอัตราเงินเฟ้อในอนาคตแล้ว ก็อาจจะต้องมีการปรับนโยบายการเงินให้เหมาะสมเพื่อดูแลให้อัตราเงินเฟ้อเป็นไปตามเป้าหมาย นอกจากนั้น การดำเนินนโยบายการเงินควรเน้นให้ความสำคัญต่อการเปลี่ยนแปลงของราคาอสังหาริมทรัพย์เนื่องจากมีความสำคัญต่อเศรษฐกิจมหภาคและเสถียรภาพทางการเงินมากกว่า เนื่องจากประเทศไทยมีโครงสร้างระบบ

การเงินที่ระบบธนาคารมีบทบาทสำคัญ และควรมีการติดตามสินเชื่อภาคเอกชนและปริมาณเงินในระบบเศรษฐกิจอย่างใกล้ชิด เนื่องจากมักจะเปลี่ยนแปลงไปพร้อมๆกันกับราคาสินทรัพย์ และใช้เป็นส่วนหนึ่งของระบบเตือนภัยทางเศรษฐกิจล่วงหน้าได้

ธนาคารกลางควรเน้นการสื่อสารอย่างมีประสิทธิภาพและจูงใจสถาบันการเงิน (Moral suasion) ให้ระมัดระวังการปล่อยสินเชื่อในช่วงเวลาที่มีฟองสบู่ และตระหนักถึงความเสี่ยงที่อาจเกิดขึ้นเมื่อฟองสบู่แตก และหากจำเป็นต้องใช้นโยบายการเงินเข้าช่วยเสริมบ้าง ก็ควรจะต้องทำในระยะเริ่มแรกที่ฟองสบู่เริ่มก่อตัว เพื่อระวังไม่ให้นโยบายการเงินกลายเป็นสาเหตุที่ทำให้ฟองสบู่แตกเสียเอง

บทวิจัยนี้ไม่สนับสนุนให้ธนาคารกลางใช้นโยบายดอกเบี้ยหรือการจำกัดสินเชื่อเพื่อทำให้ราคาสินทรัพย์ปรับตัวลดลง (เจาะฟองสบู่ให้แตก) ทั้งนี้เพราะการบ่งชี้ภาวะฟองสบู่ทั้งในแง่ขนาดและเวลาอย่างแม่นยำเป็นไปได้ยาก รวมทั้งมีความเสี่ยงที่จะส่งผลเสียต่อเศรษฐกิจโดยรวม ดังนั้น ธนาคารกลางควรให้เน้นความสำคัญต่อมาตรการระดับจุลภาคที่จะลดความผันผวนวัฏจักรราคาสินทรัพย์และ ส่งเสริมให้ระบบเศรษฐกิจมีความยืดหยุ่นมากกว่า อย่างไรก็ตาม โดยรวมแล้วนโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อมีกลไกที่สามารถช่วยรับมือกับภาวะฟองสบู่ได้ในระดับหนึ่ง

Executive Summary

Asset Price Bubble and Monetary Policy: Identification and Policy Response under Inflation Targeting

Thailand's economy is on its way to a recovery. History suggests that financial instability generated by an asset price bubble usually accompanies an economic boom. Cross-country experiences show that a seed of financial vulnerabilities can be sowed even in a stable macroeconomic environment characterized by low inflation. Financial imbalances can wreak havoc on the balance sheets of households, bank and non-bank businesses as a price boom turns into a bust. After the burst of the tech-stock "bubble" and amidst growing concern on house price bubble in the US, UK and Australia, a debate has become more intense in the US and Europe whether gunning for low inflation is sufficient or monetary policy should do more to temper episodes of asset price boom and bust.

The forward-looking Bank of Thailand should be well prepared for this potential threat. This paper explores ways to identify and deal with a possibility of future financial instability appropriately under the framework that targets low and stable inflation.

What "bubble"?

Theoretically, a bubble is defined to be the deviations of asset price from its fundamental value– or equivalently an over- or under-valuation of asset price. The task of identifying the fundamental value, and hence the bubble, is arduous and controversial under this definition. In light of this, a practical indirect definition has gained acceptance for the purpose of identifying a "bubble": a positive (negative) "bubble" is taken to mean a prolonged boom (bust) that is followed by a bust (boom). This definition simplifies the matter because booms and busts are measurable and nonjudgmental. However, because the boom-bust definition suggests that a bubble is embedded in every boom that is followed by a bust, it can confuse the issue because not all booms or busts may be a bubble as theoretically defined.

We find both definitions useful. The first compels us to understand the fundamentals that drive asset prices. The second, since it allows for easy measurements, gives us a quick statistical insight into past, necessarily stylized, relationships between booms and busts in the asset price cycles and the rest of the macroeconomic variables of interest.

Some stylized facts

Here are some of the stylized facts found: (1) Increases in asset price are gradual and decreases abrupt. (2) Only one-fourth (40 per cent) of equity (housing) booms are followed by a bust. (3) An equity bust involves a price decline of roughly 45 per cent within 10 quarters, on average, and a housing bust 30 per cent within 4 years. (4) Equity price typically fluctuates with the business cycle and GDP components, leading them by about 1 year. A housing bust coincides roughly with a GDP bust, with deeper output decline. (5) Asset price normally fluctuates with private credit, with equity leading it by 1-2 years. (6) Both CPI and core CPI fluctuate in opposite direction with equity price; both lag real equity price by roughly 3 years. (7) A bank-based economy such as Thailand is more affected by a housing bust. A capital market-based system is more affected by an equity bust.

What causes asset price boom-bust cycles?

Few economists doubt that there are both rational and irrational market participants. What is disputed is (a) whether rational traders correct the price impact of behavioral traders, and (b) what causes the boom and bust cycles in asset price, specifically how to explain stylized fact (1) above.

There are strong views within the economic profession about what causes an asset market to crash and what to do with asset price cycles. For simplicity's sake, we label the first group the "fundamentalist" and the second the "behavioralist". The "fundamentalist" view of the issue is that asset price rises and falls asymmetrically because of an asymmetry either in the underlying technology shocks that drive fundamentals (and therefore asset valuation) or in the information-processing mechanisms that characterize the market. Markets themselves are efficient and asset price and business cycles represent optimal responses of rational individuals.

The "behavioralist" view suggests that markets are subject to fads and bubbles that are irrational in their making. However, rational well-informed and well-financed arbitrageurs are unable to coordinate their selling strategies temporarily, or are overconfident, and have an incentive to time the market, thereby prolonging the bubble. Short-sale constraints also play a role in this explanation.

Direct and indirect measure of financial imbalances

Various approaches can be used to estimate the fundamental value of assets directly. We use two different approaches: We estimate P/E and the present value of dividends through the Gordon's formula. We find that these tools helped identify an overvaluation in Thailand's stock market in 1989 and 1993, according to a historical benchmark. Both also suggest that the stock market was undervalued in 2002, according to historical standard. A major drawback of this standard approach is that, *ex ante*, it depends crucially on expectations regarding the present value of dividends that is neither directly observable nor retrievable. Asset valuation could be high with positive expectations regarding dividend growth, usually during an economic boom, for example. Furthermore, a historical benchmark used may not be applicable owing to possible changes in productivity or market structure, which may not be observable in a timely manner.

Because of the obstacles to direct measurements, we complement it with the use of an indirect method; that is, an identification through the symptoms of a bubble. Here we rely on the boom-bust indirect definition. We test a set of 3 key financial variables associated with a bubble that may act as early warning indicators for financial instability, namely the real exchange rate, credit, and equity price. We find that this method allows for a forecast (with some accuracy) of the financial crisis of 1997 two years in advance, using only information available on the three mentioned variables before the crisis. These variables can form part of the financial-crisis early warning indicators of the Bank of Thailand.

Next we provide an alternative direct identification approach, which states that the value of a corporation is equal to the value of its capital, both tangible and intangible, adjusted for tax consequences. This approach is equivalent to the standard approach, but does not suffer the drawback of expectations. We use this approach to help predict trend movements in asset price. Through this approach, we find that the price of a unit of productive capital used by firms depend negatively, and exclusively, on the effective tax rates on dividends, capital gains and corporate income, and subsidies such as investment tax credits and allowed depreciation in excess of economic depreciation. Model results using this approach show that higher trend productivity growth does not justify a higher fundamental corporate equity value in the long run.

In the short run, however, changes in productivity justify changes in fundamental corporate equity valuation.

Policy implications and recommendation

Our basic stance is simple: Asset price cycles will remain a part of market economy, whether we take the "fundamentalist" or "behavioralist" view of the issue. Not every boom is followed by a bust, and not every bust leads to a financial crisis; therefore, a quick lesson points to the need to establish a resilient financial system that can withstand an asset price bust. We emphasize preventive measures such as good corporate governance, a strong regulation and supervisory regime, the development of risk-transfer instruments and the improvement and disclosure of information useful for asset pricing to help minimize the size of the bubble and make the economy more resilient to shocks generated in the asset market. A well-developed capital market can also contribute to economic resiliency.

Monetary policy's goal is to maintain long-term price stability. This is done through anchoring inflation expectations of the public. By doing so, the central bank can help ensure stable long-term interest rates, which benefit investment. This way, households and firms can work toward maximum employment and sustainable growth. To an extent, a monetary regime that promotes price stability tends to promote stability in the financial system. The inflation targeting monetary regime is forward looking, and the flexible exchange rate associated with it helps minimize imbalances that originate from the external sector. Insofar as asset prices, particularly property price, tend to lead inflation according to our stylized facts and are part of the transmission channels, monetary policy that aims to contain inflation within the target range should also moderate the asset price cycles to some degree.

We recommend that monetary policy focus on deviations of the inflation forecast from the declared target. Asset prices contain timely and valuable information that should be included in the forecast by monetary policymakers. However, asset prices are too volatile to be an additional target. To the extent that financial instability can lead to a deviation from the inflation target, monetary policy should preempt it. More emphasis should be put on property than equity price, as property price movements are more associated with changes in output and have more impact on financial stability, as Thailand is a bank-based economy. Private credit and monetary aggregates share cycles with asset prices and should be monitored closely, as a part of an early warning or an indirect identification of a bubble.

Consistent with our stylized facts, communication and moral suasion regarding credit should take the lead to induce a soft landing. If there is a need to act, the central bank should act early to buttress the effectiveness of moral suasion so that monetary policy does not become the cause of a sizable asset price collapse and possible deflation.

We do not recommend using interest rate or credit policy to pop the bubble *per se*. It is difficult to be confident about the existence of a bubble and the timing of the burst *ex ante*, and it is almost impossible to calibrate a correct magnitude of policy interest rate movement that will be just sufficient to pop the bubble without harming the economy. Credit policy may be an effective bubble-popping tool, but it is subject to the same constraint. In all likeliness, monetary and credit policy will most likely be too aggressive than necessary. If preventive measures have been exercised, it may be less risky to wait for the bust and then relax monetary policy stance to help maintain price stability. In this sense, inflation targeting provides a focused framework that is equipped to deal with asset price bubble.

Asset Price Bubble and Monetary Policy: Identification and Policy Response under Inflation Targeting

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Abstract

This paper explores ways to identify and deal with possible asset price bubble appropriately under the inflation-targeting framework. We establish statistical links between asset prices and macroeconomic and financial variables in Thailand. We also suggest ways for the central bank to identify financial vulnerabilities before they accumulate into a real threat. Finally, we explore how the BOT, in cooperation with other agencies, should respond to asset price movements. We conclude that asset prices are too volatile to be a target for monetary policy; however, they are a traditional policy transmission channel and have timely and valuable information that monetary policymakers should take into account. Monetary policy's response is best limited to deviations of inflation forecast from target, which will work through asset price. Inflation targeting and managed float already help contain bubble to some extent. The best response to bubble is preventive, namely good corporate governance, a strong regulation and supervisory regime, the development of risk-transfer instruments and the improvement and disclosure of information useful for asset pricing. These methods can help reduce bubble's size and make the economy more resilient to shocks generated in the asset market.

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Section 1. Introduction

After a long slowdown, Thailand's economy is on its way to a recovery in the medium term. History suggests that financial instability generated by inflated speculation of asset prices or asset price bubble usually accompanies an economic boom. The asset classes that may experience such a boom include commercial and residential property and corporate equity. If allowed to build up, financial imbalances can become detrimental to the balance sheets of households, bank and non-bank businesses as a price boom turns into a bust. Experiences show that financial vulnerabilities can build up even in a stable macroeconomic environment characterized by low and stable inflation.

Macroeconomic managers should be prepared to deal with a possibility of future financial instability appropriately under the framework that targets low and stable inflation. Appropriate policy responses to financial imbalances may be monetary, non-monetary (e.g. prudential measures), or coordinated. In any case, before implementing policy, the central bank must be able to identify the bubble before it bursts while being mindful that monetary policy does not become the cause of a sizable asset price collapse.

This paper explores ways to identify and deal with a possibility of future financial instability appropriately under the framework that targets low and stable inflation. The central questions we attempt to answer are the following: (1) What are the links between asset prices and macroeconomic and financial variables, such as inflation, output, money, and bank credits in Thailand? (2) How can the Bank of Thailand (BOT) identify financial vulnerabilities before they accumulate into a real threat? Finally, (3) how should the BOT use available information to deal appropriately with asset price bubble from the perspective of a responsible (preemptive) central bank that targets low and stable inflation?

1.1 What "bubble"?

Many economists and policymakers often express a sentiment about asset price bubble that displays at once their inability to define, let alone measure, it formally and their assertion of knowing it when they see one. This is so because a bubble is hard to identify, particularly *ex ante*.

Theoretically, a bubble is defined to be the deviations of asset price from its fundamental value–or equivalently an over- or under-valuation of asset price. The task of identifying the fundamental value, and hence the bubble, is arduous and controversial under this definition. In light of this, a practical indirect definition has gained acceptance for the purpose of identifying a "bubble": a positive (negative) "bubble" is taken to mean a prolonged boom (bust) that is followed by a bust (boom). This definition simplifies the matter because booms and busts are measurable and nonjudgmental. It also obviates the need to get into an esoteric theoretical discussion of the existence of something that may not be measurable in a timely manner. However, because the boom-bust definition suggests that a bubble is embedded in every boom that is followed by a bust, it can confuse the issue because not all booms or busts may be a bubble as theoretically defined.[1]

[1] This inherent limitation has to be borne in mind, because the boom-bust definition may help identify a future bust that follows this period's boom, assuming that there is a bubble in there somewhere.

We find both definitions useful. The first confronts economists with the necessity to understand the fundamentals that drive asset prices and, provided that we have reliable and sufficient data, allows us to measure the size of the vulnerabilities in the economic system in advance. The second, since it allows for easy measurements, gives us a quick statistical insight into past, necessarily stylized, relationships between booms and busts in the asset price cycles and between the boom-bust cycles and the rest of the macroeconomic variables of interest.

In this sense, these statistical relationships are not completely silent on the possible existence of a bubble or the timing of the ensuing crash, *ex ante*. An early warning system based on this type of indirect identification can be built and will be presented. For the purpose of identifying a possible financial crisis generated by an asset price bust, the indirect boom-bust approach can be useful. We can learn how often a bust or a financial crisis *typically* comes after a boom, for instance.

1.2 Some stylized facts

The following stylized facts are patterns that can be discerned and organized from the data. Owing to limited asset price data in Thailand, indeed in most developing economies, we rely on international evidence both in developed and other Asian countries to corroborate our statistical findings. Our detailed findings are reported in Section 2.

Here are some of the stylized facts for asset price: (1) Increases in asset price are gradual and decreases abrupt. (2) Only one-fourth (40 per cent) of equity (housing) booms are followed by a bust. (3) An equity bust involves a price decline of roughly 45 per cent within 10 quarters, on average, and a housing bust 30 per cent within 4 years. (4) Equity price typically fluctuates with the business cycle and GDP components, leading them by about 1 year. A housing bust coincides roughly with a GDP bust, with deeper output decline. Peaks in equity price tend to lead those in commercial and real estate prices by 1-2 years. (5) Equity price is the most volatile, followed by commercial and residential property in that order. Equity price fluctuates roughly 9 times more than real GDP does, in percentage terms. (6) Asset price normally fluctuates with private credit and monetary aggregates, with equity leading private credit and M1 by 1-2 years and 1 year, respectively. (7) Both CPI and core CPI fluctuate in opposite direction with equity price contemporaneously; but, both lag real equity price by roughly 3 years.[2] (8) A bank-based economy such as Thailand is more affected by a housing bust. A capital market-based system is more affected by an equity bust. (9) Cross-country synchronization in equity price busts is observed, especially in times of recessions, but it is not clear if house price busts are synchronized.

