出國報告（出國類別：其他）

參加 SEACEN 研訓中心
年度研究計畫「SEACEN 經濟體之貨幣政策傳遞機制」出國報告書

服務機關：中央銀行
姓名職稱：張天惠/經濟研究處副研究員
朱浩榜/經濟研究處四等專員
派赴國家：馬來西亞
出國期間：104 年 8 月 30 日至 9 月 4 日
報告日期：104 年 11 月

目　　錄

參加 SEACEN 研訓中心年度研究計畫
「SEACEN 經濟體之貨幣政策傳遞機制」出國報告書

壹、前言

東南亞國家中央銀行聯合會（South East Asian Central Banks, SEACEN）所屬研訓中心 2015 年度研究計畫為「SEACEN 經濟體之貨幣政策傳遞機制」（Monetary Policy Transmission in the SEACEN Economies），計畫目的係探討並評估 SEACEN 經濟體的貨幣政策傳遞機制及執行效果，俾助政策目標之達成。

本次研究計畫之參與成員包括來自台灣、汶萊、印尼、馬來西亞、蒙古、菲律賓、斯里蘭卡及泰國等 8 國之中央銀行研究人員，計畫主持人為中國大陸之洪浩（Hao Hong）博士。研究計畫援例在馬來西亞吉隆坡之 SEACEN 研訓中心召開兩次研討會，第 1 次研討會於 2015 年 3 月 23 日至 3 月 27 日召開，第 2 次研討會則於 8 月 30 日至 9 月 4 日召開。研討會除上述 8 國之 12 位參與成員外，尚有來自柬埔寨、印度、尼泊爾等 3 國央行之 5 位觀察人員，共計 17 位研究人員與會討論。討論內容包括各國貨幣政策傳遞管道的相關文獻、研究方法、初步實證結果及作業時程等，以利計畫執行。

報告共分為 8 個部分。除前言外，第 2 至 8 部分為本次研究計畫中，台灣部分的研究報告。內容包括研究簡介、台灣的貨幣政策架構及傳遞管道、近期的實證文獻回顧、研究方法及資料、實證模型設定及估計結果等，最後則為結論與建議。提交 SEACEN 研訓中心之英文版本詳如附件。

貳、研究簡介

貨幣政策透過許多不同的管道運作，進而影響經濟活動，故其傳遞機制是個複雜且有趣的議題，相關研究亦頗豐富。一般咸認，貨幣傳遞機制包含利率、匯率、信用、通膨預期等眾多管道，但卻仍無明確的證據顯示真正的運作方式究竟為何，以及各個管道間的相對重要性（Mishkin, 1995）。

自 1980 年代中期以來，台灣便採取貨幣目標機制作為貨幣政策架構。但過去三十幾年來，台灣的金融市場歷經許多重大變化，如金融全球化、直接金融興起、金融創新與衍生性商品發展等，而貨幣政策與經濟活動的關聯性也隨時間慢慢演變。因此，瞭解貨幣政策如何影響經濟，將有助政策分析與執行。

探討台灣貨幣政策傳遞管道的實證研究眾多。吳中書與陳建福（2010）證實台灣的廣義與狹義信用管道均存在；馮立功（2009）檢驗利率管道與信用管道，並發現貨幣政策衝擊的確會透過這兩種管道影響股票報酬。在其他研究中，Huang and Yu（2015）著重銀行放款在貨幣政策傳遞中的角色，確認信用管道的有效性；王泓仁與陳南光（2011）則無法找到統計上的證據證明財富效果管道存在。然而，上述研究多僅聚焦某幾個特定管道的存在與否，卻忽略總體經濟變數間的動態關聯，使得估計結果可能有所偏誤。目前僅吳懿娟（2004）綜合分析各個傳遞管道效果，但如前所述，貨幣政策的傳遞機制可能隨時間慢慢演變，因此，有必要整體重新估計各傳遞管道的效果。

本文將探討貨幣政策執行的有效性、貨幣政策的傳遞管道，以及各管道的效果與速度等。實證研究分成 2 個部分。首先，本文將探討貨幣政策執行的有效性，利用結構向量自我迴歸模型（structural

vector autoregressive, SVAR），限制貨幣政策工具（公開市場操作）及貨幣政策目標（操作目標為準備貨幣、中間目標為 M2）間的同期關係，估計並得知央行可藉由政策工具，透過操作目標影響中間目標，因此台灣貨幣政策的執行是有效的。

本文再利用 SVAR 模型分析貨幣政策傳遞管道。有別於多數文獻，本文並非僅著重某些特定管道，而是通盤檢驗不同傳遞管道的效果。估計結果顯示，銀行放款管道、利率管道、匯率管道及資產負債表管道均呈顯著，這些管道在台灣的貨幣政策傳遞機制扮演重要角色。

在實證分析之前，本文將簡述台灣的貨幣政策架構與文獻上常見的政策傳遞管道，並說明台灣貨幣需求的穩定性，以及貨幣需求與總體經濟變數的關係。接著，本文將回顧近期台灣貨幣政策傳遞的實證文獻，並說明用於實證分析的 SVAR 模型與相關資料。最後再探討實證分析的結果。

參、台灣的貨幣政策架構與傳遞管道

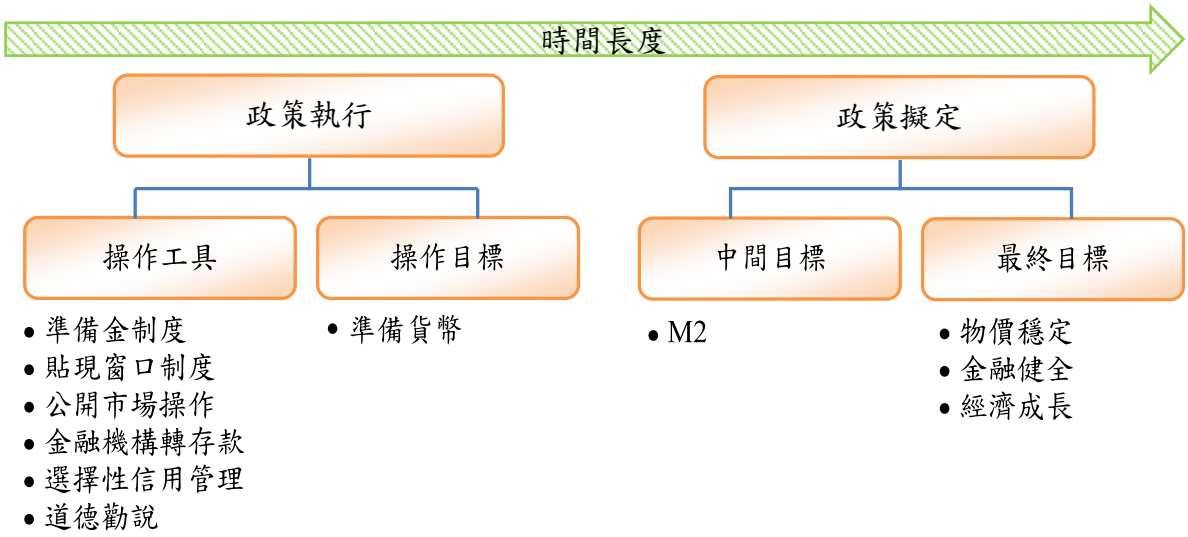
一、台灣的貨幣政策架構

台灣的貨幣政策架構係採貨幣目標機制，並自 1992 年起，每年發布 M2 成長目標區。在貨幣目標機制的基本架構下，貨幣政策的最終目標為物價穩定、金融健全與經濟成長。然而，貨幣政策的傳遞有時間落差，若央行等到政策效果顯現後再調整政策，則可能錯失達到政策目標的最佳時機與效果。因此，央行會運用貨幣政策工具影響短期操作目標，並藉由中間目標預估貨幣政策的最終效果。

在政策擬定上，央行採貨幣總計數 M2 為中間目標，並估計貨幣需求函數以擬定 M2 成長目標區。具體而言，每年年底央行會以計量方法估計貨幣需求函數，解釋變數包括實質 GDP、預期通膨率、持有貨幣的機會成本等。央行亦舉行座談會，邀集學者專家就估計結果表示意見，並經評估後提交理事會討論，擬定隔年的 M2 成長目標範圍。最後，央行定期將貨幣成長目標區的設定及相關說明刊載於中央銀行季刊，以供各界參考。

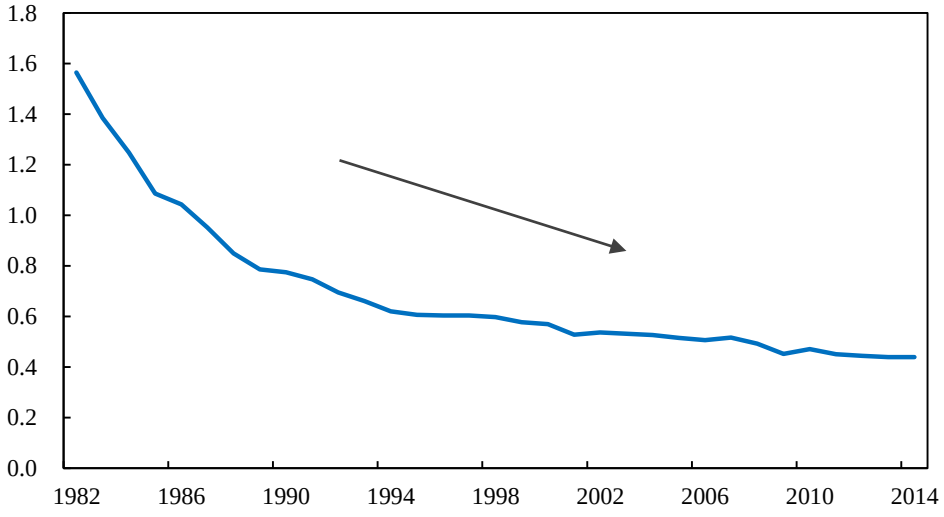
在政策執行上，由於準備貨幣可受央行政策工具直接影響，並與中間目標密切關聯，故央行採準備貨幣為操作目標，引導其日常業務操作。每月月初，央行均會設定該月的準備貨幣目標，並透過政策工具盡力達成。近年來，公開市場操作已是最重要且使用最頻繁的操作工具。其他政策工具包括準備金制度、貼現窗口制度、選擇性信用管理、金融機構轉存款或道德勸說等。另外，央行於每年年中會檢視 M2 成長率是否落在目標區內，若否，則會檢討原因並採取適當的因應措施。整體而言，台灣貨幣政策的基本架構整理如表 1。

表 1：台灣的貨幣政策架構



貨幣需求函數描繪實質餘額、實質所得及利率之間的關係，其穩定性對總體經濟模型與貨幣政策相當重要，且會影響 M2 成長目標區設定的準確性及合理性。根據貨幣數量理論的交易方程式：$MV = PY$，其中 M 為貨幣、V 為貨幣的流通速度、P 為物價水準、Y 為經濟體之實質交易量（通常以實質所得代替）、$P \times Y$ 為名目 GDP，若貨幣的流通速度不變（即 $\bar{V}$），貨幣需求將為名目 GDP 的函數，不會受利率影響。自 1980 年代以來，M2 的流通速度陡降，反映台灣的金融深化與日漸頻繁的資本流動（吳懿娟，2006；吳中書，2009）。近年來，M2 流通速度的降幅減緩，變得較為穩定。