1.3 What causes asset price boom-bust cycles?

Few economists doubt that there are both rational and irrational—or the so-called behavioral, momentum-trading, trend-chasing—market participants. What is disputed is (a) whether rational traders correct the price impact of behavioral traders, and (b) what causes the boom and bust cycles in asset price, specifically how to explain stylized fact (1) above. At issue are not only the existence and size of a bubble, but also the timing and cause of the crash that follows.

[2] This fact is established using Thailand's data only. We have not seen any quantitative work done based on international datasets.

The statistical relationships reported in Section 2 are necessarily silent on the cause of the boom-bust cycles. Why is an upswing more gradual and prolonged than a fall? A good theory is needed, and that theory not only must be able to explain the salient facts involving short-term cyclical movements and long-term trend of asset prices, but it should allow for a match between variables measured by the theoretical models and macroeconomic variables in the national income and capital stock accounts.

There are strong views within the economic profession about what causes an asset market to crash and what to do with asset price cycles. For simplicity's sake, we label the first group the "fundamentalist" and the second the "behavioralist". The "fundamentalist" view of the issue is that asset price rises and falls asymmetrically because of an asymmetry either in the underlying technology shocks that drive fundamentals (and therefore asset valuation) or in the information-processing mechanisms that characterize the market. Markets themselves are efficient and asset price and business cycles represent optimal responses of rational individuals, given shocks to the real economy and information flows, provided that there is a clearly understood market-based rule and regulation regime; and nothing need be done to improve upon this outcome.[3] Markets do crash, but not because of a bubble; indeed, bubbles are not consistent with this view.[4]

The "behavioralist" view suggests that markets are subject to fads and bubbles that are irrational in their making. However, rational well-informed and well-financed arbitrageurs are unable to coordinate their selling strategies temporarily, or are overconfident, and have an incentive to time the market, thereby prolonging the bubble. Short-sale constraints also play a role in this explanation. Policy implications suggested by some of the proponents of this view involve increasing transaction costs to reduce price volatility and trading volume, which they reason are signs of a bubble. However, it is acknowledged that the policy's effect on the size of a bubble is very modest.[5] Indeed if increasing transaction costs can help, there should be no bubble in the property market, which already has much higher transaction costs than the stock market does to begin with.

Some "behavioralists" believe that there is a role for monetary policy in limiting the impact of a bubble. Recommendations range from not reacting to asset price boom directly but relaxing monetary policy after a bust *to* raising interest rates enough as an "insurance" to contain the bubble.[6]

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[3] See Zeira (1999), Boldrin and Levine (2000), and McGrattan and Prescott (2000, 2001), for example.

[4] Proponents of the efficient market hypothesis argue that rational speculative activities would not only eliminate risk-free arbitrage opportunities, but also cases of under- or over-pricing that can only be exploited through imperfectly hedged, and therefore risky, trades. (For example, during the recent US tech-stock boom, there was no close substitute that could be used to hedge a short position in the technology sector.) In short, the existence of a bubble for a prolonged period of time is not consistent with the view of efficient markets. A crash, according to this view, must be caused by something other than the "overvaluation" itself.

[5] See Scheinkman and Xiong (2003), Abreau and Brunnermeier (2003), and Brunnermeier and Nagel (2003), for example.

[6] See Bernanke and Gertler (1999), Mervyn King (2002), and Issing (2002), for example. The do-nothing approach during the boom is close to a "fundamentalist's" recommendation.

1.4 Direct and indirect measure of financial imbalances

Various approaches can be used to estimate the fundamental value of assets directly. In Section 3 of this paper, we use two different approaches for a more comprehensive assessment of the bubble as well as a better understanding of the interactions between asset price and macroeconomic and financial variables. First, we estimate P/E and the present value of dividends through the Gordon's formula. We find that these tools helped identify an overvaluation in Thailand's stock market in 1989 and 1993, according to a historical benchmark. Both also suggest that the stock market was undervalued in 2002, according to historical standard. A major drawback of this standard approach is that, *ex ante*, it depends crucially on expectations regarding the present value of dividends that is neither directly observable nor retrievable. Asset valuation could be high with positive expectations regarding dividend growth, which usually accompanies an economic boom, for example. Furthermore, a historical benchmark used may not be applicable owing to possible changes in productivity or market structure, which may not be observable in a timely manner, for instance.

Because of the obstacles to direct measurements of the bubble mentioned, we complement our identification attempt with the use of an indirect method; that is, an identification through the symptoms of a bubble. Here we rely on the boom-bust indirect definition. The approach used, pioneered by Borio and Lowe (2002), allows us to test a set of 3 key financial variables associated with a bubble that may act as early warning indicators for financial instability, namely the real exchange rate, credit, and equity price. We find that this method allows for a forecast (with some accuracy) of the financial crisis of 1997 two years in advance, using only information available on the three mentioned variables *before* the crisis.

Next we provide an alternative direct identification approach, which states that the value of a corporation is equal to the value of its capital, both tangible and intangible, adjusted for tax consequences. This approach is equivalent to the standard approach, but does not suffer the drawback of expectations. We use this approach to help predict *trend* movements in asset price.[7] For example, if we observe movements in the market that resemble a trend, then we can investigate further if that trend can be justified by some underlying fundamental as predicted by theory without the cumbersome issue of expectations. Through this approach, we find that the price of a unit of productive capital used by firms depend negatively, and exclusively, on the effective tax rates on dividends, capital gains and corporate income, and subsidies such as investment tax credits and allowed depreciation in excess of economic depreciation. This framework also allows us to analyze the productivity trend and the demographic shift and their effects on asset value.

1.5 Policy implications and recommendation

Asset price bubble is a highly controversial area in economics. It is not the purpose of our paper to settle a theoretical dispute. We wish only to draw from these debates policy implications that are useful for Thailand to complement our stylized facts and results from the direct and indirect identification approaches.

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[7] Lack of national account data, particularly capital stock of the corporate sector and housing, prevents us from measuring the fundamental value of these assets directly using this dynamic general equilibrium approach. We find a good conceptual method of estimating the stock of intangible capital based on the rate of return to tangible capital.

We recommend that monetary policy respond to deviations of the inflation forecast from the declared target. Asset prices are too volatile to be an additional target, but they contain timely and valuable information that should be considered by monetary policymakers. Private credit and monetary aggregates share cycles with asset prices and should be monitored closely.

To the extent that financial instability can lead to a deviation from the inflation target, monetary policy should respond accordingly. Insofar as asset prices, particularly property price, tend to lead inflation according to our stylized facts and are part of the transmission channels, monetary policy that aims to contain inflation within the target range should also moderate the asset price cycles to some degree. Consistent with our stylized facts, communication and moral suasion regarding credit and monetary indicators should take the lead to induce a soft landing. If there is a need to act, the central bank should act early and it must be mindful that monetary policy does not become the cause of a sizable asset price collapse. In this sense, inflation targeting is equipped to deal with asset price bubble.

More important, we emphasize good corporate governance, a strong regulation and supervisory regime, the development of risk-transfer instruments and the improvement and disclosure of information useful for asset pricing. Ultimately, we have to live with asset price cycles. But these preventive measures should help contain the size of the bubble and make the economy more resilient to shocks. A well-developed capital market can also contribute to economic resiliency.

The structure of the paper follows: In Section 2, we organize a set of stylized facts surrounding asset prices and macroeconomic and financial variables for Thailand using international evidence to corroborate our findings. Section 3 discusses both direct and indirect approaches to identifying an asset price bubble and describes a framework for analysis of long-term asset price trend. Section 4 outlines a way to deal with asset price booms and busts based on the knowledge compiled in Sections 2 and 3. Statistical tools and models used are in the appendices.

Section 2. International evidence and stylized facts for Thailand

The set of assets the *real* prices of which we are interested in consists of equity and property, including commercial and residential.[8] [9] This section describes the major empirical regularities observed in the data of asset price and macroeconomic aggregates. The patterns are then organized along a narrow dimension into stylized facts.

To the extent that the data for Thailand are available, we provide our own description of the empirical regularities. However, owing to the paucity of the asset price data in Thailand and the need for a comprehensive review of evidence, we shall make use of available stylized facts of the industrial countries observed in the past four decades. Toward that end, the section that deals with international experiences relies heavily on the data and studies

[8] The exchange rate or the value of one currency in terms of another can also be considered an asset price. Indeed, it may be the most important price in a small open economy. It will not be explicitly discussed here.

[9] The reason we are interested in *real* rather than nominal asset price is that we wish to abstract away from movements in the general price level in our analysis so that any relationship between asset price and important macroeconomic aggregates found is free of the effects of inflation.

provided by the *World Economic Outlook* (2003), Borio and Lowe (2002, 2003), Zeira (1999), and Boldrin and Levine (2000) in that order.

Our focus is on the time paths of asset prices and other macroeconomic aggregates, both real and financial. This approach obviates the need to define or measure "bubble" for the purpose outlined. The advantage of the methodology used in the work cited above is in its emphasis on episodes of asset price boom and bust as deviations from trend[10]; and this is the main reason for citing their findings in out attempt to organize facts for Thailand.

We view that each time series consists of two components, one is the low-frequency, secular, movement or trend and the other is the higher-frequency cycle. In this paper, we are interested in 2 large sets of facts: (a) the cyclical relationship between asset price and GDP and its components (the business cycle) and between asset price and monetary and financial variables and (b) the relationship between prices across asset classes. Unless otherwise noted, all real time series in this paper are obtained by deflating nominal time series with the consumer price index (CPI). The rationale behind it is that in standard asset pricing theory, asset ownership is treated as a claim on consumer goods.[11]

It should be noted that the patterns that can be discerned from the data are in fact identified on the basis of their timing or correlations. They do not necessarily imply causality. Therefore, the usefulness of this exercise is restricted to an identification of empirical patterns that may provide a relevant point of reference for assessing current and future booms and busts.

Data on property prices are scarce, particularly for developing markets. Indeed, hardly any reliable data covering a sufficiently long period for developing markets exist. Comparing the time series across countries also proves exceedingly difficult. The heterogeneity of cross-country data makes the statistics dearth and creates difficulty for a simple gathering of stylized facts, let alone a rigorous test of economic theory.[12]

2.1 A catalogue of international evidence

The *WEO* uses quarterly equity price data from 1959:Q1 to 2002:Q3 for 19 industrialized countries and housing price data from 1970 for 14 countries that belong in the same subset of industrialized countries.[13] [14] Both indices are deflated by the CPI. The studies of Asian asset price cycles and financial crises across East Asian countries by Collyns and Senhadji (2000) confirm that international experiences discussed in the *WEO* are indeed robust across national income levels.

Official statistics do not provide commercial property price indices in many countries and so we rely on Borio and Lowe (2002) to infer that commercial property price cycles often

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[10] The *WEO* in particular focuses on episodes of extreme deviation.

[11] Deflating asset prices by the GDP deflator should not change the basic picture.

[12] We plan to discuss in Section 3 what we could do with the data, were they available, underscoring the fact that economic theory is far ahead of measurement in this field.

[13] The *WEO* essay defines a bust as a peak-to-trough decline with the price change large enough to be in the top quartile of all declines during the bear markets (more than 37 per cent decline for equity and 14 per cent for housing prices). It also defines a boom as a trough-to-peak rise with the price change large enough to be in the top quartile of all increases.

[14] Not all price series are available from those starting dates, however.

correlate with those of house price. Borio and Lowe (2002) uses the property price data for an overlapping set of 12 industrial countries, which generally date back to the 1970s. In some cases, however, commercial real estate price data are available only from the 1980s. A composite, aggregate asset price, index constructed from equity, residential and commercial real estate prices, published by the BIS since 1993, is also used in their work.

In an attempt to account for the asymmetry in asset price movements, Zeira (1999) and Boldrin and Levine's (2000) work are motivated by the behavior of equity price; in the latter's case, the Standard and Poor 500 index (divided by GNP deflator) between 1889-1984. We cite three stylized facts from Boldrin and Levine (2000) and Zeira (1999), which pertain to equity price movements.

The procedure used in all the work cited above allows booms and busts to be determined independently. As a result, a boom does not necessarily follow a bust and *vice versa*.

We now provide a collection of relevant international stylized facts.

(1) Asset Price Cycles

1.1 Increases in asset price are smaller and more persistent than decreases, i.e. increases are relatively gradual and decreases are abrupt. (Boldrin and Levine (2000))

1.2 About one-fourth of equity booms and 40 per cent of housing booms are followed by a bust. (WEO)

1.3 Many booms and busts have followed financial liberalizations. (Zeira (1999))

The fact that asset price tends to rise more gradually and fall abruptly suggests that potential vulnerabilities take time to build up whereas crashes come in an abrupt fashion. Financial liberalizations can be a cause of those buildups.

(2) Average Magnitude and Duration

2.1 An equity bust involves a price decline of roughly 45 per cent within 10 quarters, on average.[15] *A housing bust involves a 30 per cent price fall within 4 years, on average.* (WEO)

2.2 The amplitude and length of the cycles appear to be larger in the 1990s than before. (Borio and Lowe (2002))

(3) Asset price and Real Output

3.1 Both housing and equity busts generally coincide or overlap with recessions during the 1970s and 1990s. (WEO)

3.2 Equity busts lead real GDP bust by roughly 3 quarters, while housing bust coincides roughly with real GDP bust. Even as the output decline is deeper after a housing bust, output recovers 9 quarters after a bust in each asset class. (WEO and ECB (2003)[16])

(4) Relationship with Private Credit

4.1 Asset prices and real private credit typically share similar cycles. (Borio and Lowe (2002))

4.2 Private credit growth declines more sharply after a housing bust with the low reached after 4 quarters, and 7 quarters after an equity bust. Recovery in credit growth lags output recovery, especially after a housing bust. (WEO)

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[15] After the crash, stock prices are still higher than at the beginning of the episode.

[16] For many EU countries, ECB (2003) finds that real house price cycles are closely correlated with the real GDP cycles (p. 18).

(5) … and Broad Money *Broad money behaves similarly to private credit in (4.2).* (WEO)

(6) Relationship across Asset Classes[17]

6.1 Equity prices are the most volatile, followed by commercial and residential property in that order.[18] (Borio and Lowe (2002))

6.2 Half of housing busts overlap with equity busts while one-third of equity busts overlap with housing busts. (WEO)

6.3 Peak in equity prices tend to lead those in commercial and real estate prices by 1-2 years. Residential property prices typically turn last.[19] (Borio and Lowe (2002))

6.4 The spillover from housing busts to equity prices is larger in magnitude and speed than vice versa. (WEO)

It follows from (6.1) that the joint occurrences of housing and equity price busts are less frequent that a bust in each asset class; and (6.2) is consistent with (6.1).

(7) … with Real Interest Rates *Real interest rates have no clear pattern before an equity bust but typically fall afterward; rates typically increase before a housing bust and remain constant afterward.* (WEO)

Stylized fact (7) seems to contradict with (3.2) in a sense that policy interest rates respond to equity price bust, but not housing price bust while the latter has more adverse effect on real output. One way to reconcile these two stylized facts is the following: Fact (7) suggests that policy interest rate rise tends to be the cause of housing price busts and tend to be used to shore up equity prices after a crash in that market even though its impact on output may be smaller.

(8) Financial Structure *A bank-based economic system tends to be more affected by a housing bust than a capital market-based system. The latter is more affected by an equity bust.*[20] (WEO)

One area where there is still a dispute within the literature is the area of cross-country contagion in housing markets. The *WEO* and Borio and Lowe (2002) report observing cross country synchronization in equity and housing price busts, especially in times of recessions. However, ECB (2003) reports that house prices in different countries are not highly synchronized, and cyclical correlations between real house prices are significantly lower than between real equity prices across countries. This should be expected given the geographical segmentation of housing markets.