圖 1：M2 的流通速度



貨幣需求函數與總體經濟變數的關係是另一個值得探討的議題。將交易方程式的等號兩邊同取對數後微分，則可表示為 $\hat{M}+\hat{V}=\hat{P}+\hat{Y}$。當所得流通速度穩定（V 為常數，故 $\hat{V}\approx 0$），M2 的成長率將約等於經濟成長率加上通貨膨脹率（$\hat{M}\approx\hat{P}+\hat{Y}$）。圖 2 繪示 M2 成長率與經濟活動（經濟成長率與通貨膨脹率）。自 1991 年起，M2 成長率大致與通膨率同向波動，隱含台灣的貨幣流通速度相對穩定，而如前所述，所得流通速度長期穩定為 M2 可作為貨幣政策良好指標的先決條件。此外，自央行定期發布 M2 成長目標區後，除 1997 年至 1998 年亞洲金融危機、1999 年至 2001 年網路泡沫化危機及 2007 年至 2009 年全球金融危機外，M2 成長率與經濟成長率加上通貨膨脹率的走勢一致。整體而言，台灣金融市場具充分流動性，資金足以支應經濟活動所需。

圖 2：M2 成長率與經濟活動

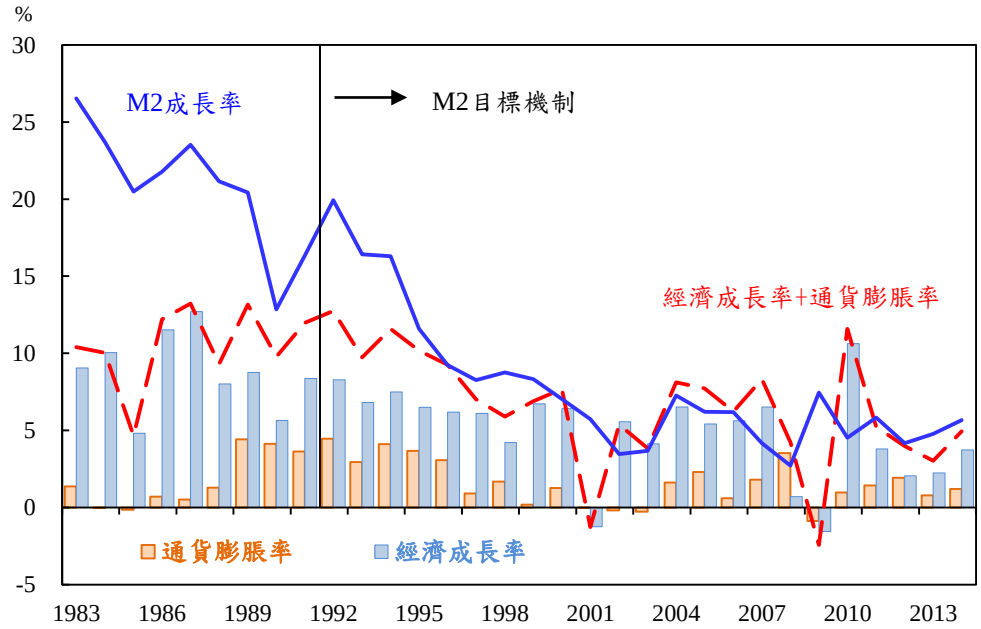
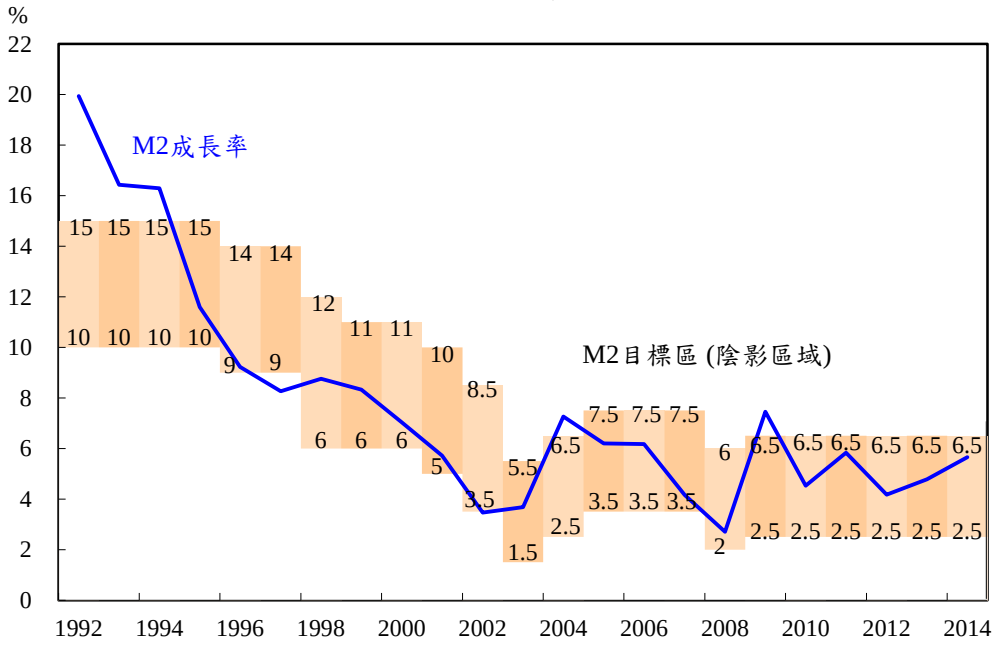


圖 3 為歷年的 M2 成長率及目標區。M2 成長目標區在 1992 年至 1995 年、1996 年至 1997 年分別為 10%至 15%、9%至 14%，1998 年因亞洲金融危機造成不確定因素增加，目標區調降並擴大為 6%至

12%，1999 年至 2000 年則為 6%至 11%。2001 年，由於國內景氣衰退，貨幣需求下降，目標區調降為 5%至 10%；2002 年、2003 年再續降為 3.5%至 8.5%、1.5%至 5.5%。2004 年，隨國內景氣復甦，目標區調升為 2.5%至 6.5%，2005 年至 2007 年則進一步調升為 3.5%至 7.5%。2008 年，由美國次貸風暴引起的金融危機導致全球性的景氣衰退，目標區隨之調整為 2%至 6%。其後，2009 年至 2014 年，目標區均維持在 2.5%至 6.5%。

圖 3：M2 成長率及目標區



前述的貨幣政策架構有助央行達成政策目標。然而，金融創新、新銀行成立，以及近年的金融全球化、資本移動等因素，均增加貨幣政策執行的複雜程度，且可能影響央行貨幣成長目標區之達成。詳如下述：

（1）新銀行成立

在 1991 年之前，台灣關於銀行的法規限制較多且嚴格，僅有 24 家本土銀行。1991 年起，政府開始著手金融市場自由化與法規鬆綁，並在 1992 年左右核准 16 家民營銀行成立。此後，銀行放款與投資急

遽成長，導致 M2 成長的不確定性上升，並使 M2 成長率在 1990 年代初超出其成長目標區。

（2）金融創新

自 2003 年起，性質類似貨幣市場基金的債券型基金快速成長，並取代部分銀行存款。債券型基金的金額在 2003 年約 2 兆 4000 億，占 M2 約 10%，規模龐大且可能影響 M2 成長。因此，央行曾在 2003 年及 2004 年設定 M2 加計債券型基金的貨幣成長目標區，分別為 3%至 7%及 4%至 8%。其後，由於「證券投資信託基金管理辦法」規範債券型基金資產組合之加權平均存續期間須在 1 年以上，債券型基金貨幣性降低，故取消加計債券型基金的貨幣成長目標區。

（3）金融全球化及資本移動

金融全球化的重要特徵之一就是國際資本移動大幅增加。若跨國間的資本移動快速且規模龐大，則可能不利匯率穩定，並引發資產價格、金融市場及貨幣成長等大幅震盪。例如，在亞洲金融危機與全球金融危機期間，國際資本移動便導致 M2 成長率高於其目標區。

二、主要的政策傳遞管道

貨幣政策的傳遞管道係指貨幣政策的變動如何影響產出及物價。有效的貨幣政策通常藉由改變貨幣與信用的成本影響經濟活動（但影響大小仍須取決於經濟結構），如金融業的隔夜拆款利率即取決於央行能控制的銀行準備金供給，以及銀行體系對準備金的需求。台灣有許多貨幣政策的傳遞管道，可將貨幣政策的變動傳達至產出及物價，並產生效果。由於貨幣政策的傳遞管道眾多[1]，以下僅說明常見的利率、信用、財富效果及匯率等傳遞管道。

[1] 可參考 Mishkin（1995）或近期的 Mishkin（2007, Chap.23）、Boivin et al.（2010），對貨幣政策傳遞管道有更全面且詳盡的討論。

（1）利率管道

利率管道是傳統總體經濟模型的主要管道。從貨幣的觀點來看，貨幣供給增加將導致利率下降，並誘發消費、投資等經濟活動，最終使得 GDP 上升。因此，當央行採行擴張性的貨幣政策，名目利率（如金融業隔拆利率等）下降，降低資金成本，使得投資的預期收益增加，並促進消費等支出增加。

（2）信用管道

信用管道包括銀行放款管道與資產負債表管道等 2 種。具體而言，擴張性的貨幣政策可從 2 個面向影響銀行信用：增加銀行可用於放款的資金（銀行放款管道），以及改善借款者的財務狀況，使得銀行的放款意願增加（資產負債表管道）。銀行放款管道是透過可用於放貸資金的多寡運作，當放款資金的供給增加，將使借款上升，投資、消費等經濟活動也將增加。資產負債表管道則是提升借款者的淨值（如擴張性的貨幣政策有助股價上漲，資產價格增加）與現金流量，使逆選擇與道德風險下降，則銀行放款意願將隨之提升，進一步增加投資支出與總合需求。

（3）財富效果管道

擴張性的貨幣政策或將提升股票或房地產等資產價格，使資產持有者的財富增加，有助提高其消費支出。

（4）匯率管道

匯率管道為貨幣政策可透過匯率影響淨出口。對小型開放經濟體而言，匯率通常被認為是重要的傳遞管道，尤其在金融全球化之後，重要性更加提高。具體而言，擴張性的貨幣政策將降低利率，國外固定收益資產的吸引力較國內固定收益資產相形提升，致本國貨幣幣值下降，使得本國商品的國際價格競爭力提高，淨出口增加。

肆、文獻回顧

探討台灣貨幣政策傳遞管道的文獻眾多，本文就近期的實證文獻擇要回顧。就常見的傳遞管道而言，貨幣政策通常透過市場利率影響其他經濟或金融變數，進而影響產出或物價等經濟活動。因此，貨幣政策變數對市場利率的影響是傳遞過程中的重要環節。高崇瑋與萬哲鈺（2014）研究台灣的利率轉嫁，發現貨幣政策的變動（以隔夜拆款利率的變動捕捉）的確會轉嫁至銀行的存放款利率，顯示台灣的央行能有效影響市場的零售利率。

其次，大部分的文獻均就各傳遞管道的效果進行探討。吳懿娟（2004）利用 1985 年至 2003 年的季資料，以向量自我迴歸（vector autoregression, VAR）模型綜合分析不同管道的效果，並發現利率管道、銀行放款管道、資產負債表管道及匯率管道均呈顯著，僅財富效果管道不顯著。