2.2 Stylized facts for Thailand

We now provide a set of stylized facts observed in Thailand's data. The purpose for this exercise is to confirm the international evidence listed above and complement it. Combined

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[17] It is essential to note that "property market" is not homogenous; different classes of property relate to different stages of the business cycle.

[18] Equity price rebounds faster after a housing price bust (4 quarters) than vice versa (11 quarters), see *WEO* (2003).

[19] As noted in Borio and Lowe (2002) p.8, the relationship across asset classes is somewhat opaque around troughs.

[20] This fact is consistent with (4) and (5).

with the above list, these stylized facts will be used to answer specific questions regarding our determination of appropriate policy action, discussed in detail in Section 4.

All data, except for those of property price in Thailand, are obtained from the Bank of Thailand's databases. Property price data used are from Jones Lang LaSalle Co., Ltd.[21] The data used are annual, from 1970 to 2002, unless otherwise noted.[22] With regard to asset price data, we only study comovements of other aggregates vis-à-vis real equity price (SET index deflated by CPI) from 1975, because the real estate statistics that we have are not long enough to cover at least 2 cycles. The property price indexed is plotted against other variables and a simple observation is adequate.

Apart from those concerning real private credit and M2, our results do not change materially when we restrict the data to be between 1970-1996; that is, overall results are robust to the crisis of 1997.

The stylized facts below are organized from the statistics reported in Tables 2.1 and 2.2. These statistics provide information on three basic aspects of the cyclical behavior of the aggregates:

- The amplitude of fluctuations
- The degree of comovements with cyclical real SET index (our measure of pro- or countercyclicality)
- The phase shift of a variable relative to the cyclical real SET index

The cyclical component of a time series is extracted using the Hodrick-Prescott (HP) filter. It is to be emphasized that deviations are in percentage, and not absolute, terms (as they are logarithmic differences). Organization of stylized facts in the business cycle literature usually relies on the method of cross correlation between cyclical components of the relevant time series (usually between cyclical real GDP and other aggregates). The rationale behind our usage of the HP filter to extract the trend and cyclical components of the time series has its roots in growth theory. A justification for the application of this empirical tool is outlined in Appendix A.

In Tables 2.1 and 2.2, the *x(t)* column indicates the degree of contemporaneous comovements with Thailand's real equity price. The statistics in that column show the correlation coefficients between cyclical deviations of each series and cyclical deviations of Thailand's real equity price. A number close to 1 indicates that a series is highly *procyclical* with real equity price. A number close to –1 indicates that a series is highly *countercyclical* with real equity price. A number close to 0 indicates that a series is *uncorrelated* comtemporaneously with Thailand's real equity price, i.e. the series does not vary contemporaneously with Thailand's real equity price in any systematic way. The other columns display the correlation coefficients when the series have been shifted forward or backward, relative to Thailand's real equity price, by 1-5 years. The numbers do indicate if there is a phase shift in the movement of a time series relative to Thailand's real equity price.

If the number in the column *x(t)* is positive, but largest in column *x(t-i)*, where $i > 0$, then the series is procyclical, but tends to peak roughly *i* periods ahead of Thailand's real equity price;

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[21] The dataset includes prices and rents of condominium, office and retail space in the central business district.

[22] Data for the SET index start in 1975, those for core CPI in 1985, and those for import and export (and hence, net export) in 1980.

we say that the series *leads* the equity price cycle by *i* periods. Correspondingly, if *x(t)* is positive, but largest in column *x(t+j)*, where *j* >0, then the series is procyclical, but tends to peak *j* periods after real equity price; in this case, we say the series lags the real equity price cycle by *j* periods.

A straightforward way of interpreting the numbers in Tables 2.1 and 2.2 is as follows: For example, the percentage standard deviation of cyclical real private credit displayed in Table 2.2 is 2.17 times larger than that of real GDP. Based on the information between 1970-2002, if one permits oneself to believe that this period is a good representative of a much longer time series, then one would expect to see real private credit lag behind real equity price by 1 year roughly 64 per cent of the time, with real private credit deviating from its mean twice (2.17 times) more than real GDP does in percentage terms, on average (that is, in the law-of-large-number sense). Lead-lag relationship between real and financial variables with respect to the business cycle as measured by cyclical real GDP can be found in Appendix C.

While cross correlation does not indicate immediately the causality between the cyclical time series involved, a Granger causality test between the cyclical series (or even between the actual series) usually confirms the lead-lag relationship found through cross correlation.[23] The reason we use cross correlation instead of Granger causality is to avoid any judgment regarding the choice of autoregressive lag length and methods of dealing with potential nonstationarity in the series to which empirical results for Granger causality can be subject (see Hamilton (1994)). However, it is nice to know that results from Granger causality tests almost surely confirm those from cross correlations.[24] Results show that variables such as stock prices reflect forward looking behavior and are often found to be excellent predictors of many other economic time series.[25]

Here are some of the stylized facts found for Thailand:

(1T) Asset Price Cycles *Increases in asset price are relatively gradual and decreases are abrupt.*

(2T) Average Magnitude *The amplitude of the equity price cycles appear to be roughly 9 times as large as the business cycle (as measured by cyclical real GDP) and 2.5 times as large as that of investment.*

(3T) Asset price and Real Output and its Components

3T.1 Thailand's real equity price typically is procyclical with the business cycle (output) and leads it by 1 year.

3T.2 Private (both construction and machinery and *equipment components) and total investment, consumption, export and import are all pro-cyclical with equity price, each lagging equity price by 1 year.*

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[23] This should not come as a surprise considering that "Granger causality" is a test whether one time series (or variable) has information that can be used to help forecast another.

[24] The test for Granger causality used to confirm our results is based on the simplest sutoregressive specification. A variety of Granger causality tests have been proposed, but Monte Carlo simulations suggest that the most simple and straightforward test based on the autoregressive specification [11.2.2] in Hamilton (1994) may well be the best -- even as this test is valid only asymptotically.

[25] For a variable to be an excellent predictor obviously does not mean that it *causes* GDP or inflation to move. The values of these series (equity prices for example) may reflect the market's best information about the direction that GDP and inflation might be headed. In this sense, Granger causality tests has been used to assess whether markets are concerned with or are able to forecast GDP or inflation, but it should not be used to infer a direction of causation in this case.

Table 2.1 Cross correlation between real SET and real GDP and its components†

X	%StdDev	$\frac{\sigma_{Xi}}{\sigma_{GDP}}$	$\frac{\sigma_{Xi}}{\sigma_{SET}}$	X(t-5)	X(t-4)	X(t-3)	X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)	X(t+3)	X(t+4)	X(t+5)
Real SET	39.57	8.53	1.00	-0.20	-0.16	-0.04	0.14	0.56	1.00	0.56	0.14	-0.04	-0.16	-0.20
Consumption	4.35	0.94	0.11	-0.37	-0.44	-0.36	-0.21	0.01	0.42	0.77	0.71	0.50	0.22	0.00
Private	4.79	1.03	0.12	-0.35	-0.39	-0.30	-0.13	0.07	0.47	0.80	0.71	0.47	0.19	-0.04
Public	4.92	1.06	0.12	-0.29	-0.46	-0.60	-0.65	-0.42	-0.19	0.16	0.31	0.38	0.34	0.29
Investment	16.02	3.45	0.40	-0.24	-0.31	-0.27	-0.11	0.11	0.50	0.76	0.64	0.40	0.10	-0.13
Private	20.18	4.35	0.51	-0.16	-0.23	-0.16	0.00	0.20	0.56	0.75	0.55	0.26	-0.50	-0.24
Construction	23.81	5.14	0.60	-0.16	-0.19	-0.13	-0.02	0.21	0.60	0.73	0.52	0.20	-0.16	-0.29
Equipment	19.80	4.27	0.50	-0.17	-0.26	-0.19	0.00	0.19	0.51	0.74	0.57	0.32	0.06	-0.18
Public	20.26	4.37	0.51	-0.43	-0.49	-0.53	-0.40	-0.26	-0.04	0.31	0.52	0.59	0.49	0.30
Export	7.84	1.69	0.20	-0.28	-0.14	-0.12	0.16	0.40	0.54	0.60	0.45	0.18	0.14	0.06
Import	15.86	3.42	0.40	-0.19	-0.24	-0.18	-0.02	0.16	0.49	0.78	0.55	0.23	0.08	-0.07
Net Export	12.01	2.59	0.30	0.07	0.22	0.16	0.13	0.05	-0.30	-0.63	-0.43	-0.19	-0.01	0.13
Real GDP	4.64	1.00	0.12	-0.30	-0.33	-0.28	-0.11	0.10	0.50	0.80	0.71	0.48	0.23	-0.05

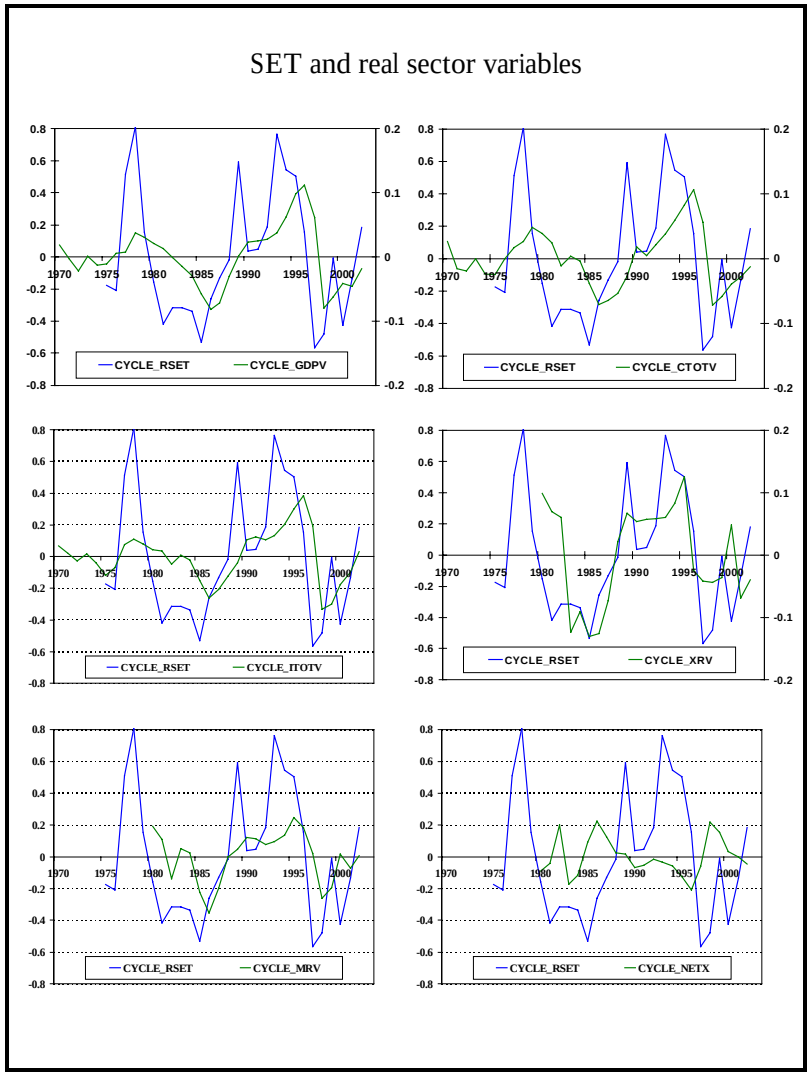
†Consumption, investment, and real GDP are from 1970 to 2002; real SET from 1975 to 2002; and, exports and imports from 1980 to 2002.

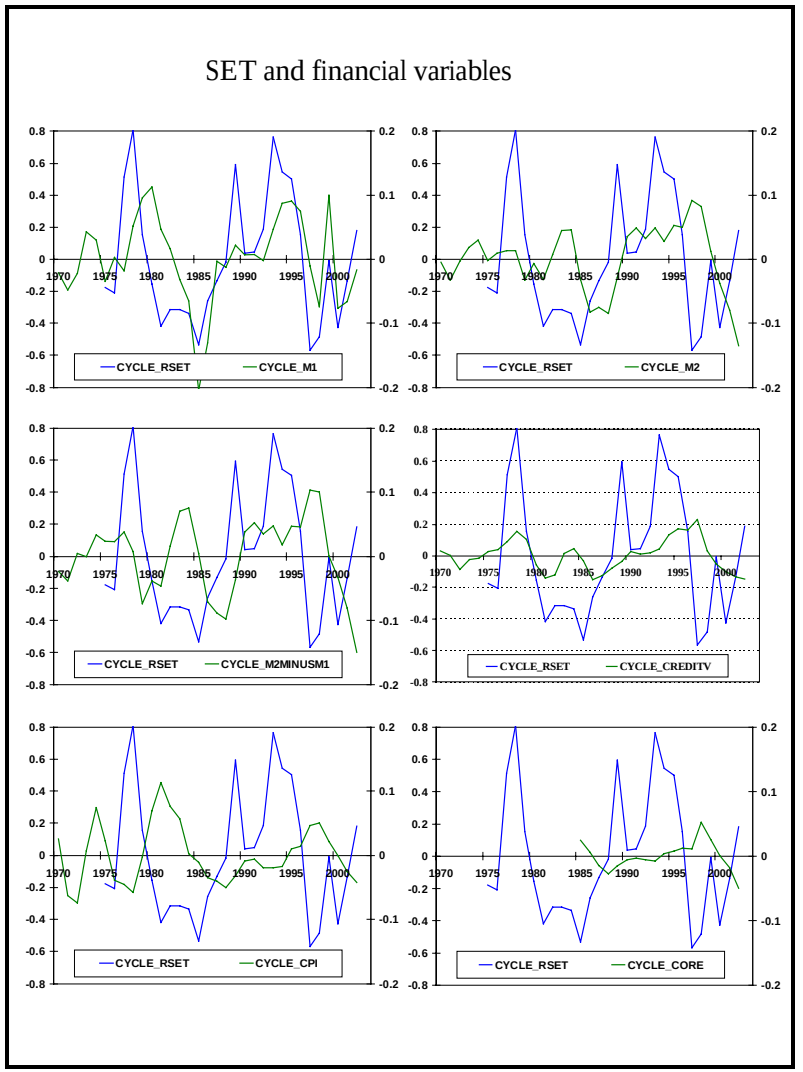
Table 2.2 Cross correlation between real SET and money and prices‡

X	%StdDev	$\frac{\sigma_{Xi}}{\sigma_{GDP}}$	$\frac{\sigma_{Xi}}{\sigma_{SET}}$	X(t-5)	X(t-4)	X(t-3)	X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)	X(t+3)	X(t+4)	X(t+5)
Money Aggregate, Real Credit and Price Level														
M0	6.30	1.36	0.16	-0.33	-0.33	-0.26	-0.27	-0.20	0.28	0.47	0.52	0.62	0.51	0.23
M1	6.82	1.47	0.17	-0.30	-0.42	-0.30	-0.13	0.04	0.54	0.61	0.50	0.43	0.26	0.05
M2	5.15	1.11	0.13	-0.16	-0.11	-0.13	-0.10	-0.07	0.06	0.26	0.46	0.48	0.60	0.46
M2 – M1	5.93	1.28	0.15	-0.10	-0.03	-0.05	-0.05	-0.07	-0.05	0.10	0.30	0.37	0.56	0.47
Real credit	0.07	2.17	0.25	-0.17	-0.20	-0.25	-0.12	0.08	0.37	0.64	0.52	0.30	0.27	0.22
CPI	4.53	0.98	0.11	-0.17	-0.22	-0.31	-0.49	-0.61	-0.53	-0.13	0.34	0.59	0.61	0.40
Core CPI	2.24	0.48	0.06	-0.19	-0.02	-0.17	-0.40	-0.39	-0.40	-0.08	0.32	0.48	0.61	0.59

‡Monetary aggregates, real credit, and CPI are from 1970 to 2002. Core CPI is from 1985 to 2002

Figure 2.1 Cyclical real equity price and cycles of key real sector and financial variables
(Description of variables in Appendix B)





(4T) Relationship with Private Credit

4T.1 Real private credit is procyclical with real equity price, with real equity price leading it by 1-2 years.

4T.2 Real private credit and output are highly correlated, with the former lagging the latter slightly by about 0-1 year.