馮立功（2009）以 1989 年至 2008 年的日資料，擷取 SVAR 模型隔拆利率變動的正交殘差（orthogonal residual）作為貨幣政策意外變量，估計台灣的貨幣政策衝擊對股票報酬的影響。該文的估計結果支持利率管道存在，並以資本密集與景氣相關性較高之消費部門影響較大；此外，估計結果亦支持信用管道存在，且以受財務制約較強的公司影響較大。

關於信用管道，其一為吳中書與陳建福（2010）。該文建構季頻率的台灣總體計量模型，分析貨幣政策的信用管道。實證結果顯示，準備貨幣增加會影響銀行放款及民間投資，代表狹義信用管道存在；隔拆利率下降會影響股票市場、房地產市場、銀行放款及國內需求，代表廣義信用管道存在。此外，國際經濟情勢惡化也會造成信用緊

縮，並對民間消費與投資造成負面影響。

另一篇為張瑞娟等（2010），作者收集商業銀行自 1993 年 1 月至 2008 年 6 月的追蹤資料（panel data）估計貨幣政策對銀行放款的不對稱效果，貨幣政策的代理變數為隔拆利率。該文發現台灣的貨幣政策可透過銀行放款管道傳遞，且緊縮性貨幣政策對銀行放款的影響較寬鬆性政策為大，具不對稱性。不對稱性的效果則取決於銀行資產負債表的特性，如銀行資產規模、持有流動性資產強度等。

近來，Huang and Yu（2015）運用 VAR 模型，以 1997 年 1 月至 2011 年 5 月的資料，研究台灣的銀行放款管道。該文發現，緊縮的貨幣政策衝擊將改變銀行放款組合，使得企業放款與擔保放款增加、消費性放款與無擔保放款減少。由於係銀行部門的放款供給受影響，故得以確認銀行放款管道存在。

關於財富效果，王泓仁與陳南光（2011）使用 1992 年第 1 季至 2009 年第 3 季的總體資料，以及 1996 年至 2006 年的家戶調查資料，估計資產價格變動對民間消費支出的影響。根據該文的估計結果，股票的總體財富效果顯著但影響不大；在家戶層級上，年輕世代對股價的反應不顯著，中、老年世代卻會隨股價上升而增加消費。房地產的總體財富效果並不顯著，且在家戶層級上，房地產價格上升對年輕世代、老年世代與租屋者的消費支出有顯著的負面影響。

此外，Osorio et al.（2011）利用加權總和（weighted-sum）及主成分分析（principal components analysis）等方法，以 2001 年第 1 季至 2010 年第 2 季的資料，建構 13 個亞洲經濟體的金融情勢指數（financial condition index, FCI）。該文發現，匯率管道對台灣相對重要，如同香港、新加坡等依賴出口的小型開放經濟體。

綜上所述，本文將台灣貨幣政策傳遞機制的相關實證文獻整理如表 2。首先，政策利率的變動的確會轉嫁至銀行的存放款利率（高崇瑋與萬哲鈺，2014），因此央行可影響市場的零售利率；其次，台灣大部分的傳遞管道均顯著，包括利率管道（吳懿娟，2004；馮立功，2009）、銀行放款管道（吳懿娟，2004；吳中書與陳建福，2010；張瑞娟等，2010；Huang and Yu, 2015）、資產負債表管道（吳懿娟，2004；馮立功，2009；吳中書與陳建福，2010）與匯率管道（吳懿娟，2004；Osorio et al., 2011）等，僅財富效果管道不顯著（吳懿娟，2004；王泓仁與陳南光，2011）。由於台灣的財富效果不顯著或效果不大，因此本文的實證部分將聚焦在其他更重要且更有效的傳遞管道。

表 2：台灣貨幣政策傳遞的相關文獻

	估計方法	樣本期間	主要結論
吳懿娟（2004）	VAR	1982Q1-2003Q4	利率管道、匯率管道、信用管道均呈顯著
馮立功（2009）	OLS	1989/1/1-2008/12/31	貨幣政策衝擊會透過利率管道與信用管道影響股票報酬
吳中書與陳建福（2010）	總體計量模型	-2008Q2	狹義與廣義信用管道均存在
張瑞娟等（2010）	追蹤資料 GMM	1993M1-2004M6	貨幣政策可透過銀行放款管道傳遞，且不對稱效果取決於銀行資產負債表的特性
Osorio et al.（2011）	建構 FCI（加權總和/主成分分析）	2001Q1-2010Q2	匯率管道對台灣相對重要
王泓仁與陳南光（2011）	OLS/2SLS/VECM/隨機效果模型	1992Q1-2009Q3/1996-2006	財富效果不顯著或效果不大
高崇瑋與萬哲鈺（2014）	ARDL（門檻模型/共整合模型）	1980s-2011	隔夜拆款利率的變動的確會轉嫁至銀行的存放款利率
Huang and Yu（2015）	VAR	1997M1-2011M5	貨幣政策衝擊會影響銀行部門的放款供給

伍、研究方法及資料

一、結構向量自我迴歸模型

由於 VAR 模型可衡量產出或物價等經濟活動受到特定衝擊後的變化，故廣為用於貨幣政策傳遞的實證文獻，其濫觴為 Sims（1980）對於貨幣政策的研究。然而，Cushman and Zha（1997）認為，一般的 VAR 模型雖廣為用於相關文獻，但可能較為適合相對封閉且規模較大的經濟體，較不適合小型開放經濟體。與縮減式（reduced form）且運用遞迴式排序（recursive order）的 VAR 模型相較，SVAR 模型對模型參數的限制更具彈性，並可估計變數間的同期關係。因此，本文藉限制變數間之同期影響的認定條件（identification）建立 SVAR 模型，並估計衝擊反應函數（impulse response function）與預測誤差變異數分解（forecast error variance decomposition），以分析貨幣政策變動對總體經濟（即產出與物價）的效果。

首先，假設 k 個內生變數且落後 p 期的 SVAR 模型：

$$\mathbf{A}\boldsymbol{y}_t = \sum_{i=1}^{p} \mathbf{A}_i L^i \boldsymbol{y}_t + \boldsymbol{e}_t,$$

其中 $\boldsymbol{y}_t$為 $k \times 1$ 的向量，$\mathbf{A}$ 與 $\mathbf{A}_1$，…，$\mathbf{A}_p$為 $k \times k$ 的矩陣，L^i為落後運算元（lag operator），$\boldsymbol{e}_t$則為具白噪音（white noise）性質的殘差向量，符合

$$\mathrm{E}[\boldsymbol{e}_t \boldsymbol{e}_t'] = \mathbf{D},$$

其中 $\mathbf{D}$ 為正定（positive definite）矩陣，$\mathrm{E}[\mathrm{e}_{it}\mathrm{e}_{jt}] = 0$且 $i \neq j$。

由於 **A** 矩陣代表變數間的同期關係，因此認定條件即透過限制 **A** 矩陣規範變數間的同期影響效果。**A** 矩陣又稱作短期限制（short-run restrictions）。遞迴式排序是一種常見的短期限制條件。在遞迴式模型

中，**A** 矩陣設定為下三角矩陣，代表 y_{jt} 受 y_{it} 同期影響（$i < j$），但反之則不然；故變數的排序有其經濟意義。雖然遞迴式的 SVAR 模型可完全認定（just-identified）且較易估計，但僅以變數排序決定變數之間的關係卻使模型的應用受到限制且缺乏彈性。因此，為了避免這項缺點，Blanchard and Watson（1986）、Bernanke（1986）、Sims（1986）及 Sims and Zha（2006）等建議更一般化的 SVAR 模型，使用非遞迴的結構式規範參數間的同期影響。

接著，SVAR 另有兩個議題值得探討。首先，對於應使用變數的水準值或差分值進行估計，文獻上頗為分歧。對於 VAR 模型的變數，一般有 3 種處理方式：（1）取差分使變數轉呈定態；（2）仿照 Sims（1980）與 Christiano et al.（1996），逕以變數的水準值估計 SVAR 模型；（3）應用向量誤差修正模型（vector error correction model）進行共整合分析。以上作法皆各有支持或反對的理由，惟目前尚無明確論據認為 VAR 模型的變數須為定態或水準值，何種作法較佳仍待探討[2]。例如，Bernanke and Blinder（1992）、Sims（1992）、Levy and Halikias（1997）、Peersman and Smet（2001）使用變數的水準值估計 VAR 模型；Kim and Roubini（2000）使用變數的水準值估計 SVAR 模型；Monticelli and Tristani（1999）則採定態變數估計 SVAR 模型。

再者，Toda and Yamamoto（1995）指出單根檢定在有限樣本的情況下的檢定力不高，且共整合檢定並不十分可靠，故依此對變數取差分或進行共整合分析可能會有事前檢定誤差（pretest biases）的問題。此外，對變數取差分亦將喪失其部分訊息，因此本文將以變數的水準值估計 SVAR 模型。

[2] 可參考 Hamilton（1994）對多變量時間序列模型（VAR 或 SVAR）全面且技術性的討論。

另一個議題是落後期數的選擇。在 SVAR 模型的相關文獻中，落後期數的選擇通常較為任意（ad hoc）。例如，Cushman and Zha（1997）選擇落後 12 期的落後期數；而 Gordon and Leeper（1994）、Kim and Roubini（2000）與 Kim（2003）則選擇 6 期的落後期數。本文依據 Toda and Yamamoto（1995）的建議，採用$p + d_{max}$作為模型的落後期數；其中 p 為一般評選方法選出的最適落後期數，d_{max}則為變數可能存在的最大積數（integration）。

二、資料說明

本文分析 2000 年後主要貨幣政策管道的傳遞效果，樣本期間為 2000 年 1 月至 2014 年 12 月，共 180 筆月資料。變數及資料來源整理如表 3。實質經濟活動的變數包含產出（Y）與物價（P）。由於 GDP 的資料頻率為季度，故以工業生產指數作為產出的替代變數。物價的替代變數則為消費者物價指數，兩者的基期年皆為 2011 年。

表 3：變數說明及資料來源

	變數說明	資料來源
Y	工業生產指數	工業生產統計月報
P	消費者物價指數	物價統計月報
L	全體貨幣機構放款與投資—對民間部門債權	金融統計月報
NCD	央行可轉讓定期存單	金融統計月報
RM	準備貨幣	金融統計月報
M2	貨幣總計數 M2	金融統計月報
R	金融業隔夜拆款利率	金融統計月報
ER	新台幣兌美元匯率	金融統計月報
SP	台股加權指數	金融統計月報
OIL	國際原油價格（世界均價）	IMF

本文以「全體貨幣機構放款與投資—對民間部門債權」作為銀行放款的替代變數[3]。值得注意的是，本文選用「全體貨幣機構放款與投資」而非「全體貨幣機構放款」[4]，主因全體貨幣機構的投資涵蓋公司債等，是企業融資其投資或營運的重要管道之一；且全體貨幣機構投資的變動也會影響貨幣總計數 M2，因此全體貨幣機構投資亦與經濟活動及 M2 有關[5]。

其他變數方面，本文以金融業隔夜拆款利率（R）作為貨幣政策的代理變數。匯率變數（ER）為新台幣兌美元雙邊匯率。股票市場的表現（SP）則以台股加權指數作為代理變數。此外，台灣為小型開放經濟體，經濟活動可能受國際油價變動影響，故本文將國際油價（OIL）作為外生變數，以捕捉此效果。

另一方面，為瞭解台灣貨幣政策執行的有效性，本文亦估計政策工具及貨幣政策目標之間的關係。貨幣政策目標包括中間目標與操作目標等 2 種，前者為貨幣總計數 M2，後者為準備貨幣（RM），係逐日操作之標的。由於公開市場操作為最重要且最常用的貨幣政策工具，且央行最常使用的公開市場操作工具為央行可轉讓定期存單（NCD），故本文以 NCD 餘額作為政策工具變數。

除了利率之外，所有的變數皆取對數值，而變數的時間序列走勢則繪於圖 4。觀察圖 4，可知產出在 2008 年的金融危機期間大幅衰退。物價與國際油價走勢相近，尤其從 2007 年中至 2008 年，兩者皆明顯走升。利率在樣本期間內兩次大幅下降，分別是 2001 年中至 2003

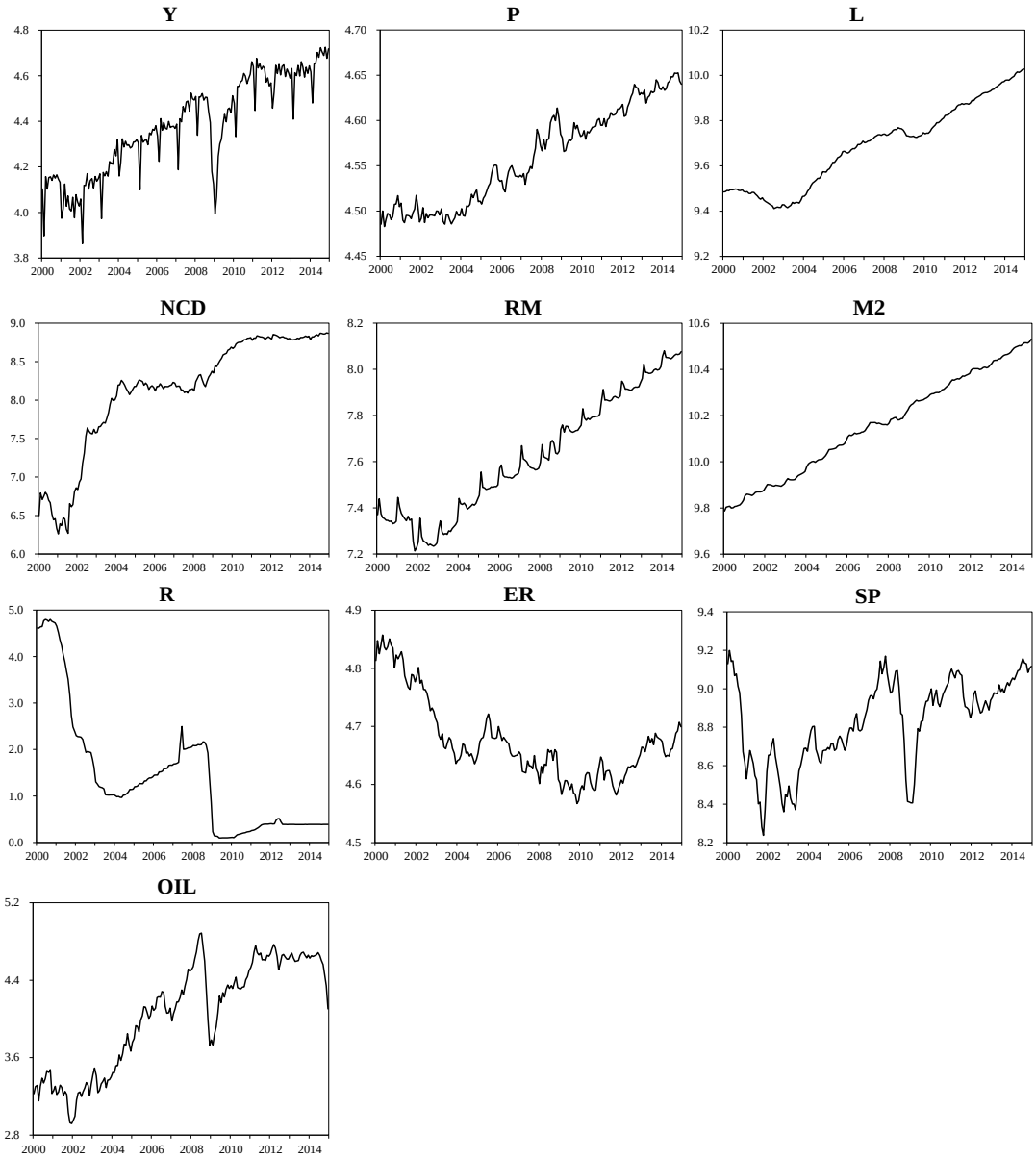
[3] 除銀行外，「全體貨幣機構」尚包括信用合作社、農漁會信用部等其他信用創造機構。

[4] 在樣本期間內，「全體貨幣機構放款」占「全體貨幣機構放款與投資」約 88%至 96%。

[5] 本文亦使用「全體銀行放款—對民間部門債權」取代「全體貨幣機構放款與投資—對民間部門債權」作為穩健性測試，但結果差異不大，詳後討論。

年，以及 2008 年的金融危機期間，主要反映經濟衰退及國內需求不振等因素。NCD 餘額分別在 2001 年中至 2003 年，以及 2008 年中至 2010 年兩度明顯上升，至 2014 年底累計約新台幣 7.1 兆元。準備貨幣有明顯的季節性，主因農曆新年致貨幣需求暫時性增加。

圖 4：各變數時間序列走勢圖



陸、貨幣政策執行的有效性

一、認定條件

首先，本文建構 4 個變數的 SVAR 模型，估計政策工具及貨幣政策目標之間的關係，瞭解政策工具是否能有效影響操作目標及中間目標，以檢驗台灣貨幣政策執行的有效性。

模型的變數向量為 {NCD, R, RM, M2}，其中 NCD 為政策工具，R 與 RM 代表準備金市場的利率及資金，M2 為貨幣政策的中間目標。模型的認定條件如下：

$$\mathbb{A}\mathrm{y}_t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ \mathbb{a}_{21} & 1 & 0 & 0 \\ \mathbb{a}_{31} & 0 & 1 & 0 \\ 0 & \mathbb{a}_{42} & \mathbb{a}_{43} & 1 \end{bmatrix} \begin{bmatrix} \mathrm{NCD}_t \\ \mathrm{R}_t \\ \mathrm{RM}_t \\ \mathrm{M2}_t \end{bmatrix} = \sum_{i=1}^{p} \mathbb{A}_i L^i \mathrm{y}_t + \begin{bmatrix} \mathrm{e}_t^{\mathrm{NCD}} \\ \mathrm{e}_t^{\mathrm{R}} \\ \mathrm{e}_t^{\mathrm{RM}} \\ \mathrm{e}_t^{\mathrm{M2}} \end{bmatrix}.$$

由於 NCD 發行與否、發行量皆可由央行自行決定，故模型第一式假設政策工具 NCD 不會受其他變數同期影響。第二及第三式假設央行藉 NCD 的發行量影響準備金市場的利率及資金，故 R 與 RM 受 NCD 的同期影響，其中 RM 為央行的操作目標。第四式假設中間目標 M2 受利率及準備貨幣影響，故 NCD 可透過 R 與 RM 間接影響 M2。此外，模型包含月虛擬變數、農曆春節假期變數[6]，以及 2008 年金融危機虛擬變數等外生變數[7]。

若估計結果顯示 NCD 可影響 R 與 RM，且 RM 可影響 M2，表示政策工具可影響政策變數，台灣貨幣政策的執行是有效的。

---

[6] 本文利用美國普查局（U.S. Census）提供之 Genhol 程式取得農曆假期虛擬變數，詳情可參考 X-12 使用手冊。

[7] 2008 年金融危機虛擬變數，其值自 2008 年 9 月至 2009 年 8 月設定為 1，其餘為 0。

二、實證結果

本文根據赤池資訊評選準則（Akaike information criterion, AIC），得到模型最適落後期數為 7（p=7）。由於總體時間序列變數可能存在的最大積數通常為 1，故本文假設d_{max}=1，並據此選定模型的落後期數為 8（$p + d_{max}$=8）。

表 4 為同期相關影響係數的估計結果，R、RM 與 M2 的衝擊反應函數則繪示於圖 5。從表 4 可知，隔拆利率及準備貨幣對 M2 的同期影響皆呈顯著：隔拆利率下降，M2 上升（$\mathbb{a}_{42} > 0$）[8]；準備貨幣上升，M2 上升（$\mathbb{a}_{43} < 0$）。雖然 NCD 對 R 與 RM 的同期影響並不顯著，但從圖 5 的衝擊反應函數圖形可知，央行增加發行 NCD 之衝擊將使準備貨幣下降，隔拆利率上升。此外，準備貨幣衝擊對 M2 有正向且持久的效果，利率衝擊對 M2 為負向，且在 10%的水準下顯著。

表 4：同期相關影響係數（模型 1）

	係數	標準誤	*t*-統計量	*p*-值
$\mathbb{a}_{21}$	0.056	0.151	0.374	0.708
$\mathbb{a}_{31}$	0.053	0.034	1.564	0.118
$\mathbb{a}_{42}$	0.005*	0.003	1.798	0.072
$\mathbb{a}_{43}$	-0.073***	0.012	-6.262	0.000

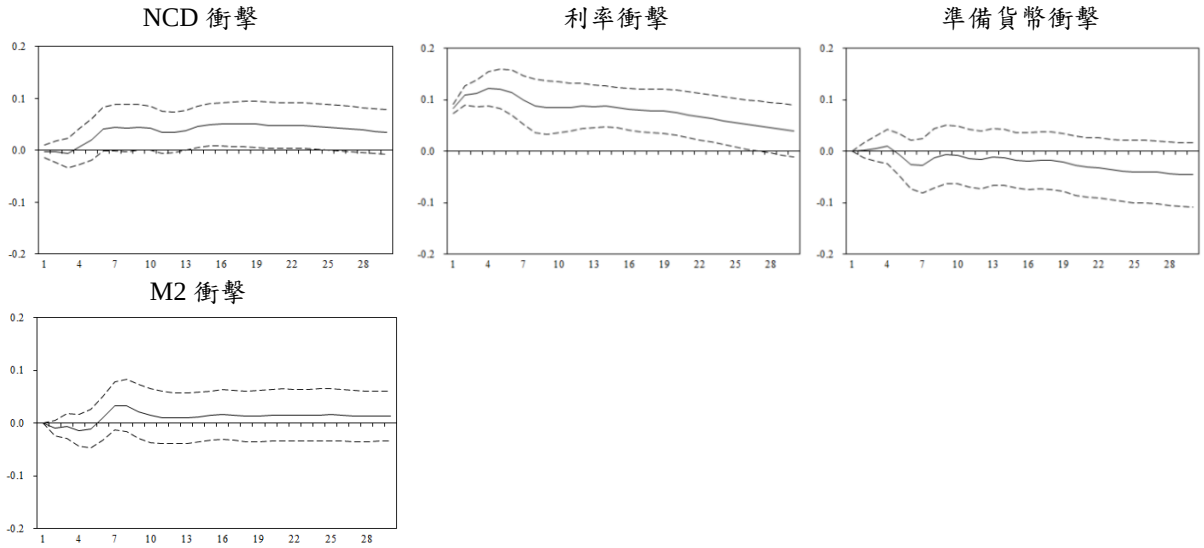
說明：***、**與*分別表在 1%、5%與 10%的水準下顯著。

綜上所述，央行可藉由發行 NCD 吸收過剩流動性，影響隔拆利率與準備貨幣，並進一步影響 M2。估計結果顯示，政策工具可透過操作目標影響中間目標，台灣貨幣政策的執行是有效的。