(5T) … and Monetary Aggregates *Both the monetary base (M0) and M1 (currency and demand deposits) are procyclical with real equity price; but neither leads equity price. M1 and M2 lag real equity price by roughly 1 and 4 years, respectively. The components of M2 not in M1 (time and saving deposits) lag real equity price by 4 years.*

(6T) Relationship across Asset Classes

- *Peak in equity prices tend to lead those in commercial and real estate prices by 1-2 years. Condomenium and commnercial (office and retail) price tend to move together.*

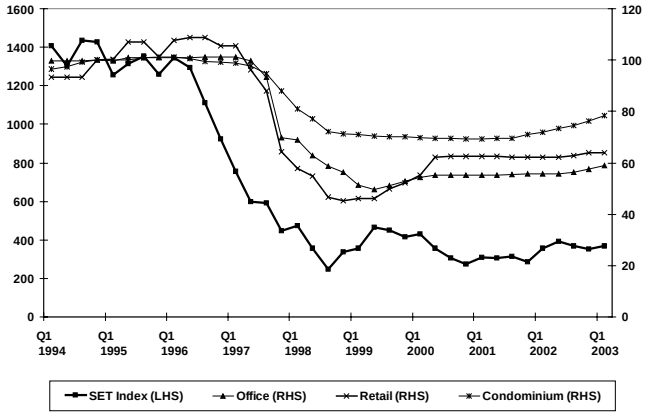
(9T) Equity Price and Inflation *Both CPI and core CPI are counter-cyclical to real equity price. Both lag real equity price by roughly 3-4 years. The amplitude of the equity price cycles appear to be roughly 10 times larger than cyclical CPI and 20 times larger than that of core CPI.*

Remarks

It is worth emphasizing that assets differ considerably across classes; for example, equity and property are dissimilar in many aspects. The following characteristics of the two asset classes should be taken into account when we consider its valuation.

Figure 2.2 SET and property price indices

Source: Jones Lang Lasalle and SET



(1) *Liquidity.* While equities are liquid and related to a tradable sector, properties are less liquid and related mostly to a non-tradable sector. Short sale constraints are more binding in property than in equity market. (2) *Financial structure*. Although both form a large part of household wealth, the proportions of equity and property in total wealth vary across economies. These proportions may depend on the financial structure in an economy, whether it is more capital-market based or bank based. Households in a bank-based economy tend to hold more wealth in property than equity. (3) *Transparency.* The two also have different degrees of transparency, as property market's information and market structure tend to be more limited and inadequate compared to those of the equity market. (4) *Credit dependency*. Different financing methods to acquire equity and property are observed, as most households and businesses depend on borrowings to purchase property while using their savings to buy equity. (5) *Tax and subsidies.* The tax regimes pertaining to both asset classes are found to be different in every country and also different across countries.

Section 3. Identification of asset price bubble

A number of approaches can be used to estimate the fundamental value of assets. In this section we focus on corporate equities and property, specifically housing. Measuring a bubble directly is difficult and controversial, particularly *ex ante*. Esoteric asset pricing models abound that can be used to find fundamental asset value. In this section, we rely on simple models that are easy to use to illustrate a point and complement them with an indirect method that focuses on identifying a bubble through its symptoms. Without complete property price data or corporate income and capital stock data available, matching more sophisticated asset pricing models to real data simply cannot be done. We apply insights from some of the dynamic general equilibrium asset pricing models in our assessment of the long-term trend of fundamental asset price relative to GDP. We find that identification of a bubble requires a comprehensive approach both direct and indirect, theory that can help distinguish a bubble from a normal boom or bust, and most important, better asset price and income and capital stock data.

First, we examine traditional indicators commonly used for direct identification of equity and house price bubble, namely the price-to-earning ratio and the Gordon's formula. We test them to identify past episodes of suspected asset price bubble in Thailand. Next, we discuss an indirect approach that focuses on the symptoms of bubble or "financial imbalances", rather than directly identifying a bubble *per se*. Consistent with the international stylized facts recorded in the previous section, this approach relies on key financial variables such as asset price, credit-to-GDP ratio, and the real exchange rate. We also test the indirect approach on past episodes of suspected equity price bubble in Thailand and find it useful as an early warning method. Specifically, we find that through the use of only *ex ante* data, this method warns of a financial crisis two years before it happens; it turns out that crisis is the now-known 1997 crisis.

Early warning indicators cannot be substituted for analysis, so we explore implications of changes in fundamental determinants on asset-price trend and cycles, using a state-of-the-art model developed by McGrattan and Prescott (2000, 2002). We stress the need for a combination of direct and indirect approaches and better understanding on how fundamentals affect asset price valuation. With better corporate income and capital stock data in the future, we could conceivably calibrate these models to the Thai economy and solve for fundamental asset valuation, hence a possible bubble. Then as now, we must rely on several approaches to determine existence of financial imbalances and the length of asset price cycles in advance.

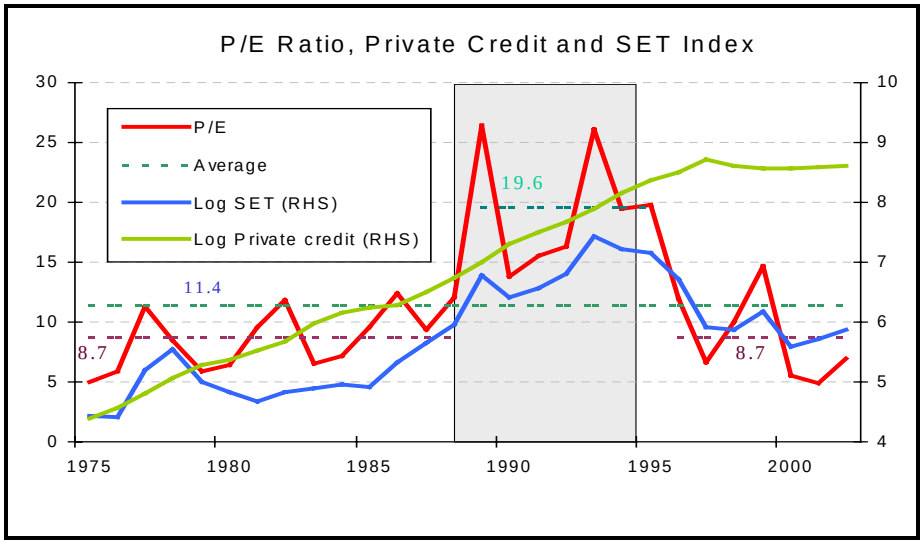
3.1 Direct identification of asset price bubble

3.1.1 Equity price

In general, asset price bubble is difficult to identify in real time or even after the fact. Several methods have been suggested to help ascertain if there is a bubble; prominent among the simpler ones are the P/E ratio and the Gordon's formula.

Various price-to-return ratios, such as price-to-earnings ratio, seem to have more potential as an indicator of a bubble than simple rates of price appreciation. A simple and widely used yardstick is the historical evolution of price-earnings (P/E) ratio. This ratio simply indicates how fair a firm's equity price is when compared with its earnings.

Figure 3.1 PE ratio and SET index (1975-2002)



As displayed in Figure 3.1, the average P/E ratio of corporations traded on the Stock Exchange of Thailand (SET) is 11.4 during 1975-2002. Between 1988 and 1995, the P/E averages 19.6, peaking above 25 in 1989 and 1993 or about four times higher than the average P/E in the preceding period (1975-1988). In particular, the high PE ratios during 1993-1995 are associated with rapid credit growth as a result of financial liberalization. Using this historical benchmark, it can be suggested that cases of equity price bubble is witnessed in 1989 and 1993.

The Gordon's formula, which derives from the notion that equity price is equal to the net present value of the expected future stream of dividend, is also widely used as a tool for asset price bubble identification (see Appendix D). Assuming that earnings growth, risk-free interest rate and the risk premium are constant, the price of an asset in each period can be expressed as the ratio of the dividend times its (gross) growth rate over the sum of nominal (risk-free) interest rate and the risk premium for holding securities *less* the nominal growth rate of dividends or earnings.

The formula is given here:

$$P_t = \frac{D_t(1+g)}{i+\rho-g},$$

where P, D, g, i and ρ are the price of the asset, the dividends, the (net) growth rate of dividends, the risk-free interest rate, and the equity risk premium, respectively.[26]

This formula indicates that equity prices should rise (fall) as the interest rate and investors' risk premium fall (rises), and the growth of earnings increases (decreases). An

[26] The Gordon's formula can be written in the form of P/E if we assume that dividends are paid as a constant fraction of earnings.

equity price misalignment is then identified through the comparison of computed risk premium from the above formula in each period against a historical benchmark. If there is no reason to believe that the risk premium should be any different today from what it used to be, on average, and they turn out to differ, then it is argued that an asset price bubble may be at play. Equity price is overvalued (undervalued) when the imputed risk premium in that period is below (above) its historical benchmark. This is because, *other things being equal*, equity price is higher with lower risk premium.

Table 3.1 Estimates of potential stock market misalignment for 1989 and 1993
(Percent, except for price-earnings ratio)

Historical	Price-Earnings Ratio	Dividend Yield	Potential GDP Growth	Real Interest Rate	Inflation Rate	Implicit Equity Premium
1980-1988	9.4	5.0	6.6	4.2	4.9	8.0 (1)
1980-1992	12.1	4.0	7.5	4.7	4.9	7.4 (2)
Current	**Price-Earnings Ratio**	**Dividend Yield**	**Potential GDP Growth[1]**	**Real Interest Rate[1]**	**Inflation Rate**	**Implicit Equity Premium**
As of 1989	26.4	2.1	8.0	3.6	5.9	6.8 (3)
As of 1993	26.1	2.0	8.0	3.6	4.4	6.7 (4)
Potential Overvaluation	**Implied Equity Premium Reduction[2]**					
As of 1989	1.2 (1) - (3)					
As of 1993	0.7 (2) - (4)					

[1] Assume Potential GDP Growth = 8% real interest rate = 3.6 %
[2] Historical implicit equity premium less current implicit equity premium
Sources: BOT staff estimates

To confirm the identified equity price overvaluation using the P/E ratio in 1989 and 1993, a test based on the Gordon's formula is performed. To assess the present situation using the latest available annual data, we also test for a bubble in 2002. The risk premium benchmarks used are the averages of historical implied risk premium during 1980-2002. In computing each period's implied risk premium, GDP growth and current interest rate are used as proxies for future earnings growth and future interest rates, respectively. As reported in Table 3.1, we find that equity price is somewhat overvalued in 1989 and 1993, assuming that potential real GDP growth and real interest rate are 8 and 3.6 percent, respectively, as the corresponding average historical implied risk premium is higher than the current implied risk premium. As for 2002, it is clear from these measurements that equity price is undervalued compared with historical averages using the average risk premium during 1980-2002. Therefore, this method gives a similar assessment as the P/E ratio does for 1989, 1993 and 2002.

Even though they are conceptually straightforward and easy to use, the above methods have limitations. A major drawback of this, or any other dividend-cash flow type, model of equity valuation is that it relies on the expectations of future earnings and interest rate. The future path of these variables can be influenced by overly optimistic or unduly pessimistic investor expectations. Therefore, these variables can fluctuate sharply in the short and medium terms. More important, one has to be ready to judge or assume the appropriate value of the equity risk premium required by investors, which can be difficult to determine particularly if productivity and market structure changes over time. In this

regard, relatively small changes in the equity premium, resulting from varying the benchmark periods used, can have major effects on fundamental valuation.

Table 3.2 Estimates of potential stock market misalignment for 2002
(Percent, except for price-earnings ratio)

Historical	Price-Earnings Ratio	Dividend Yield	Potential GDP Growth	Real Interest Rate	Inflation Rate	Implicit Equity Premium
1980-2002	12.3	3.1	5.7	3.9	4.4	5.3 (1)
1985-2002	13.4	3.1	5.8	4.0	3.8	5.3 (2)
Current	**Price-Earnings Ratio**	**Dividend Yield**	**Potential GDP Growth**	**Real Interest Rate**	**Inflation Rate**	**Implicit Equity Premium**
2002	7.0	2.7	5.0	0.2	1.6	7.7 (3)
Potential Overvaluation	Implied Equity Premium Increase[1]					
1980-2002	-2.4 (1) - (3)					
1985-2002	-2.4 (2) - (3)					

[1] Historical implicit equity premium less current implicit equity premium
Sources: Authors' estimates

In the long run, real profit and earnings cannot grow systematically faster than real output, unless the share of corporate profit in GDP increases.[27] Earning growth and real interest rate are potentially determined by productivity growth and factors such as, the subjective rate of time preference and the degree of risk aversion. The idea is that if the equity risk premium is mean-reverting in the long run, then so should the P/E ratio. However, if *average* risk premium falls for some exogenous reasons, then a price rise can be justified through rising fundamental valuation.

3.1.2 Property (house) price

In practice, there are two indicators that are commonly used to gauge whether houses are properly priced, the P/E ratio and the house-price-to-income ratio.

Similar to equity, house price should equal its discounted value of future income stream from owning a house. As a result, it should reflect future benefit of ownership, either from rental income earned or implicit rent saved by an owner-occupier. The P/E ratio seems to be the best available indicator to judge whether houses are overvalued against historical benchmark. At present, reliable long-run time series of both rental and house price in Thailand are unavailable. We rely on selected prices and rents, as described below.

An alternative measure is found in the house price to income ratio. The ratio of average house price to average income tracks long-term house affordability. However, this ratio is sensitive to the exact measure of income used.

[27] Cross-country data indicate that the share of corporate profit in GDP tend to be stable over time, however.

Figure 3.2 Ratio of condominium price to rent and to average income
Source: data from Jones Lang Lasalle and NESDB
(Dec 1994 = 100)

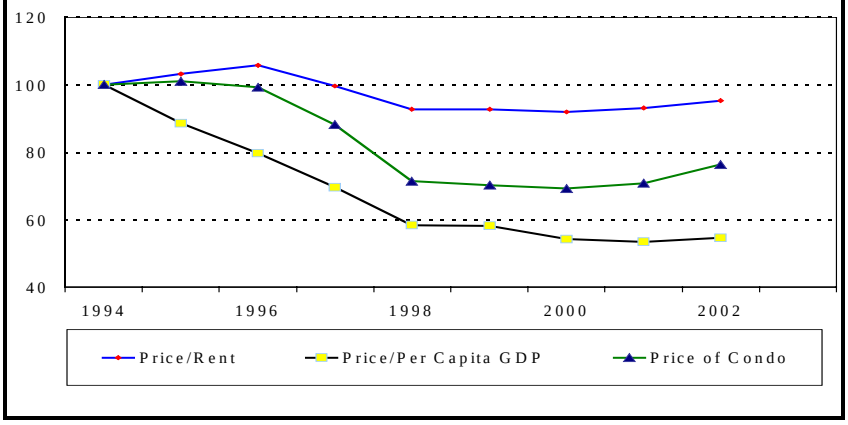


Figure 3.2 displays the price index, price-to-rent and price-to-average-income ratios of representative luxury condominiums in the central business district of Bangkok from 1994. The available condominium price and rent data reveal that the price-to-rent ratio increases during 1994-1996, declines in 1997-1998 before becoming more or less constant afterwards. While price-to-rent increases, the price-to-per-capita-GDP ratio is constant. Price-to-income declines sharply up until 1998 and slightly afterward.

The time series above are too short and not representative of the housing market to be used to forming a judgment based on historical benchmark; particularly that 1994 could be the house price bubble's peak. It would be interesting to see if the divergence between the two measures before the 1997 crisis forms a pattern. If so, that would indicate that factors other than average income helped push condominium price upward, for example credit availability. The two methods above are clearly limited in this case and our effort needs to be complemented through other methods.[28]

3.2 Indirect identification

Asset price booms tend to be associated with the rapid growth of credit. This suggests that in our attempt to identify a bubble indirectly, we should focus on factors that tend to be identified with asset price booms and busts. Consistent with the stylized facts presented earlier, Issing (2003), for instance, argues that paying particular attention to the money supply and credit can help identify and prevent the emergence of serious financial imbalances.[29]

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[28] Other accepted indicators for asset price bubble that should be monitored closely are excessive trading volume and price volatility, based on historical standards. We do not go into detail on these indicators here, but wish to make a note that they are accepted as major characteristics of a bubble.

[29] Indeed, this is one of the main reasons that the European Central Bank places special emphasis on money growth, within its inflation-fighting framework.