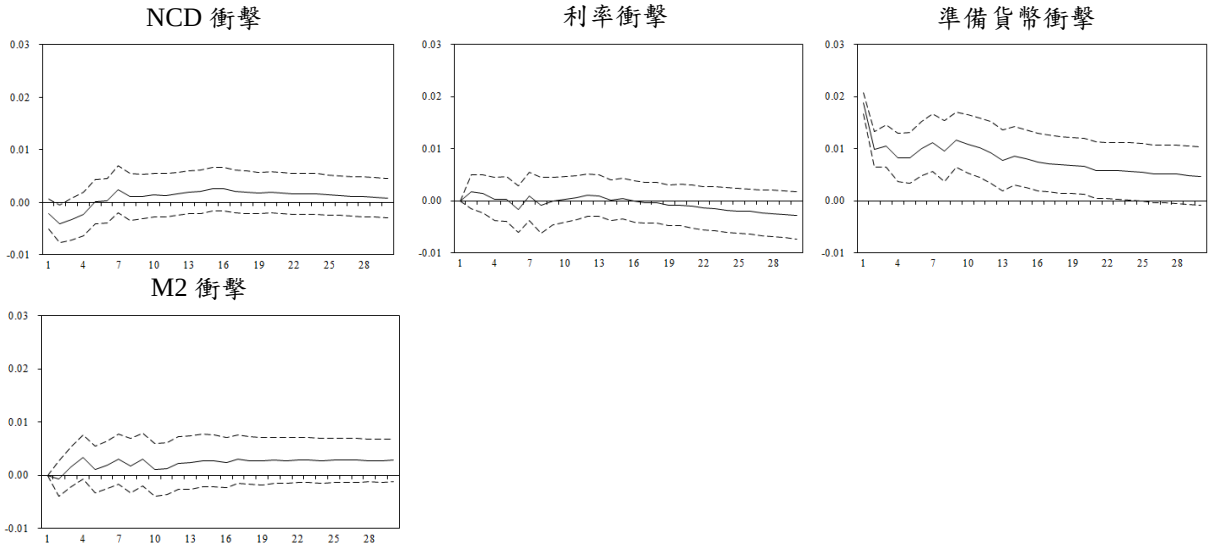
[8] 在模型設定上，代表變數間同期關係的 **A**（$\mathbb{A}$）矩陣與被解釋變數同位於等式左側，故解讀時應改變其正負號。

圖 5：衝擊反應函數（模型 1）

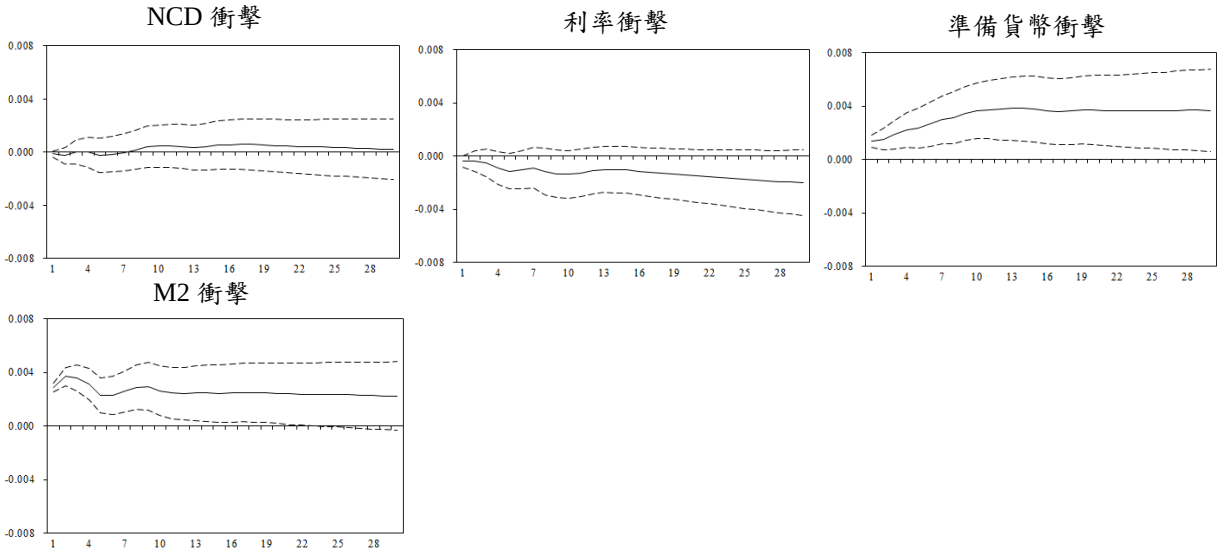
(a) 利率(R)的衝擊反應函數



(b) 準備貨幣(RM)的衝擊反應函數



(c) M2 的衝擊反應函數



說明：1. 衝擊大小為 1 個標準差；
2. 虛線為 95%信賴區間。

柒、貨幣政策的傳遞管道

一、認定條件

本文主要目的係檢視台灣貨幣政策的傳遞管道，在此 SVAR 模型中，模型的變數向量為 {Y, P, L, M2, R, ER, SP}。前兩個變數，工業生產指數（Y）與消費者物價指數（P）分別代表產出與物價，為貨幣政策的最終目標。為檢視個別管道的效果，本文考慮銀行放款（L）、隔拆利率（R）、匯率（ER）及股價（SP）等 4 個中間變數，分別代表銀行放款、利率、匯率及資產負債表等不同 4 個傳遞管道[9]。由於央行可藉公開市場操作影響利率，故 R 亦可代表貨幣政策態勢。此外，台灣貨幣政策係採 M2 目標機制，M2 為重要的中間變數，故亦將 M2 納入考量。

參考相關的實證文獻，本文貨幣政策傳遞管道 SVAR 模型的認定條件如下：

$$\boldsymbol{A}\boldsymbol{y}_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & a_{35} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & a_{45} & 0 & 0 \\ a_{51} & a_{52} & 0 & 0 & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & a_{67} \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \mathrm{Y}_t \\ \mathrm{P}_t \\ \mathrm{L}_t \\ \mathrm{M2}_t \\ \mathrm{R}_t \\ \mathrm{ER}_t \\ \mathrm{SP}_t \end{bmatrix} = \sum_{i=1}^{p} \boldsymbol{A}_i L^i \boldsymbol{y}_t + \begin{bmatrix} \mathrm{e}_t^{\mathrm{Y}} \\ \mathrm{e}_t^{\mathrm{P}} \\ \mathrm{e}_t^{\mathrm{L}} \\ \mathrm{e}_t^{\mathrm{M2}} \\ \mathrm{e}_t^{\mathrm{R}} \\ \mathrm{e}_t^{\mathrm{ER}} \\ \mathrm{e}_t^{\mathrm{SM}} \end{bmatrix}.$$

模型的第一及第二式描述實質經濟活動。由於合約限制或調整成本等因素，產出及物價的調整皆較為遲滯，故假設 Y 與 P 皆不受其

[9] 根據文獻回顧，可知財富效果皆不顯著或影響不大，因此本文不考慮財富效果管道。參見吳懿娟（2004）、陳南光與王泓仁（2011）等。

他變數的同期影響。

第三式描述當銀行部門對民間部門做放款決策時，會將總體經濟與貨幣政策態勢納入考量，故假設 L 受 Y、P 與 R 的同期影響。第四式假設 M2 受 Y、P、R 與 L 的同期影響。根據貨幣數量理論，M2 為產出、物價及利率的函數；而銀行放款增加也會導致 M2 擴增，故 M2 也是銀行放款的函數。第五式代表總體經濟情勢為貨幣政策的最終目標，產出與物價為央行制定貨幣政策（以隔拆利率表示）時的主要考量因素，因此假設 R 受 Y 與 P 的同期影響。

最後，由於匯率與股價皆具前瞻性資產價格的特性，故第六及第七式假設 ER 與 SP 將立即受其他經濟金融變數影響，即時反映市場訊息。然而，當股價表現佳（差）時，可能會誘使資本流入（出）致匯率變動，故假設 ER 將立即反應 SP 的變動，反之則不然。此外，模型亦包含月虛擬變數、農曆春節假期變數、2008 年金融危機虛擬變數，以及國際油價等外生變數。

二、實證結果

在估計 SVAR 模型前，仿照前述選定模型落後期數的做法，首先根據 AIC 得到最適落後期數為 2，再加上總體變數可能存在的最大積數（通常為 1），據此選定模型的落後期數為 3。

本文根據模型的估計結果，得到概似比率檢定（Likelihood Ratio test）的檢定統計量及其顯著水準分別為 χ^2 (1) = 1.918 與 0.166，無法拒絕模型認定條件為合理的虛無假設，因此 SVAR 模型的認定條件應屬合理。模型同期相關影響係數的估計結果列於表 5。

表 5：同期相關影響係數（模型 2）

	係數	標準誤	*t*-統計量	*p*-值
a_{31}	-0.018**	0.009	-2.021	0.043
a_{41}	0.014**	0.006	2.375	0.018
a_{51}	-0.559***	0.152	-3.676	0.000
a_{61}	0.015	0.019	0.781	0.435
a_{71}	-0.322***	0.095	-3.387	0.001
a_{32}	0.102*	0.060	1.695	0.090
a_{42}	-0.098**	0.039	-2.540	0.011
a_{52}	0.547	1.051	0.521	0.603
a_{62}	0.253**	0.126	2.009	0.045
a_{72}	0.377	0.632	0.595	0.552
a_{43}	-0.074	0.048	-1.547	0.122
a_{63}	-0.122	0.155	-0.788	0.431
a_{73}	0.181	0.778	0.232	0.816
a_{64}	0.447*	0.255	1.756	0.079
a_{74}	-5.563***	1.211	-4.593	0.000
a_{35}	0.003	0.004	0.714	0.475
a_{45}	0.001	0.003	0.455	0.649
a_{65}	-0.011	0.009	-1.217	0.224
a_{75}	-0.004	0.044	-0.079	0.937
a_{67}	0.079***	0.015	5.303	0.000

說明：***、**與*分別表在 1%、5%與 10%的水準下顯著。

表 5 中，呈現統計顯著的同期相關影響係數估計值，符號多與理論預期相符。如產出上升將增加對銀行放款的需求（$a_{31} < 0$）。雖然產出對 M2 的同期影響為負（$a_{41} > 0$），但 M2 對產出的衝擊反應在當期後仍將轉正（參見附圖），故產出上升將致 M2 需求增加，惟存有落後效果；而物價上升亦將致 M2 需求增加（$a_{42} < 0$）。此外，產出上升將使利率調升（$a_{51} < 0$）；物價對利率的影響（a_{52}）並不顯著，有兩個可能的解釋：（1）在樣本期間內，台灣的通貨膨脹率已經維持在低而穩定的水準[10]；（2）央行係以前瞻性（forward-looking）的方式制定

[10] 自 2000 年 1 月至 2014 年 12 月，CPI 年增率的平均值為 1.07%，樣本變異數為 2.10。

貨幣政策（陳旭昇與吳聰敏，2010）。

（一）衝擊反應分析

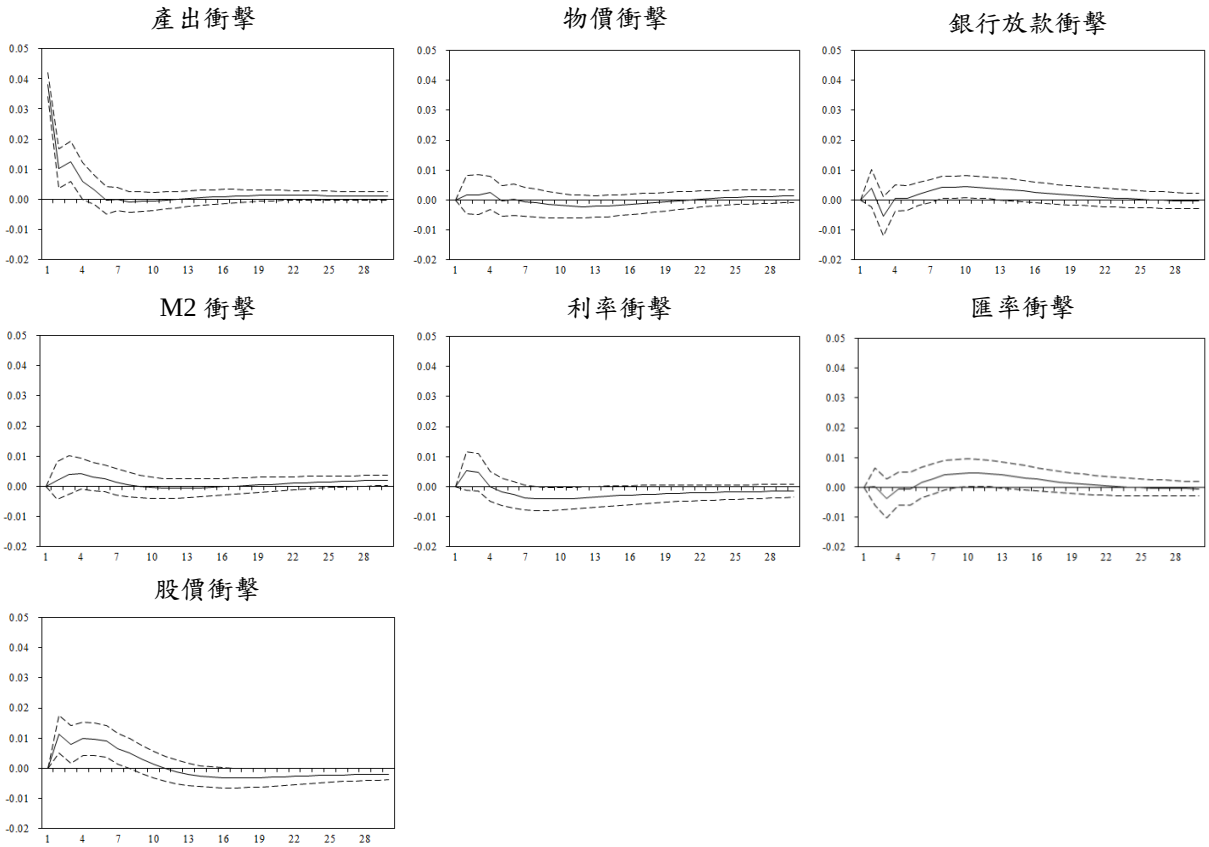
衝擊反應函數為變數在面對外生結構性衝擊時的動態行為，有助分析政策變動時的效果。本文的目的在探討貨幣政策如何影響經濟活動的傳遞管道，因此將討論焦點集中在產出及物價。圖 6 為產出與物價的衝擊反應函數，衝擊大小為 1 個標準差的正向結構性衝擊，兩側虛線為顯著水準 95%的信賴區間，反應期間為 30 期。（關於銀行放款、M2 及股價的衝擊反應函數，參見附圖。）

圖 6 上半部為產出的衝擊反應函數。如圖所示，面對利率上升的衝擊，產出在第 7 個月後顯著下降且持續約 13 個月，利率管道具顯著性。面對新台幣貶值（匯率上升）的衝擊，產出顯著上升（第 9 至 14 個月），表示在貨幣政策傳遞的過程中，匯率亦為重要的管道。面對銀行放款增加的衝擊，產出顯著上升（第 8 至 15 個月），表示銀行放款管道顯著，銀行放款增加可促進經濟成長。最後，產出對股價上升的衝擊反應呈顯著且快速，並於第 9 個月回復至初始水準，故資產負債表管道亦呈顯著。然而，值得注意的是，除了資產負債表管道，股價衝擊也可能有部分係反映產業動態或國際經濟金融情勢的變化。

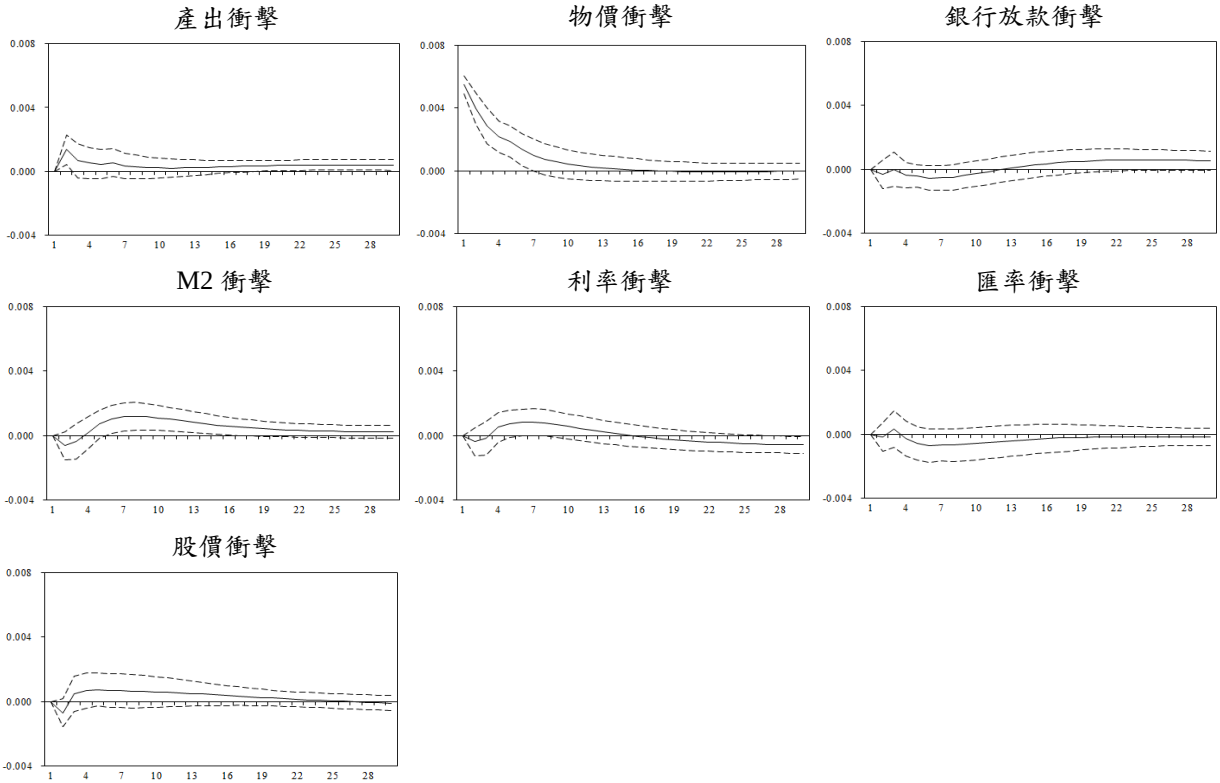
圖 6 下半部為物價的衝擊反應函數。面對銀行放款增加的衝擊，物價在第 22 個月後顯著上升，遞延效果較長。面對利率上升的衝擊，物價略升，但之後即轉呈不顯著且持續下降，並於第 24 個月後顯著低於初始水準。新台幣貶值對物價的影響較為複雜，與廠商的轉嫁能力，或是 CPI 的組成、貿易財的價格、受國際影響的程度等有關。在本文中，新台幣貶值的衝擊對物價並不顯著。最後，面對 M2 上升的衝擊，物價自第 5 個月後顯著上升，且效果持續 16 個月。

圖 6：產出與物價的衝擊反應函數（模型 2）

(a) 產出(Y)的衝擊反應函數



(b) 物價(P)的衝擊反應函數



說明：1. 衝擊大小為 1 個標準差；
2. 虛線為 95%信賴區間。

（二）預測誤差變異數分解

由於產出與物價為貨幣政策的最終目標，因此本文利用預測誤差變異數分解，分解產出與物價之預測誤差的變異數，以瞭解各個變數之衝擊所能解釋的比例，並將結果列於表 5。

表 5：產出與物價的預測誤差變異數分解（模型 2）

(a) 產出(Y)

期數 (月)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00
6	72.84	0.51	2.11	2.21	2.53	0.70	19.10
12	62.39	1.02	5.31	2.03	5.46	4.62	19.18
18	57.84	1.48	6.53	1.91	6.73	6.13	19.39
24	56.30	1.46	6.53	2.02	7.37	6.06	20.26
30	55.20	1.67	6.38	2.55	7.66	5.94	20.60

(b) 物價(P)