Financial crises tend to arise primarily from deteriorating economic fundamentals or the discovery of it, notably declines in asset fundamentals. While the timing of the crisis may be unpredictable, it should be possible to detect the symptoms of the buildup of financial imbalances. This argument finds support in stylized fact (1) above; vulnerabilities tend to build up over time, reflecting the mutually reinforcing interactions between the financial sector and the real economy. Consistent with this pattern in the data, Borio and Lowe (2002, 2003) construct simple composite indicators[30] of banking crises based on individual and joint calibration of signals of three macroeconomic variables: credit-to-GDP ratio, the real effective exchange rate and real equity price.[31] To capture the cumulative processes of the imbalances, each variable is represented by its "gaps" as measured by a percentage deviation from an *ex ante* recursively calculated Hodrick-Prescott trend. The "gap" is indeed equivalent to the concept of "cycle" we put forth in Section 2 and throughout the paper. The only methodological difference in this subsection is in the use of purely *ex ante* information.

Borio and Lowe (2002, 2003) adopt a signal approach, which assesses variables that change significantly in the periods leading up to a crisis to examine if they can be used successfully as early warning indicators. A good indicator should have two properties: First, it should predict a high fraction of past crises. Second, it should not signal crises that do not materialize. If an indicator has both properties, they are considered to have a low "noise-to-signal" ratio. For each indicator, a gridline search is applied to find a threshold for which the noise-to-signal ratio is lowest. However, rather than using the thresholds with minimum noise-to-signal ratios, these thresholds are subjectively adjusted to allow for better capability to detect crisis signals. This step reflects the view that the cost of failing to predict a crisis is larger than that of predicting one that does not materialize.

Table 3.3 Composite indicators for emerging market economies

Horizon Years	Credit (4) and asset price (40)		Credit (4) and exchange rate (5)		Credit (4) and asset (stock) price (40) or exchange rate (13)	
	Noise/signal	% crises predicted	Noise/signal	% crises predicted	Noise/signal	% crises predicted
1	0.23	38	0.15	58	0.16	67
2	0.12	54	0.11	58	0.12	71
3	0.08	58	0.10	58	0.09	75

Source: Borio and Lowe (2002b). Numbers in parentheses are threshold in percentage terms.

Three composite indices using (a) credit and asset price, (b) credit and the exchange rate, and (c) credit, asset price or the exchange rate are found to be quite successful in assessing the risk of future financial distress based on past observations with a reasonable degree of confidence, as shown by their comparatively low noise-to-signal ratios and the relatively high percentages of the correctly predicted crisis.[32] For example, the composite

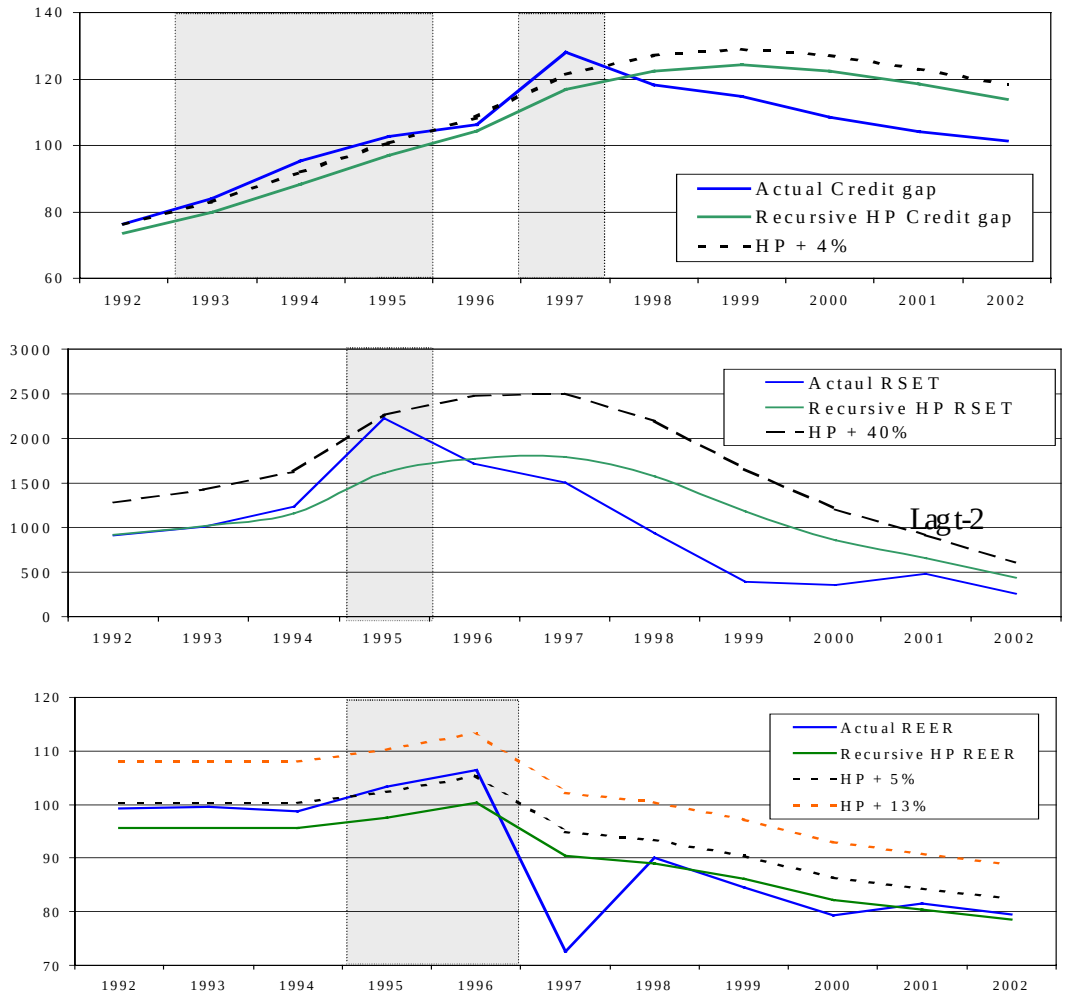
[31] Their sample includes 34 countries (21 industrial and 13 emerging market economies).

[32] It should be noted that within the group of two-variable composite indicators, the combination of credit and the exchange rate gives better results than others.

index of credit-to-GDP and asset price (with the credit-to-GDP "gap" threshold of 4 percent and equity price "gap" thresholds of 40 percent, respectively) correctly predicts 58 out of 100 crises within 3 years and the ratio of incorrect signals (no crisis occurs) over the ratio of correct signals (crisis follows within 3 years) is 0.08.

In applying the above method of indirect identification for the case of Thailand, we first show that the calibrated thresholds are appropriate for crisis signaling in case of the crisis in 1997. Then, using these thresholds, we assess a possible future crisis from today's information.

Figure 3.3 Credit gap, SET index, REER and early warning signals



Source: Authors' calculation

1) All composite indicators signal in 1995 and correctly predict the crisis in 1997 two years in advance. Among the individual indicators, the credit-to-GDP "gap" gives repeated warning signals between 1993 and 1995 and again in 1997; the real exchange rate "gap" shows signals of overvaluation in 1995 and 1996 whereas real SET "gap" gives a warning signal in 1995. The three composite indices all signal potential danger in 1995.

2) At the present time, none of the individual and composite indicators displays a warning signal for future financial crisis. Credit-to-GDP and equity price are still significantly below trends whereas the exchange rate is roughly at par with its trend. Consistent with the patterns of the individual indicators, none of the composite indices flashes a warning either.

A question may be posed whether the thresholds from a study in which the samples include countries with various economic structures are appropriate for Thailand. While this observation may be valid, we find that thresholds must come from a study with large enough samples of crises, which is a low-frequency event. A threshold value based on any single country's experience will not provide enough crisis observations for calibration. In practice, policymakers may want to adjust the thresholds according to their countries' specifics. Nevertheless, the adjustment should be conservatively biased toward giving a warning early on.

The main advantage of this approach is that it is easy to apply and does not require any knowledge about fundamental values or expectations of future variables that are currently unobservable in order to identify possible episodes of bubble. It must be kept in mind that its usefulness is limited to what it is designed to do. No crises exactly share the same characteristics. Although the prediction using the thresholds from the international data sends correct warning signals of the 1997 crisis in Thailand, it does not guarantee that trend-based predictions using these thresholds will be successful for warning against future crises. For example, the thresholds used may be insensitive to regime change, which is a common problem facing any early-warning tool that is designed for low-frequency shocks. Under a flexible exchange rate regime currently adopted, a trend-based early earning indicator such as above can be biased because of changes in the real exchange rate and warn of a crisis based on its movements when in fact these movements provide an automatic stabilizer intended to prevent such a crisis in the first place.

The indirect method outlined should be used with the Gordon's formula and P/E ratio to gauge asset price overvaluation ahead of time. In any case, the early warning will be useful if applied with sound judgment; that is, when the alarm sounds, a deep analysis must take place to gauge whether there is indeed an imbalance. A good early warning tool cannot serve as a substitute for analysis of particular events based on sound theory and good data. A crash may or may not come after the alarm, but the indirect method is silent on the reasons of the crash, e.g. a cause of a crash could come from factors exogenous to the three variables used.

3.3 Analysis of fundamentals

A number of approaches can be used to estimate the fundamental value of corporate equities. The usual, standard approach is to estimate the present value of dividends net of taxes. One of the methods outlined in the previous subsection, the Gordon's formula, falls into this category. A major drawback of this standard approach is that it depends crucially on expectations regarding the present value of dividends that is neither directly observable nor retrievable.

We may look at past data, take averages, and state that things should remain as they were. We can claim that stock prices are too high because price-earnings ratios are above their

historical averages. We also know that that may not be enough. What we want to do eventually is ask what level of the stock market is justified by the value of tangible and intangible assets owned by corporations. We know that theory is rich enough today that with available corporate income and capital stock data available (as they are in industrialized countries), we could build and calibrate a model and use it to measure the fundamental value of productive assets owned by corporations directly.[33]

Much work in the asset pricing literature either abstracts away from production or disregard the matching of model's variables with national income and capital stock data. The following discussion is based on insights gained from the perspective of asset pricing in dynamic general equilibrium.

Theory stresses that movements in corporate equity price in the long run depend on the changes in four key fundamentals (the first three as a ratio of GDP) as follows: the corporate capital stock, after-tax corporate earnings (profits), corporate net debt, and the tax and regulation system.

The approach discussed here relies on an implication of competitive theory, the *q* theory of stock market value, to estimate the fundamental value of corporate equity. This implication states that the value of a corporation (or a set of real assets) is equal to the value of its capital adjusted for tax consequences. Theoretically, the market value of equity plus the market value of debt liabilities should equal the market value of debt assets plus the value of productive assets. Therefore, standard economic theory implies that the value of corporate equity should equal the value of productive assets in the corporate sector, provided that net indebtedness is small. If net indebtedness is not small, then corporate debt holdings and liabilities have to be modeled as well, and market value of equity should equal market value of productive assets *less* net debt, where net debt is debt liabilities less debt assets.

Productive assets in this case include not only *tangible* assets – such as plants and equipment, office buildings, inventories and land – but also *intangible* assets – for example, patents, brand names and firm-specific human capital, including managerial skill –or the so-called good will.[34] A good measure of the value of these assets should also include those used by domestic corporations outside of the country through their foreign subsidiaries.

Provided that we have sufficient data, we can compare this measure to the value of corporate equity. If they are equal, then, according to standard economic theory, the market for equity is correctly valued.[35]

Here, we give the formula for the fundamental value of corporate equities, V:

$$V = (1-\tau_d)\left[(1-\tau_s)K_T' + (1-\tau_c)K_I' + K_F'\right],$$

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[33] See McGrattan and Prescott (200, 2001, and 2002).

[34] Intangible capital stock can be estimated from another condition of competitive theory, that the real rate of return of tangible and intangibles must be equal in equilibrium. See McGrattan and Prescott (2000) for an excellent discussion on this measurement.

[35] In the near future, we plan to extend the model of McGrattan and Prescott (2002) to include housing and deduce from it the formula for the fundamental value of a "house".

where τ_d is the tax rate on corporate distributions, τ_s is the subsidies for corporate capital investment, τ_c is the tax rate on corporate income, $K_T^{'}$ is the end-of-period tangible corporate capital stock, $K_I^{'}$ is the end-of-period intangible corporate capital stock, and $K_F^{'}$ is the end-of-period capital stock of domestic firms' foreign subsidiaries after income taxes and subsidies.

3.3.1 Rationale behind the tax factors and their interpretation

The rationale behind the tax factors is described as follows: Corporate earnings are higher than corporate investment and therefore aggregate corporate distributions are positive. Corporate distributions may take two forms, that is as dividends or share repurchases (or equivalently, liquidation of operations). Historically, corporate distributions have been in the form of dividends. The price of a unit of tangible capital for shareholders is $(1-\tau_d)(1-\tau_s)$ for the following reasons: While a dollar reinvested is not taxed, a dollar distributed is, and therefore the distribution tax affects this price. A subsidy to tangible investment affects this price because it makes investing in tangible assets cheaper. Subsidies may come in different forms, but the two important ones are investment tax credits for the purchase of new capital goods and allowed rate of depreciation (in book-value terms) in excess of economic depreciation. As a result, the cost of a unit of tangible capital in terms of forgone consumption is on margin $(1-\tau_d)(1-\tau_s)$; in equilibrium, the capital market will clear so that the price and cost of one unit of tangible capital are equal.

Similarly, the price of a unit of intangible capital is $(1-\tau_d)(1-\tau_c)$. The price (and cost in terms of forgone consumption of a unit of intangible capital) depends on the tax on distribution for the same reason as above. It also depends on the corporate income tax because *investments* in (unmeasured) intangible capital, for example R&D, are expensed and reduce corporate taxable income.[36]

In this model as in reality, capital gains are taxed upon realization[37], and therefore the relevant tax rate for corporate distributions in the equation above is the personal income tax rate, τ_{pers}, in case corporations make distributions to households by paying dividends; and it is the realized capital gains tax rate, τ_{cg}, if the corporations make distributions by share repurchases or liquidating operations. If a combination of the two is used, then the effective rate will be between the two rates.

If equity is held in tax-deferred retirement accounts or pension funds, then the appropriate tax on distributions is zero even if contributions are taxed when they are

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[36] As corporate tax rate increases, the price of a unit of intangibles falls. This is consistent with the fact that as corporate tax rate increases, there is more incentive to invest in intangibles and expense it, reducing taxable income.

[37] The accrual-equivalent alternative (see Auerbach (2001), for example) should be thought of as being considerably less than the actual capital gains tax rate, because it takes into account the fact that not all gains are realized in every year, and that gains realized in the future benefit from a deferral advantage. So one can expect a significant difference in valuation between the two approaches.

withdrawn. This is because the withdrawals from retirement accounts and pension funds are deferred payments of labor income, and so the tax liability is a deferred tax payment on this labor income, *not* on corporate distributions. As a result, the marginal tax rate on corporate distributions to retirement accounts is zero even though taxes are paid on withdrawals. The tax should not affect corporate valuation, and does not affect *V* relative to GDP. Note also that taxes on consumption, labor, property and interest do not affect the corporate equity value.

3.3.2 Application to Thai equity and housing markets: Looking forward

Empirical work that tries to explain house price movements econometrically has highlighted the shortcomings of its findings more than convincing the reader of its usefulness, given the complex dynamics and the importance of expectations, specifically during the periods of booms and busts. House prices are highly autocorrelated. Much of the explanatory power of econometric models of house prices derives from lagged values of the dependent variable (house prices) itself and are consequently uninformative about the underlying mechanisms driving house price dynamics.

ECB (2003) provides an interesting array of principal factors affecting house price dynamics. The list includes household incomes, real (and "possibly" also nominal) interest rates, household formation or other demographic variables, supply side variables, credit availability, and taxes, subsidies and other housing-related public policies.