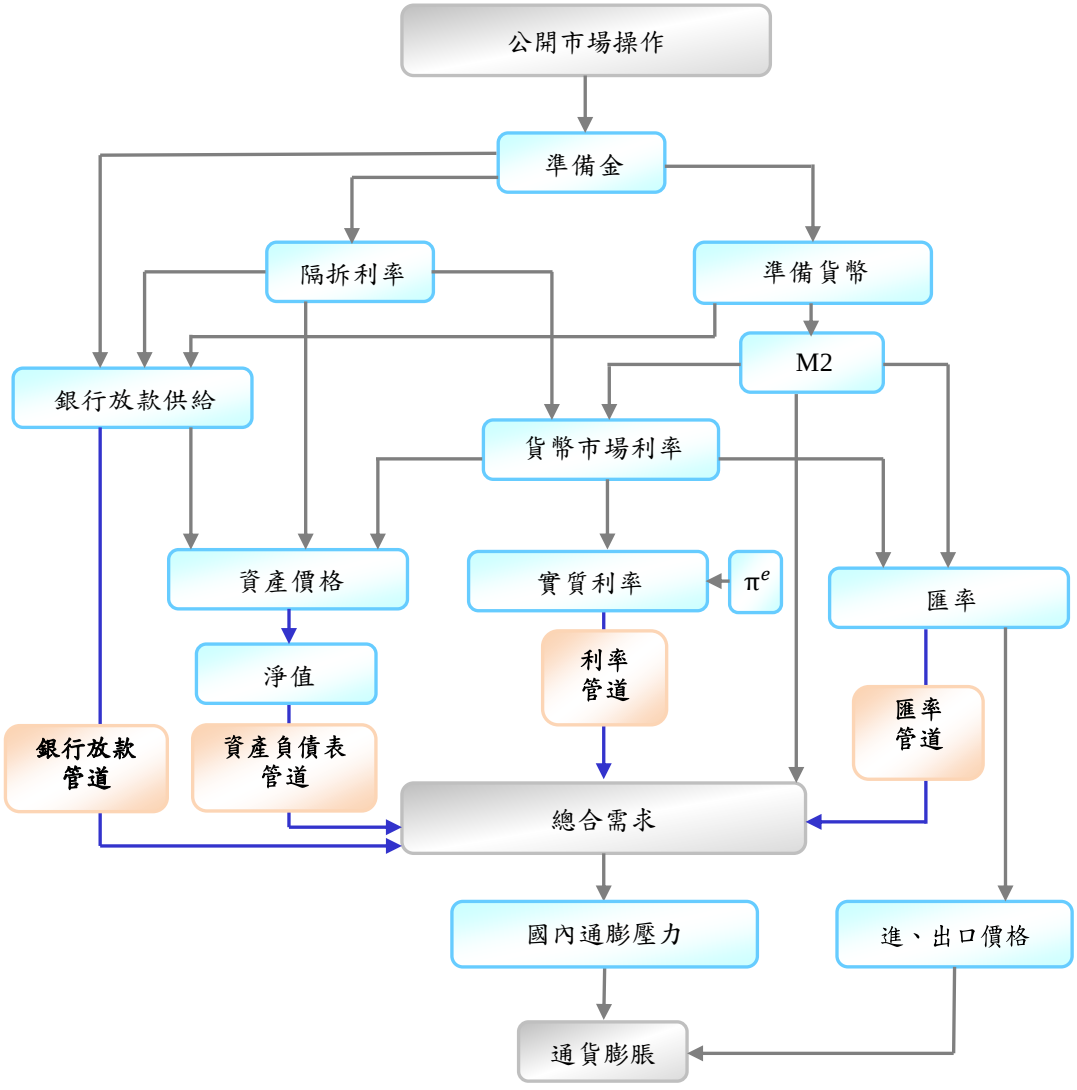
期數 (月)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	0.00	100.00	0.00	0.00	0.00	0.00	0.00
6	4.11	85.68	0.92	2.82	2.20	1.33	2.93
12	3.77	71.91	1.57	10.17	4.47	3.29	4.82
18	4.09	68.00	2.16	12.19	4.34	3.63	5.58
24	4.76	64.87	3.95	12.36	4.94	3.62	5.51
30	5.47	61.72	5.58	12.11	6.30	3.56	5.26

關於產出的變動，除了其本身，股價變動所能解釋的變異數比率最高。股價變動可能改變借款者的淨值或現金流量，進而影響產出；惟如前所述，股價變動，除了呈現資產負債表效果，亦可能反映產業動態或國際經濟金融情勢的變化，顯現小型開放經濟體易受國際因素影響的特性。此外，在第 18 個月後，銀行放款、利率與匯率的變動合計占產出約 20%的變異數比率。關於物價的變動，除了其本身，

M2 所能解釋的變異數比率最高；且在第 18 個月後，銀行放款、利率、匯率與股價的變動合占物價約 16%至 20%的變異數比率。

根據衝擊反應函數及預測誤差變異數的分析結果，產出的變動可由銀行放款、利率、匯率及股價等衝擊解釋。因此，本文發現在台灣的貨幣政策傳遞機制中，銀行放款管道、利率管道、匯率管道及資產負債表管道皆呈顯著；此實證結果與相關文獻一致。最後，貨幣政策影響最終目標主要的傳遞管道整理如圖 7。

圖 7：台灣的貨幣政策傳遞管道



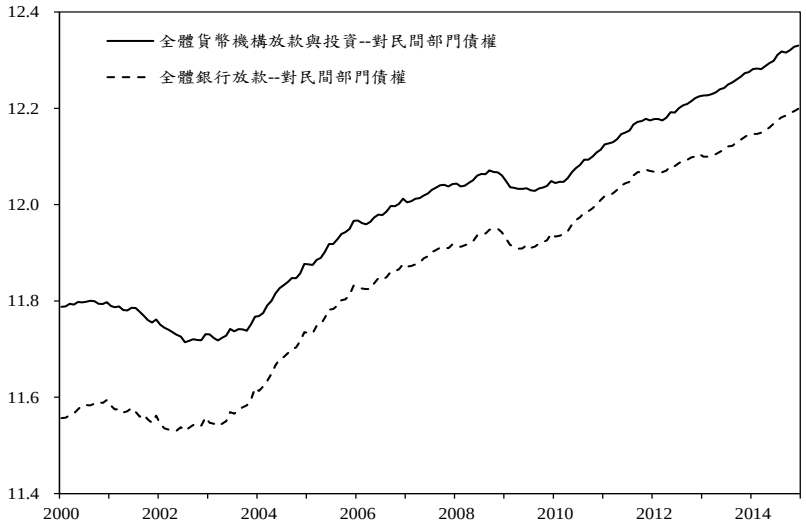
說明：→ 表示效果顯著。

三、穩健性測試

本文以兩種方式測試實證結果的穩健性。首先，前文採用「全體貨幣機構放款與投資—對民間部門債權」作為銀行放款的替代變數，但部分文獻在探討台灣信用管道的存在與否時，卻是使用「銀行貸款」（吳中書與陳建福，2010；張瑞娟等，2010；Huang and Yu, 2015）；因此，本文亦使用「全體銀行放款—對民間部門債權」作為銀行放款的替代變數[11]。

圖 8 為「全體貨幣機構放款與投資—對民間部門債權」與「全體銀行放款—對民間部門債權」的時間序列走勢圖（對數值）。在樣本期間內，「全體銀行放款—對民間部門債權」占「全體貨幣機構放款與投資—對民間部門債權」約 80%至 90%，且兩者走勢十分相近。

圖 8：不同的銀行放款變數

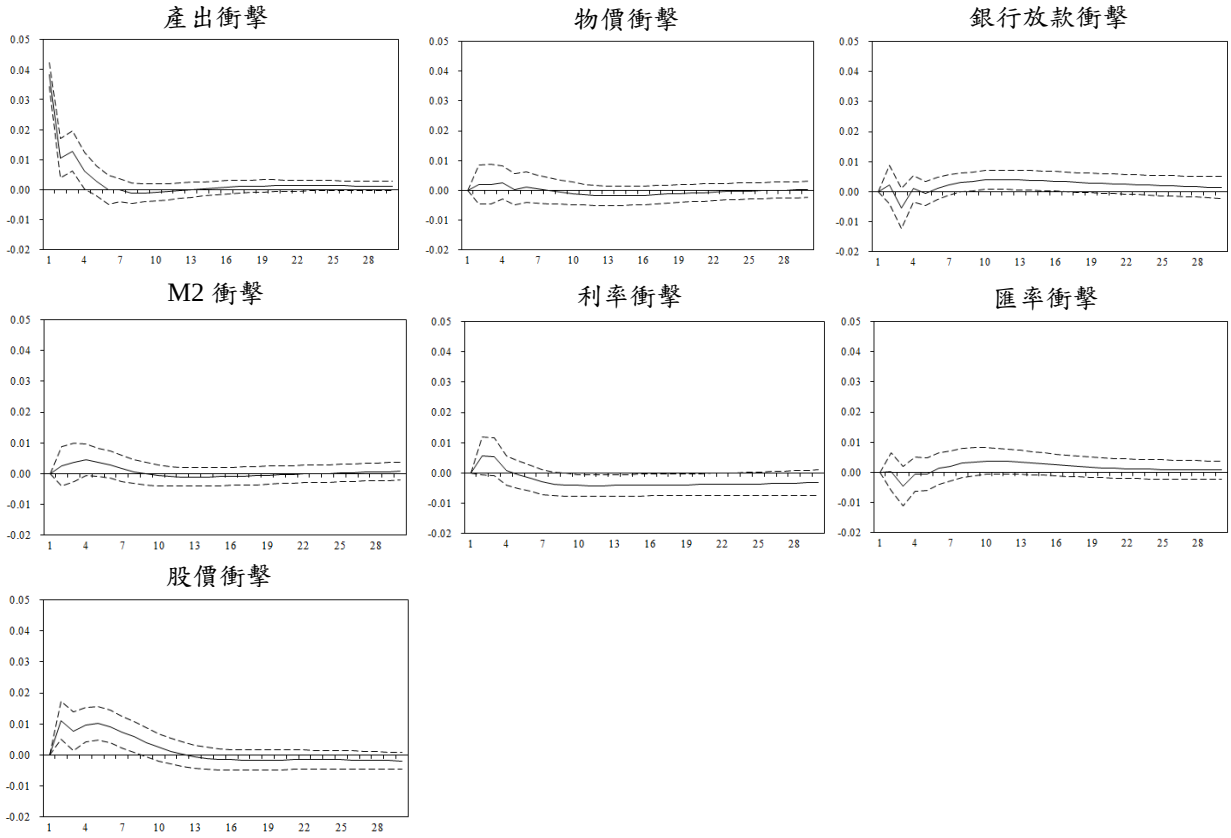


使用不同的銀行放款變數後，本文將產出與物價的衝擊反應函數繪於圖 9，且其走勢與圖 6 相近；而表 6 列示預測誤差變異數分解，可發現各變數變異數比率的相對大小亦與表 5 相近。

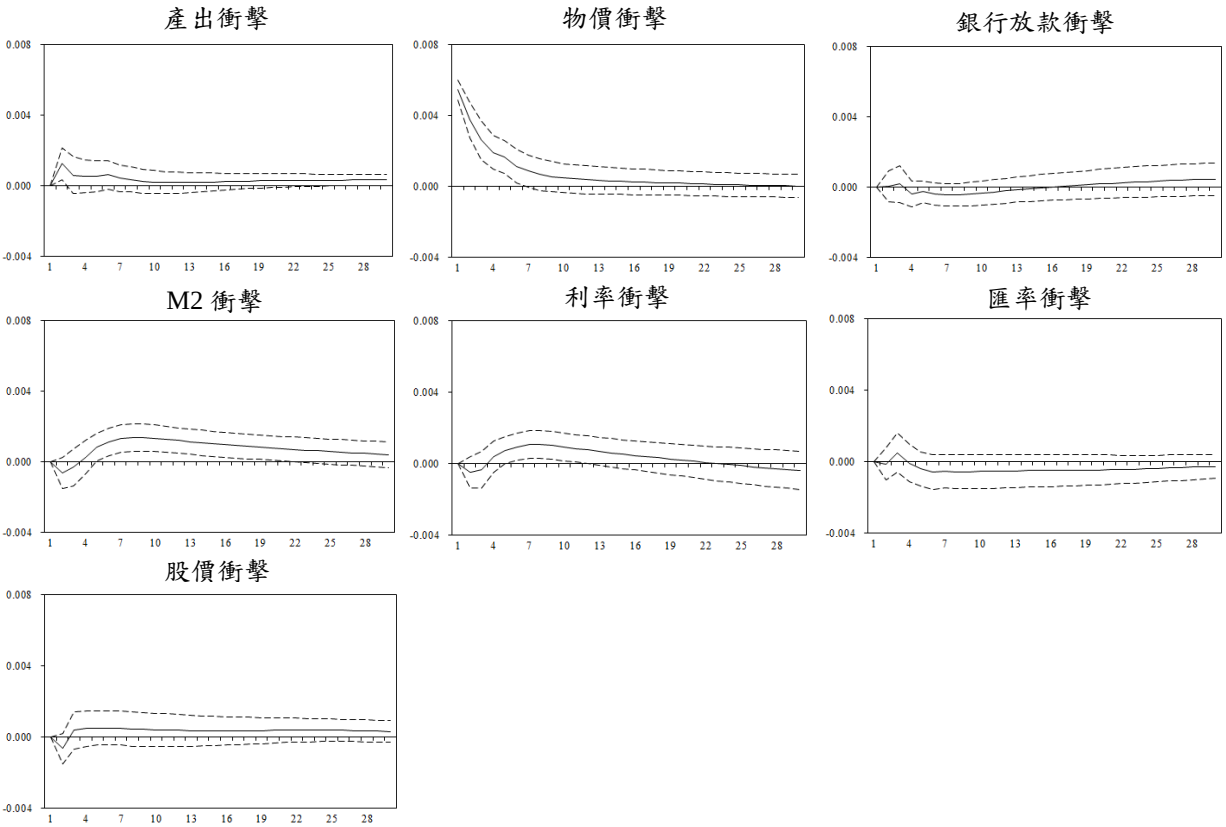
[11] 「全體銀行放款—對民間部門債權」係依借戶部門別，由「對民營企業」與「對個人等」相加而得，資料來源為金融統計月報。