In the long run, without friction from time-to-build and other financial costs, house price should equal to the costs of land and constructions.[38] Like other capital goods, Tobin's *q* for a house, the ratio of a house's market value to its replacement cost, should be constant and close to unity. Therefore, in the long run, demographic factors such as population growth and household formation characteristics should form crucial demand-side determinants of house price growth, as land for new housing is limited. Taxes and subsidies as well as financial and credit policy can greatly influence house price in the long run as well as in the short run.[39]

In the short to medium run, the dynamics of house price is driven by demand and supply side factors as follows: On the demand side, household income should play a significant role in determining house price together with real and nominal interest rates; rising income and decreasing interest rates are generally found to drive up housing price. The effect of interest rate change on house price is generally found to be positive, as a decline (increase) in interest rate may expand (shrink) household budget constraints, hence more affordability and higher house price.[40]

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[38] In the short to medium run, financing availability is a specific factor for several markets. Lack of available financing puts more pressure on house price.

[39] Knowledge about the transitional dynamic of tax changes is still limited.

[40] Although it is possible that a decline in interest rate can lead to lower house price due to lower borrowing cost, this effect is usually found to be smaller when market is not competitive, i.e. there is monopoly power. Interest rate effect may depend on whether mortgage rates are fixed or flexible. The effect will be larger in the case of flexible interest rate because the interest cost is passed on from banks to the borrowers. The effect can be amplified if loan refinancing is possible.

On the supply side in the long run, the cost of building new houses relative to the cost of goods and services should depend on the productivity difference between the real estate and the general goods and services sectors. The time-to-build factor for new houses is another friction that contributes to higher prices than implied by long-run fundamentals; excess supply of available houses may eliminate this friction unless taste and preferences dictate that available houses are no longer desirable.

We plan to extend the model of McGrattan and Prescott (2002) in our future research to shed light on the working of the housing market and its interaction with the equity market from a long-term (trend) general equilibrium perspective. The underlying idea is that if a house can be thought of as a firm that produces consumption goods (in this case the comfort of shelter) much like a firm does, then a share in the house has a price, much like a share in the firm is stock price. We can extend the implications of the above model to housing fundamentals. This way we can formalize econometric evidence from ECB (2003) into a model with prediction that can be used to identify key changes that may have effects on Thailand's equity and housing markets. Changes in policy can then be analyzed along with developments in taxes, productivity, real interest rate, inflation, and demography.

Here we outline the qualitative long-term prediction on price of *corporate equity* for each of the determinants, leaving house price for future research.

(1) Effective tax rate on corporate distributions

1.1 *Individual income tax rates.* Since dividends paid to households are taxed either at a flat withholding rate (10 per cent in Thailand) or as ordinary income, a large enough cut in individual income tax rates may imply a drop in marginal tax rates paid on dividends to some degree. In that case, V should rise, *ceteris paribus*, relative to GDP.

1.2 *Fraction of equity held by non-taxed entities.* With more equity in non-taxed or tax-deferred accounts, the effective tax rate on corporate distributions become lower. An entrance of a pension fund-type player may lead to a rise in fundamental equity value because of the lowered tax rate. Changes in the tax law can lead to a rise in non-taxed retirement accounts, and insofar as they do that, they contribute to reducing the effective tax on corporate distributions, driving up fundamental equity value relative to GDP.

1.3 *Capital gains and dividend taxes.* If capital gains are taxed at a lower rate than dividends, then the increasing realization of capital gains lowers the effective tax rate on distributions.[41] The tax incentive disappears if there is no difference between the tax rates on capital gains and dividends. In Thailand taxes on dividends and capital gains are zero for resident corporate investors, and the withholding tax rate on dividends is higher at 10 per cent for individual investors. Differences in the effective tax rates on dividends and capital gains exist but may be quantitatively small.

(2) Tax rate on corporate income

The income tax rate on corporations is an important tax for the value of corporate equity. In addition to how it affects the price of intangible capital as mentioned earlier,

[41] Usually prohibition against manipulation of stock prices and deception puts constraints on repurchases. If regulations on share repurchases are relaxed, then more share buybacks can be used as a way to distribute corporate earnings

corporate financial policy may change because corporate income tax rate changes. A prominent example can be given that involves a swap of debt for equity (provided that the debt market exists in a functional way, of course). If the tax rate on personal interest income falls below the tax rate for corporate profits, then we should expect to see a swap in preference of debt financing for equity financing. This would result in a fall in equity value relative to GDP.

(3) Subsidies to corporate investment

3.1 *Investment tax credits* for the purchase of new capital goods. Increases in this type of subsidies imply that capital goods should be cheaper and fundamental equity price should decline.

3.2 *Allowed depreciation in excess of economic depreciation*. We believe (3.2) is more important than (3.1). By definition, economic depreciation is the decline in the value of capital goods (itemized as consumption of fixed capital in the national income accounts). If there is a period of a shortening of the useful lives of capital goods allowed by the tax authorities, the rate at which capital could be depreciated for tax purposes will increase. When this happens, *total* depreciation can exceed the original cost of an asset; in essence, the shortening of the useful lives helps subsidize the price of capital, thereby making it cheaper. This increases the discrepancy between allowed and economic depreciation, and can explain a period when apartment complexes and office buildings change hands every few years or so in some country.

(4) Productivity

As the rate of technological progress increases, simulation results from the same model that is calibrated to fit the US economy shows a higher risk-free rate but a similar risk premium. According to this model, results from simulations show that the fundamental value of equity does not change significantly, the reason being that there are two consequences of higher productivity growth on equity value. One is that with more rapid growth, future corporate payouts are larger. If market discount factors remained fixed, then these higher payouts imply larger equity value. The second consequence is that of higher growth on the discount rate. Higher growth leads to greater discounting of future payouts, which reduces the current value of future payouts. Simulations performed on the US economy shows that the two types of effect of higher productivity growth on corporate equity value roughly offset each other. Therefore, higher trend productivity (equivalently GDP) growth does not justify a higher fundamental corporate equity trend value. The result changes for higher equity value only when the corporate after-tax profit share of income rises, an empirical evidence that is yet to materialize in long-term data.

In the short run, however, changes in productivity justify changes in fundamental corporate equity valuation. We use short-term cyclical prediction from Boldrin and Levine (2000) to study effects of productivity shocks on stock market valuation. Total factor productivity usually fluctuates tremendously in the short run. Moreover, it is almost impossible to tell whether an increase in productivity represents a short-term rise or a change in trend. In Boldrin and Levine's (2000) paper, for example, the basic technology shock is the discovery that an existing type of capital is played out. This does not reduce the existing stock, but it makes future production possibilities less attractive than they would be if the technology did not play out.

What is important is the impact that a negative productivity shock has on the market value of the existing capital stock. If market participants have a low degree of risk aversion, then simulation results show that the market value decreases.[42] This is due to a combined effect of the bad news on future interest rates and on future consumption (dividend) flows. In this model, good news has a marginal impact on the value of capital, but bad news causes it to change abruptly.

(5) Demography

Demography is essentially trivial in the McGrattan-Prescott model. As population increases in the economy—not necessarily from higher birthrate but from an entrance of investor/consumer market participants—corporate equity valuation should not increase relative to GDP. The only way that change in population growth can affect corporate equity value relative to GDP is through the subsidy in (3.2) above. Note that as population growth increases and the allowed rate of depreciation is unchanged, the discrepancy between actual economic depreciation and allowed rate of depreciation increases. This is because an increase in population growth reduces the actual depreciation rate of capital.[43]

Conclusion

Without better data for property price, corporate, noncorporate income and capital stock, for example, matching this sophisticated asset pricing model to the real Thai economy simply cannot be done. We can only apply insights from this model and simulation results for the US economy in our assessment of the long-term trend of fundamental asset price relative to GDP. We find that identification of a bubble requires a comprehensive approach both direct and indirect and theory that can help distinguish a bubble from a normal boom or bust. But, most important, better data are necessary.

In this section, traditional means, namely the price-to-earning ratio and the Gordon's formula have been tested to identify past episodes of suspected asset price bubble in Thailand. An indirect approach that focuses on the symptoms of bubble or "financial imbalances" has been presented. This approach is consistent with the international

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[42] If agents are highly risk averse, then interest rates drop sufficiently that even though the value of future consumption to which current capital is a claim goes down, the present value actually goes up. This is a common feature that applies to all consumption-based asset pricing models. What it means is that when consumption growth shocks are positively correlated, the risky asset is a good hedge against risk, so that with high risk aversion the risk premium is actually negative.

[43] To illustrate this point, let $\tau_s = \tau_x + \tau_\delta$, where τ_x is the investment tax credit and τ_δ represents the equivalence of allowed rate of depreciation in excess of economic depreciation. On a balanced growth path, $\tau_\delta = \tau_c \left[\hat{\delta}_x + \left(1 - \hat{\delta}_x\right) \left(\frac{\hat{\delta}_m \left[\left(1-\delta_m\right)\left(1+\pi\right) - 1 + \hat{\delta}_m \right]}{\left(i + \pi + \hat{\delta}_m\right)\left(\gamma + \eta + \pi + \hat{\delta}_m\right)} \right) \right]$, where $\hat{\delta}_x$ is the allowed rate of immediate expensing of corporate investment, $\hat{\delta}_m$ is the allowed rate of depreciation on tangible corporate capital, δ_m is the economic rate of depreciation on tangible corporate capital, and i, π, γ, η are the real interest rate, the rate of inflation, GDP-per-capita growth rate and the rate of population growth, respectively. The term $\tau_\delta = 0$ when the two rates of depreciation are equal. It is easy to show that when η increases, τ_δ declines, *ceteris paribus*.

stylized facts recorded in the previous section. Specifically, we have found that through the use of only *ex ante* data, this method warns of a financial crisis two years before it happens; it turns out that crisis is the now-known 1997 crisis.

Early warning indicators cannot be substituted for analysis, so we explore implications of changes in fundamental determinants on asset-price trend and cycles, using a model developed by McGrattan and Prescott (2000, 2002). We stress the need for a combination of direct and indirect approaches and better understanding on how fundamentals affect asset price valuation. In the end, we must rely on several approaches to determine existence of financial imbalances and the length of asset price cycles in advance.

Section 4. Policy response to asset price cycles

In this section, we address the issue of appropriate policy response to asset price cycles, taking into account the stylized facts in Section 2 and the current knowledge of bubble identification before it bursts as discussed in Section 3.

Our basic stance is simple: Asset price cycles will remain a part of market economy, whether we take the "fundamentalist" or "behavioralist" view of the issue (see Section 1). Not every boom is followed by a bust, and not every bust leads to a financial crisis; and therefore, a quick lesson points to the need to establish a resilient financial system that can withstand an asset price bust. We emphasize preventive measures such as good corporate governance, a strong regulation and supervisory regime, the improvement and disclosure of information useful for asset pricing to help minimize the size of the bubble and make the economy more resilient to shocks generated in the asset market.

Monetary policy's goal is to maintain long-term price stability. This is done through anchoring inflation expectations of the public. By doing so, the central bank can help ensure stable long-term interest rates, which benefit investment. This way, households and firms can work toward maximum employment and sustainable growth. To an extent, a monetary regime that promotes price stability tends to promote stability in the financial system. Inflation targeting along with the managed float exchange rate regime should help contain a bubble to a degree. Insofar as asset prices, particularly property price, tend to lead inflation according to our stylized facts and are part of the transmission channels, monetary policy that aims to contain inflation within the target range should also moderate the asset price cycles. It would be an overstatement, however, to suggest that monetary policy could preempt every shock in every contingency, and an outright mistake to assume that monetary policy should take the lead to solve the mispricing problem in the asset market.

We recommend that monetary policy focus on deviations of the inflation forecast from the declared target. To the extent that financial instability can lead to a deviation from the inflation target, monetary policy should preempt it. It has been demonstrated in Section 2 that asset prices contain timely and valuable information that should be included in the forecast by monetary policymakers. However, asset prices are too volatile to be an additional target. Private credit and monetary aggregates share cycles with asset prices and should be monitored closely, as a part of an early warning or an indirect identification of a bubble.

Consistent with our stylized facts, communication and moral suasion regarding credit should take the lead to induce a soft landing. If there is a need to act, the central bank should act early to buttress the effectiveness of moral suasion so that monetary policy does not become the cause of a sizable asset price collapse and possible deflation.

We do not recommend using interest rate or credit policy to pop the bubble *per se*. It is difficult to be confident about the existence of a bubble and the timing of the burst *ex ante*, and it is well-nigh impossible to calibrate a correct magnitude of policy interest rate movement that will be just sufficient to pop the bubble without harming the economy. Credit policy may be an effective bubble-popping tool, but it is subject to the same constraint. In all likeliness, monetary and credit policy will most likely be too aggressive than necessary. If preventive measures have been exercised, it may be less risky to wait for the bust and then relax monetary policy stance to help maintain price stability. In this sense, inflation targeting provides a focused framework that is equipped to deal with asset price bubble.

Section 4.1 below provides a brief summary of recent debates on appropriate monetary policy response. Section 4.2 discusses more specifically how monetary policy under the inflation targeting framework should respond to asset price bubble in the case of Thailand. Finally, we discuss the crucial role of prudential regulation and other preventive measures briefly in Section 4.3.

4.1 Current positions in the literature on appropriate monetary policy response

It is a commonly accepted position today that asset prices have important information content that can help forecast private consumption and investment, hence output; and in that sense, it may help forecast inflation as well. Consequently, information regarding the effective exchange rate, equity, bond and property prices should be taken into account in the conduct of monetary policy.

What is currently under debate is the appropriate monetary policy response to asset price cycles, particularly to an asset price boom. Recent experiences in the industrial economies have shown that price stability does not guarantee small asset price cycles; it is now clear that financial imbalances can build up even in an environment of stable general price levels. Consequently, a debate arises whether it is enough for monetary policy to aim for low and stable inflation and not to respond directly to asset price movements. Three different views can be described briefly:

4.1.1 Asset price boom

The first view[44], labeled here as the "no action" view, holds that the best way to deliver economic and financial stability was to keep the inflation low and stable. The use of monetary policy to curb rapidly rising asset prices is not desirable. Instead, the use of micro-level policies to contain the bubble and protect the financial system is preferred.

[44] For example, Alan Greenspan in his speeches and testimonies, and Bernanke and Gertler (1999).

It argues for letting the asset market takes its course and supporting the economy after a bubble bursts through an easing monetary policy stance, aggressively if necessary.

The second[45], labeled as the "lean-against-the-bubble" view, agrees with the "no action" view to the extent that monetary policy should take account of and respond to the implications of asset price changes on its macroeconomic objectives. However, this view holds that monetary policy should be used to temper the suspected asset price bubble. Specifically, monetary policy should not only respond to a rapid asset price boom to offset its likely effects on the output and inflation forecasts, but an additional interest rate increase of perhaps 50 basis points is also recommended to discourage a potentially excessive boom. The basic idea is to "buy a little insurance" against an excessive asset price buildup.

The third view holds that an asset price bubble should be aggressively dealt with using monetary policy. Aggressive "bubble-poppers" advocate a proactive move to eliminate a potential bubble through a vigorous hike in the interest rates. Asymmetric monetary policy response to asset price booms and busts–-lowering interest rates after a bust but not raising them during a boom, a moral hazard that makes speculative bubbles more likely–-is cited as bad policy. This view also agrees that slow and limited monetary policy response may not be sufficiently effective or timely to reduce the size of the bubble, hence the aggressiveness.

As documented in Sections 2 and 3, a bubble is difficult to identify with certainty *ex ante* and monetary policy is a tool with long and variable lags. Major interest rate swings can, with more certainty, result in exacerbating the business cycle, hence most mainstream economists dismiss the third view as impractical. The rationales behind these views are summarized in Table 4.1.

[45] Some of the recent work advocating more proactive responses to bubbles includes Bordo and Jeanne (2002), Borio and Lowe (2002), Cecchetti, Genberg, Lipsky, and Wadhwani (2000), Cecchetti, Genberg, and Wadhwani (2002), Dupor (2002), and IMF (2000). Though these papers take the same view, they differ considerably in their specific arguments and approaches. Central bankers advocating this view include Issing (2003) and King (2002).

Table 4.1 Summary of the debates on appropriate monetary policy response

	Arguments for "no action"	Arguments for intervention
Identification difficulties	Identification of bubble difficult, *ex-ante*. Credit growth not reliable indicator of bubble--may simply reflect tendency of joint increases of credit and asset price during economic booms. Unsustainable increases in asset price often associated with improper financial liberalization. Solution should focus on prudence in liberalization process.	Identification problem no excuse for inaction; central bankers always deal with uncertainty. Can identify buildup of financial imbalances and associated risks indirectly.
Credibility issues	Focus on primary objective. Possible inflation-fighting credibility loss if monetary policy focuses on many goals. Public confusion regarding objectives of monetary policy. Asset price too volatile and expectation-dependent to be a target. Uncertain policy results may lead to loss of central bank credibility.	Reputation at stake, if central bank perceived to underestimate or neglect financial instability issue. Demonstrate willingness to deal with or insure against formation of asset-price bubble.
Policy effectiveness	Risk of economic downturn from popping bubble especially because of incorrect signals. Interest rate too blunt a tool. Impossible to calibrate size of policy for desired effect during different periods over business cycle.	Causing recession better than alternative. Letting bubble grows leads to buildup of other imbalances, e.g. excessive debt or over-investment. A natural burst may mean longer economic downturn.

4.1.2 Asset price bust

Although the views differ during the boom, economists tend to agree that monetary policy should react quickly and be more accommodative after a bust; moreover, that the central bank should be willing to play the lender-of-last-resort role when needed. This is due to the disruptive nature of a bust and the risks of a potentially costly crisis that may ensue.

4.2 Appropriate monetary policy response to asset price cycles in Thailand

In this subsection, we describe a monetary policy response to asset price cycles that we believe is best for Thailand.

The inflation targeting monetary regime currently adopted is forward looking in its goal of anchoring public inflation expectations, and the flexible exchange rate that is

associated with it helps minimize imbalances that originate from the external sector.[46] To the extent that asset prices, particularly property price, tend to move with the business cycle, which in turn leads inflation by roughly 2 years according to our stylized facts, monetary policy that aims to contain inflation within the target range should also moderate the business and asset price cycles. In that sense, inflation targeting with flexible exchange rate already helps in the prevention of financial instability to a degree.

A dilemma for monetary policy arises only in the case that there is a wish to contain the asset price boom in the presence of low and stable inflation expectations (within the target range) in order to prevent the buildup of financial imbalances that may destabilize the financial system in a longer horizon.

We recommend ways to reconcile financial stability with the monetary policy goal of price stability for Thailand in the medium-term accordingly:

(1) *Take a longer perception of the inflation process.*[47] The internationally accepted 2-year forecast horizon should be viewed as an *operational* horizon, not necessarily a conceptual one. The key is to anchor long-term inflation expectations. Financial imbalances that may cause inflation expectations to fall at a more distant future can gather during an asset price boom. Concern about financial crisis and deflation both arise from a potential asset price bust, the timing of which is unknown. In this regard, having a longer perception of the inflation process is essential since an intertemporal trade-off may be desirable.

Conceptually, this is how it works: the central bank may raise interest rate modestly and decrease inflation over the traditional two-year forecast horizon, possibly making inflation drop below target. The hope is that, with the rate increase, the size of the bubble will be smaller; and if and when it bursts, its effect on inflation expectations beyond 2 years' time may be less severe.

We do not necessarily believe that a modest increase in interest rate *alone* will do much to contain the bubble, but we stress the concept to show the limit of monetary policy, which needs to be augmented, and demonstrate that a conflict between price stability and financial stability that arises when viewed under too short a policy horizon can be reconciled when the horizon is lengthened.

(2) *Set a sufficiently broad target range.*[48] If the target range is sufficiently broad, the probability that inflation will fall below target becomes smaller should a rate increase in (1) is pursued for example, which is positive for central bank credibility. A 3 to 3.5 per

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[46] When the exchange rate is allowed to adjust in line with underlying economic fundamentals, persistent exchange rate misalignment that leads to excessive current account deficit and the buildup of external debt that makes the economy more vulnerable to shocks can be avoided to a large degree. Moreover, flexible exchange rate helps reduce the amplification of real shocks, especially productivity shocks, which tend to be persistent, and thus helps dampen the business and asset price cycles.

[47] This has been suggested by King (2003), Issing (2003) and Borio and Lowe (2003).

[48] There is a literature in support of an argument that emerging market economies find it more difficult than advanced economies to keep inflation within a tight target for a variety of reasons. For example, Ho and McCauley (2003) argues that emerging market economies experienced larger exchange rate pass-through, hence exchange rate swings can be associated with missed inflation targets in emerging market economies. Thailand's exchange rate pass-through is as low as some industrialized countries, however.

cent range is sufficiently broad. It is likely that, without a history of high inflation and central bank's credibility problem, Thailand can perhaps afford to have a wider target than other inflation-prone countries without material loss to its inflation-fighting credibility. Targeting an annual average rate of inflation instead of quarterly average is also consistent with this argument.

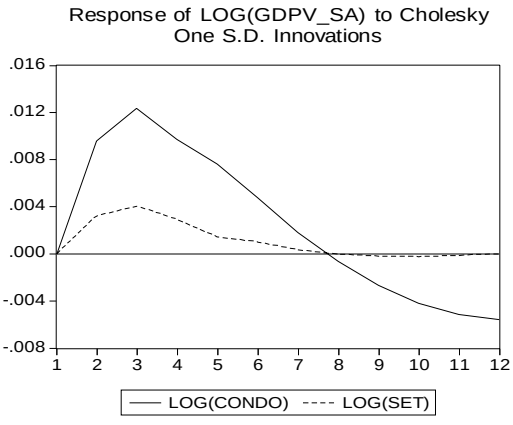
(3) *Pay particular attention to house price and credit growth*. Stylized facts in Section 2 indicate that equity price leads inflation by at least 3 years, suggesting that it may not be very useful in forecasting inflation directly. However, equity price tends to lead output and its components by one year; so, it can be used in the forecast of real output instead. House price, on the other hand, is correlated contemporaneously with real output, which leads inflation by roughly 2 years. Furthermore, house price should have a closer link with core CPI through its association with rent in the CPI basket (22.6 per cent of the core CPI basket in Thailand is house rent).

According to Sections 2 and 3, in monitoring asset price, particularly house price, monetary policymakers should pay close attention to credit growth and developments in the monetary aggregates for signs of potential financial imbalances.

Stylized facts indicate that equity price is much more volatile than property price and has a very noisy signal. Moreover, property price busts,[49] particularly house price, tend to have larger impact on output and pose more threat to financial stability, particularly since Thailand's is a heavily bank-based financial system. House price should also be more responsive to monetary policy than equity price does. We substantiate these conclusions below as we simultaneously underscore the need for house price data for Thailand.

To verify this observation for Thailand, we conduct two simple VAR analyses based on a basic model that includes real output (GDP), consumer price index (CPI), 3-month deposit interest rate (DEP3M), house price as proxied by condominium price (CONDO), and equity price (SET). The latter two are our measure of asset price.[50] The estimate is done using quarterly, seasonally adjusted data from 1994Q1 to 2002Q4 with a lag length of two periods.

Figure 4.1 Effects of asset price shocks on output



[49] Housing wealth is an important asset of the household and housing-related expenses (e.g. mortgage payments or rents) represent a major part of their expenditure (16.7 % and 22.6% in CPI and core CPI basket). Thus, changes in housing prices, rents and mortgage interest rates should have a significant impact on aggregate demand and inflation, and play a more important role in the transmission mechanism of monetary policy (than equity price movement).

[50] In addition to a constant term, the VAR also contains REER as an exogenous variable to control for the 1997 crisis. The setup of our model is similar to Disyatat and Vongsinsirikul (2002), which uses SET as a proxy for asset price, for benefit of result comparison. The effect we observe on output from an equity price shock is similar to that of Disyatat and Vongsinsirikul (2002).

The result in Figure 4.1 reveals that one standard-deviation innovations in house price (1.1%), as proxied by CONDO, is associated with 3 times larger change in real output (1.2% from baseline versus 0.4%) than one standard-deviation innovations in equity price (16%). That is, a one standard-deviation house price change may "cause" or simply forecast 3 times larger change in real output than one standard-deviation equity price change does in percentage terms.

In addition, result in Figure 4.2 and Figure 4.3 suggests that property price is more responsive to monetary policy than equity price. This is consistent with our prior knowledge--that the property market is interest-rate sensitive (the interest rate channel) and also associated closely with credit (the credit channel of monetary policy transmission).

The VAR analysis suggests that CONDO responds negatively to innovations in interest rate (DEP3M) and falls with the maximum response occurring after about 5 quarters and lasting for 12 quarters. In contrast, an increase in interest rate (DEP3M) results in an immediate but small decline in equity price that lasts for only about four quarters.

Figure 4.2 Effects of interest rate shock on CONDO prices

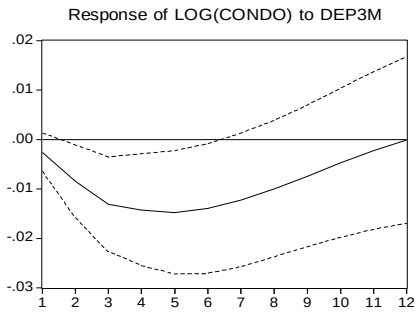
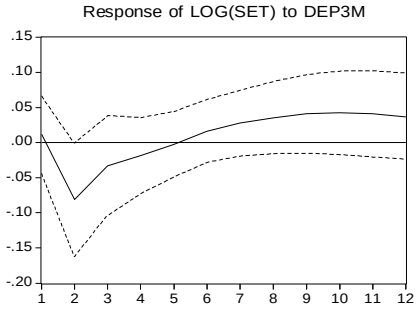


Figure 4.3 Effects of interest rate shock on equity price



4.3 Non-monetary policy response by central bank and others

Complementary to, indeed more important than, monetary policy response are the following preventive measures:

(4) *Moral suasion and communication* with the public *and prudential regulation and supervision should be priority*. Under inflation targeting, the role of monetary policy is limited as discussed in (1), but it could be used in support of effective communication. A clear communication of the central bank's view may lead market participants to be more prudent and raise doubt about private assessment of asset prices. Buying insurance should not be done only through policy interest rate; prudential regulation and strict supervision regime, particularly during a boom, are the most effective insurance against the financial crisis that may come from the burst of a bubble.

The focus here should be on ways to make the financial system, and hence the economy, more resilient to shocks. Asset price cycles will remain with market economies, whether one takes the "fundamentalist" view of asset valuation, which holds that these cycles, like the business cycle, occur as an optimal response by rational market participants to productivity shocks, or the "behavioralist" view that an irrational bubble is prolonged

partly through rational incentive to time the market. The common ground that the "fundamentalist" and the "behavioralist" views share is in building a resilient economic system that can withstand excessive asset price swings, and in this task, regulatory and supervisory policies should take the lead.

Financial intermediaries are highly leveraged firms. They should be well capitalized and their portfolio of assets diversified in anticipation of large asset price shocks, which can be indirectly identified to an extent. Major problems associated with financial intermediaries over the business cycle are two-folds: that of "disaster myopia" or the tendency over time to underestimate the probability of low-frequency shocks[51], e.g. an asset price bust, and that of perverse incentive to ignore the risks of a disaster because of safety net for depository institutions.

Practical ways have to be found to alleviate both problems insofar as asset price cycles are concerned. Financial intermediaries and regulators should take a longer view of risk assessment over the business cycle. For example, provisioning for loan loss can be done procyclically in advance—the so-called "statistical provisioning" adopted in Spain is based on knowledge of past business cycles. Loan-to-collateral value ratios should be realistic, e.g. related to real change in asset prices over past business cycles. Capital adequacy requirements should be related to the rate of private credit growth relative to trend, as above-trend credit growth is often associated with succeeding financial distress. Regulatory forbearance at the height of the business cycle usually increases vulnerabilities of the banking system to a collapse in asset prices and should be avoided.[52]

Retaining blanket guarantees for too long can encourage excessive risk-taking behavior by banks. Perverse incentive in the financial system should be addressed through the phasing out of blanket guarantee in favor of a well-designed deposit insurance system.[53]

(5) *Promote risk-transfer financial instruments for banks and capital market*. Another way to reduce real-estate risk exposure to banks is through the promotion and development of risk-transfer financial instruments, especially asset-backed securities, which allows for a transfer of risk exposure to property price changes out of banks' balance sheets. Security lending and borrowing (SBL) to reduce short-sale constraints and derivatives markets

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[51] High-frequency shocks such as credit card receivables, car loans, or routine deposit withdrawals are not significant source of banks' insolvency exposure, as they can be estimated with confidence. See Herring and Wachter (2002) for more discussion.

[52] Specific measures to address this concern are discussed at length in the process toward the New Basel Capital Accord. The Accord currently under debate provides more risk sensitive approach to calculating regulatory capital compared to the current 1988 accord. Besides market and credit risk concerns of the 1988 accord, the New Basel Capital Accord in its 3 pillars introduces methodologies to deal with operational risk, supervisory review process, and market discipline issues. However, in its search for greater risk sensitivity, the minimum capital on a given portfolio under the New Accord will change alongside its perceived risk, which can result in a much better measurement of cross-sectional or relative risk. However, it may have unintended consequences with respect to the time dimension of risk and raise serious concerns that minimum capital requirements will be smaller during a boom and larger during a bust compared to the current arrangements.

[53] Transitioning from an explicit blanket guarantee to a deposit insurance system will reduce protection for depositor and creditor and alter the risk-return profile of the entire financial system. A careful phase-out of blanket guarantee on the bank deposit will allow for an orderly disintermediation process and help to expand the presence of non-bank investors, especially wealthy households, in government securities and other assets.

should be developed to allow heterogeneity of investors' opinions to check equity bubble. Admittedly, even with these instruments in place, the "behavioralist" view contends that a bubble may still exist. With them, however, market will be more efficient and the size of the bubble can become smaller than otherwise. Moreover, a more mature capital market can help reduce vulnerabilities to the economy from the instability of the banking system.

(6) *Greater care should be taken in the process of financial liberalization.* A financial liberalization reduces entry costs and induces entry of new investors, and thus generates an asset price boom. Episodes of booms and busts in the US in the 1920s and 1980s, Chile during the 1970s and early 1980s, Japan in the 1980s, and Indonesia, Thailand, Israel in the late 1980s and early 1990s all followed financial deregulation that reduces entry costs (see Zeira (1999)). Examples of the mentioned financial deregulations involve the savings-and-loan industry, pension and provident funds, and capital flow policy, particularly with an implicit guarantee embedded in the fixed exchange rate regime.

(7) *Better corporate governance.* Transparency helps minimize information asymmetries between investors and managers. Development and enforcement of accounting and auditing standards, including the quality of disclosure and the frequency and means of information dissemination useful in asset pricing are desirable. In this regard, the establishment of a credit bureau [54] and property information pooling system are essential.

Limits to monetary policy and prudential regulation underscore the need for greater cooperation between monetary and prudential authorities in the prevention and management of financial instability.

4.3 Final remarks

Positive asset price bubble is usually confused with a boom. As remarked earlier in Section 2, based on historical measures, the stock market was not overvalued in 2002. An asset price appreciation at the current stage of the business cycle may be welcome, as it will help with the resolution of the debt-overhang problem in the economy and enhance the effectiveness of the credit channel.[55] However, there is a continual need to monitor closely for signs of financial imbalances with particular attention paid to asset price valuation, credit-to-GDP ratio, household debt and banks' exposure to property price movements.[56] An orderly disposal of non-performing loans and assets at the current stage as well as higher risk awareness of bank and corporations should help

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[54] Information provided by *credit bureaus* help to reduce lending risk, thereby lowering the likelihood of NPL occurrence and raising the confidence of commercial banks. In due course, this should facilitate the return to normal functioning of the financial sector and promote sound credit culture in the longer term.

[55] The sectors with highest percentage of NPL-to-total loans in the sector were construction, leasing and real estate, respectively. The fact that the majority of NPL in housing loan was more than 12 months overdue suggested that debt restructuring in the housing loan sector has been slow.

[56] Supervision Report 2001-02: In addition to NPL, non-performing asset (NPA) such as foreclosed assets can impact financial institutions financial position. Over the past few years, the amount of immovable properties in banks book has been increasing. Banks continue to receive these assets through debt repayment or debt restructuring process. The fact that more than 50 percent of these assets are vacant land partly explains why the rate at which these assets can be successfully sold is rather low.

restrain the rise in asset price bubble, while better corporate governance and financial literacy can help reduce incidents of asset mispricing.

Throughout the paper, we have emphasized the need for a central bank and market to have access to timely asset price data, particularly those of house and land, and information on the fundamentals that are necessary for asset valuation. Inflation targeting along with the managed float exchange rate regime should help contain a bubble to a degree. But, it cannot be left to monetary policy alone to minimize the chance of a bubble occurring or the size of it. Instead, moral suasion and cooperation between monetary and prudential authorities is encouraged in establishing incentive mechanisms that will help contain inflated speculations in asset price and sending signals to the markets about potential vulnerabilities. The key is in preventive measures early on so that the economy becomes more resilient to asset price shocks and that policy itself does not become the cause of a massive price collapse.

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Appendix A: Rationale behind the use of the Hodrick-Prescott filter as an empirical tool[57]

Economic activities in industrial and some developing markets are characterized by sustained growth in per capita terms. Lucas (1977) defines business cycle as *deviations* of real GDP from *trend*; but did not define what that trend is. The concept of trend, however, is guided by steady-state growth theory, e.g. by the fact that (a) Labor-augmenting technology implies that effective labor grows at a constant given rate, γ – even when labor hours are constant; (b) Per-capita output, consumption, investment, capital stock, and real wage all grow at same constant rate, γ.; and (c) Productive time allocated to market activity and real return on capital are constant.

If the rate of technological change, γ, were constant, then the trend of the logarithm of real GDP would be a linear function of time. But the rate of technological change (productivity growth) varies over time and across countries, and so we should not expect to see a constant trend. Therefore, if (b) and (c) can be observed in Thailand, then using HP filter for the specific purpose of obtaining cycles can be justified, particularly when γ may not be constant.

Raw data may be too complicated to yield any meaningful information to the naked eye. Since we are interested in the long-term behavior in the data, we require a useful tool in extracting the slowly varying unobserved path from the observed raw time series. This tool is found in the HP filter. The slowly varying path or "trend" can be viewed as one representation of the raw data and it may give meaningful summary information of the series' long-term behavior.

The observed time series are viewed as the sum of two major components: cyclical and trend (or growth) components. The cyclical components are viewed as deviations from the slowly varying path. Let the original time series be represented as s_t, for t = 1, 2, 3, … Technically, the HP filter is a two-sided linear filter that computes the smoothed series τ of s by minimizing the variance of s around τ, subject to a penalty that constrains the sum of the squared second difference of τ. That is the HP filter chooses, τ_t to minimize the following problem:

$$\min_{\tau_t} \sum_{t=1}^{T} (s_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} \left((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})\right)^2$$

The residual $s_t - \tau_t$ is commonly referred to as the cyclical or "business cycle" component. The Lagrange multiplier, λ, is in fact a penalty parameter that controls the smoothness of the series τ_t. Hence, the name "smoothing factor". What λ does is that it assigns a weight to balance the two opposing forces in the minimization problem above: one force is attempting to minimize the sum of squared cyclical residuals, and the other minimizing the sum of squared $\Delta^2 \tau_t$ or $\left((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})\right)^2$. The larger λ is, the smoother is τ_t. As $\lambda \to \infty$, τ_t approaches a linear trend.

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[57] This appendix is based largely on Prescott (1989) and Ahuja (2001).

The value of the smoothing factor, λ, for the HP-filter used in this paper is equal to 100, as is conventional with annual data. The value 100 comes from an adjustment to the smoothing factor commonly used for quarterly data of 1600. Hodrick and Prescott (1980) argues in favor of λ = 1600 based on a 5 percent deviation from trend per quarter and an eighth of a percent change per quarter in the trend component. They also show that this *a priori* chosen smoothing factor can be interpreted as a ratio of the variance of the business cycle component and the variance of the change in the trend component, i.e. $5^2/(1/8)^2 = 1600$, for quarterly data. In the case of annual data, the smoothing factor is conventionally adjusted to annual frequency by multiplying the standard quarterly value of 1600 with the square of the alternative (in our case, annual) frequency, that is $\left(\frac{1}{4}\right)^2 \cdot 1600 = 100$.

In selecting the proper smoothing factor, Hodrick and Prescott (1980) has the following statistical fact in mind: If the cyclical components, $(s_t - \tau_t)$, and the second differences of the trend components, $\Delta\tau^2$, are identically and independently distributed normal variables with means zero and constant variances $\sigma^2_{(1)}$ and $\sigma^2_{(2)}$, the conditional expectation of τ_t, given the observations, would be the solution to the minimization program above when $\lambda = (\sigma^2_{(1)}/\sigma^2_{(2)})$.

Equivalently, Reeves, Blyth, Triggs, and Small (2000) shows that under similar assumptions, the solution τ_t to the above program is the maximum likelihood estimator of the underlying trend. That is, τ_t maximizes the joint probability density function of $(s_t - \tau_t)$and $\Delta\tau^2$.

In short, the HP filter is guided by growth theory and has statistical foundation. Because the underlying rate of technological change (i.e. TFP growth) is not constant, the scheme used to detrend must let trend vary over time, but not too rapidly. One must keep in mind that any definition of the trend/cycle/seasonal components is necessarily statistical and that decomposition is a representation of the data. Decomposition is useful if, in light of theory, it reveals interesting patterns in the data. This is a fundamental idea of inductive science; empirical methods should depend on theory.

The selection of a trend definition is guided by these criteria:
1. The trend component for real GDP is approximately a curve drawn through the time plot of the time series; 2. The trend of given time series is a linear transformation of that time series (i.e., the first two moments of the transformed series is a function of those of actual series.); 3. Lengthening the sample period should not alter significantly the value of deviations at a given date, except possibly near the end of the original sample; and 4. The scheme should be well defined, almost judgment free, and cheaply reproducible.

We find that a trend extracted by the HP filter satisfies all of the above criteria. Moreover, HP filter can be applied to stationary or nonstationary time series. Since most of the time series we deal with are potentially nonstationary, we find that the HP filter presents us with a suitable tool for a specific purpose of obtaining a secular, slowly

moving trend and the cyclical component of the observed time series without having to deal with the sometimes off-the-mark concern about econometric (covariance) stationarity in economic analysis.

Appendix B: Cross correlations between the business cycle and other financial variables.

The following variables in Fig C.1 and Fig. 2.1 are:
GDPV = real GDP, CTOTV = real total consumption, ITOTV = real total investment, XRV = real export, MRV = real import, NETX = real net export, RSET = real SET index, M2/M1 = components of M2 not in M1 (saving and time deposits), CREDITV = real private credit, CPI = consumer price index, CORE = core consumer price index.

Table B.1 Cross correlation between real GDP and its components†

X	%StdDev	$\frac{\sigma_{Xi}}{\sigma_{GDP}}$	X(t-5)	X(t-4)	X(t-3)	X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)	X(t+3)	X(t+4)	X(t+5)
Real GDP	4.64	1.00	-0.31	-0.19	0.05	0.36	0.75	1.00	0.75	0.36	0.05	-0.19	-0.31
Consumption	4.35	0.94	-0.43	-0.30	-0.05	0.25	0.67	0.96	0.76	0.41	0.11	-0.11	-0.22
Private	4.79	1.03	-0.36	-0.21	0.03	0.33	0.72	0.97	0.74	0.36	0.04	-0.17	-0.26
Public	4.92	1.06	-0.57	-0.58	-0.47	-0.35	-0.02	0.27	0.39	0.43	0.42	0.28	0.14
Investment	16.02	3.45	-0.25	-0.16	0.03	0.31	0.71	0.96	0.70	0.27	-0.07	-0.27	-0.31
Private	20.18	4.35	-0.13	-0.04	0.15	0.41	0.75	0.90	0.55	0.06	-0.26	-0.38	-0.32
Construction	23.81	5.14	-0.12	-0.03	0.14	0.41	0.75	0.84	0.52	0.03	-0.33	-0.44	-0.32
Equipment	19.80	4.27	-0.15	-0.06	0.13	0.39	0.72	0.91	0.58	0.11	-0.19	-0.32	-0.31
Public	20.26	4.37	-0.52	-0.47	-0.33	-0.19	0.10	0.48	0.63	0.66	0.48	0.22	0.00
Export	7.84	1.69	-0.14	0.07	0.36	0.69	0.73	0.60	0.29	0.00	-0.07	-0.18	-0.31
Import	15.86	3.42	-0.17	-0.07	0.11	0.43	0.75	0.85	0.48	0.04	-0.13	-0.24	-0.28
Net Export	12.01	2.59	0.14	0.14	0.08	-0.12	-0.51	-0.73	-0.44	-0.05	0.12	0.20	0.16
Real SET	39.57	8.53	-0.05	0.23	0.48	0.71	0.80	0.50	0.10	-0.11	-0.28	-0.33	-0.30

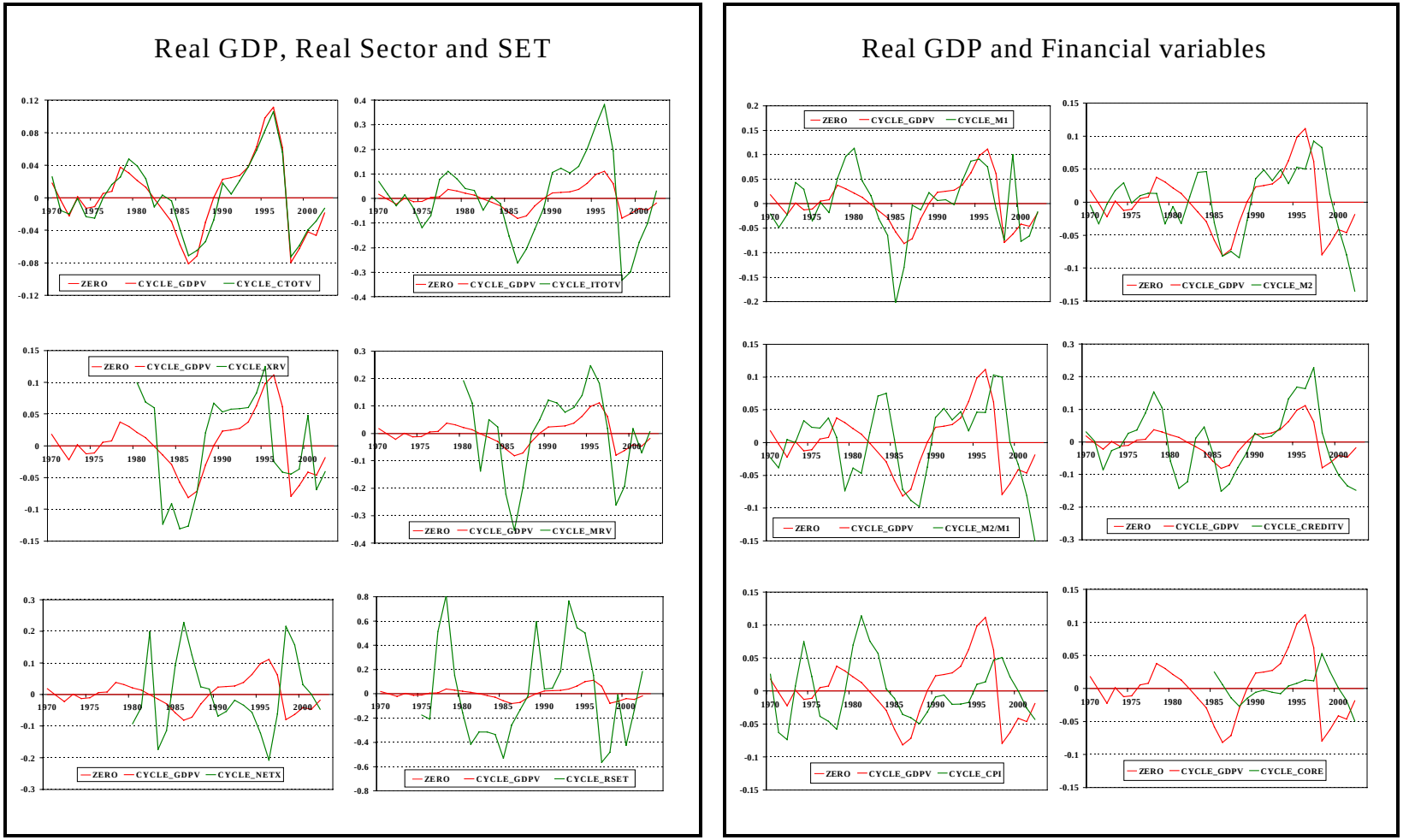
†Consumption, investment, and real GDP are from 1970 to 2002; real SET from 1975 to 2002; and, exports and imports from 1980 to 2002.

Table B.2 Cross correlation between real GDP and money and prices‡

X	%StdDev	$\frac{\sigma_{Xi}}{\sigma_{GDP}}$	X(t-5)	X(t-4)	X(t-3)	X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)	X(t+3)	X(t+4)	X(t+5)
M0	6.30	1.36	-0.35	-0.26	-0.15	0.09	0.46	0.63	0.52	0.64	0.49	0.14	-0.17
M1	6.82	1.47	-0.34	-0.16	0.11	0.41	0.67	0.63	0.34	0.31	0.17	-0.06	-0.23
M2	5.15	1.11	-0.10	-0.10	-0.12	0.00	0.19	0.48	0.71	0.70	0.52	0.20	-0.24
M2 - M1	5.93	1.28	-0.03	-0.07	-0.15	-0.10	0.06	0.33	0.61	0.63	0.48	0.22	-0.18
Real credit	10.07	2.17	-0.15	-0.17	-0.05	0.15	0.41	0.72	0.73	0.52	0.26	0.02	-0.02
CPI	4.53	0.98	-0.39	-0.43	-0.42	-0.34	-0.16	0.11	0.36	0.46	0.48	0.35	0.12
Core CPI	2.24	0.48	-0.15	-0.26	-0.36	-0.36	-0.26	-0.07	0.43	0.72	0.74	0.49	0.03

‡Monetary aggregates, real credit, and CPI are from 1970 to 2002. Core CPI is from 1985 to 2002

Figure B.1 Business cycle and cyclical real and financial variables



Appendix C: Identification of Asset Price Bubble

Theoretical and empirical literature on bubbles is extensive (for example of a good survey, see Campbell (2000)). In general, a bubble (B_t) is defined as the difference between the fundamentals-determined price (P^{PV}) and the observed price (P_t). In the case of stocks, the fundamentals price can be expressed as the sum of discounted expected future cash flows—or dividends—to the investor.

1) $P_t = P_t^{PV} + B_t$

The bubble term, B, if it exists, can be expected to grow at the real rate of interest.

Gordon's Formula is the simplest form of discounted dividend model. Algebraically, it can simply be written as,

2) $P_t = \dfrac{D_t(1+g)}{i+\rho-g}$,

where P, D, g, i and ρ stand for the price of the asset, the dividends it pays, the growth rate of dividends, the risk-free interest rate, and the equity risk premium, respectively. With dividends being generally paid as a stable percentage share d of earnings ($D = dE$), E can be shifted to the left-hand side of the equation to derive the "equilibrium" price-earnings ratio,

3) $\dfrac{P_t}{E_t} = \dfrac{d_t(1+g)}{i+\rho-g}$,

where g stands for the growth rate of earnings. The P/E ratio is a simple and commonly used benchmark indicator for stock valuations. To test whether the asset price is overvalued (undervalued), one needs to compare the imputed risk premium, ρ, with some required benchmarks and see if it is too low (high).

The Gordon formula is similar to the more sophisticated econometric analysis and tests conducted by Shiller, Cambell and others. For example, Herrera and Perry (2002) uses the test for bubbles in Latin America with the simplest structure (Campbell, Lo, and McKinlay, 1997). The general idea is to verify or reject existence of a stable (non-explosive) relationship among stock prices, dividends, and returns. The equation that establishes the basis for the tests is:

4) $d_t - P_t = -\dfrac{k}{1-\beta} + E_t \sum_{j=0}^{\infty} \beta^j (-\Delta d_{t+1+j} + r_{t+1+j})$,

where d_t = log dividends, p_t = log prices, and r_t = return, and $0 < \beta < 1$.

Given the accounting identity nature of the above equation, if prices go up, either dividends go up, or expected future cash flow go down to maintain the dividend-to-price ratio stationary. Hence, the tests are oriented toward examining the stationary (or explosive) behavior of the log dividend-price ratio and the existence of a stable relationship among dividends, prices, and returns.