圖 9：產出與物價的衝擊反應函數（模型 2，不同的銀行放款變數）

(a) 產出(Y)的衝擊反應函數



(b) 物價(P)的衝擊反應函數



說明：1. 衝擊大小為 1 個標準差；
2. 虛線為 95%信賴區間。

表 6：產出與物價的預測誤差變異數分解（模型 2，不同的銀行放款變數）

(a) 產出(Y)

期數 (月)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00
6	72.80	0.66	1.56	2.50	2.60	0.94	18.94
12	63.77	0.83	3.89	2.38	5.44	3.19	20.51
18	58.67	1.31	5.97	2.36	8.15	4.32	19.22
24	55.99	1.35	6.86	2.25	10.43	4.42	18.71
30	54.24	1.31	7.15	2.22	12.16	4.37	18.56

(b) 物價(P)

期數 (月)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	0.00	100.00	0.00	0.00	0.00	0.00	0.00
6	4.32	85.57	0.59	3.64	2.85	1.12	1.91
12	3.81	66.85	1.25	14.30	8.33	2.81	2.65
18	3.72	60.24	1.16	18.77	9.04	3.96	3.12
24	4.02	56.82	1.43	20.58	8.62	4.78	3.75
30	4.41	54.34	2.27	21.00	8.61	5.12	4.26

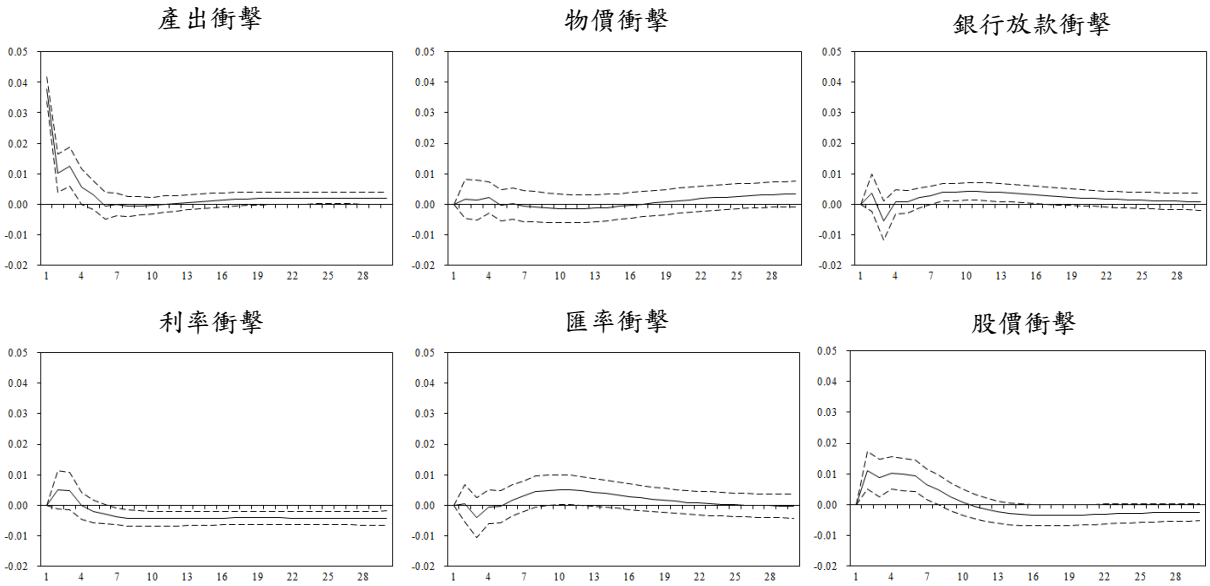
再者，根據本文的實證結果，可知 M2 是模型中的重要變數（如 M2 對物價有直接的影響）。然而，在大部分的文獻中，M2 通常不被視為「傳遞管道」，而僅視為管道內的一個環節；故本文去除模型中的 M2，留下其餘 6 個變數，以測試其他管道的穩健性。

去除 M2 後，本文將產出與物價的衝擊反應函數繪於圖 10，其走勢仍與圖 6 相近。表 7 列示預測誤差變異數分解，可發現各變數對產出變動的變異數比率的相對重要性亦與表 5 相近；至於物價的變動，產出的相對重要性則較為提高，但物價本身仍是最重要的因素。

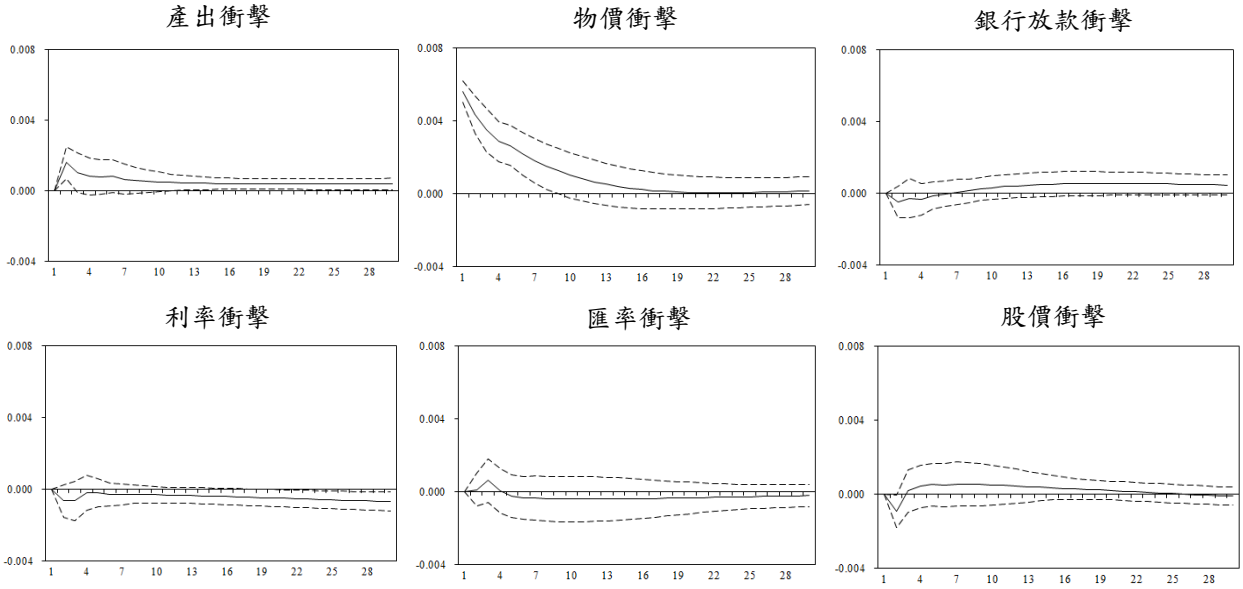
綜上所述，無論是使用不同的銀行放款變數，或是從模型中去除 M2，估計結果仍大致相同，顯示本文的實證結果具穩健性。

圖 10：產出與物價的衝擊反應函數（模型 2，去除 M2）

(a) 產出(Y)的衝擊反應函數



(b) 物價(P)的衝擊反應函數



說明：1. 衝擊大小為 1 個標準差；
2. 虛線為 95%信賴區間。

表 7：產出與物價的預測誤差變異數分解（模型 2，去除 M2）

(a) 產出(Y)

期數 (月)	Y (%)	P (%)	L (%)	R (%)	ER (%)	SP (%)
1	100.00	0.00	0.00	0.00	0.00	0.00
6	73.51	0.42	2.06	2.51	0.82	20.69
12	62.59	0.67	5.05	6.01	5.30	20.37
18	56.69	0.73	6.56	8.86	6.82	20.35
24	53.42	1.21	6.73	11.39	6.52	20.72
30	50.56	2.72	6.47	13.64	6.10	20.52

(b) 物價(P)

期數 (月)	Y (%)	P (%)	L (%)	R (%)	ER (%)	SP (%)
1	0.00	100.00	0.00	0.00	0.00	0.00
6	6.16	89.93	0.47	1.07	0.63	1.74
12	6.96	86.37	0.88	1.43	1.38	2.98
18	7.54	82.53	2.23	2.17	2.08	3.45
24	7.98	79.03	3.64	3.42	2.49	3.44
30	8.35	75.78	4.67	5.23	2.66	3.31

捌、結論與建議

現今金融市場快速變遷，貨幣政策與經濟活動間的關聯可能受其影響而有所改變。本次研究計畫旨在探討並評估 SEACEN 經濟體的貨幣政策傳遞機制及執行效果，俾助各國央行達成貨幣政策目標。爰此，本文探討台灣的貨幣政策傳遞機制，並就政策執行的有效性及傳遞管道進行實證分析。

首先，本文討論台灣的貨幣政策架構、貨幣需求的穩定性，以及貨幣需求與總體經濟變數的關係，得知近年 M2 流通速度穩定，市場資金足以支應經濟活動所需，且 M2 多能在目標區內穩定成長；因此，台灣的貨幣政策架構妥適且具一致性，當有助貨幣政策傳遞機制的運作及效果。

接著，本文藉由 SVAR 模型進行實證分析。有別於遞迴式的排序方法，本文的 SVAR 模型考慮貨幣政策與重要變數間的同期影響，再予以適當的限制條件，描繪變數間的同期關係，使模型設定更具彈性。本文首先檢視貨幣政策執行的有效性，並發現央行可藉由貨幣政策工具（公開市場操作），透過操作目標（準備貨幣）影響中間目標（M2），顯示台灣貨幣政策的執行是有效的。其次，本文通盤檢驗不同傳遞管道的效果。雖然台灣研究貨幣政策傳遞的實證文獻眾多，但多僅著重某些特定管道的存在與否，而忽略總體經濟變數間的動態關聯。估計結果顯示，銀行放款管道、利率管道、匯率管道及資產負債表管道均呈顯著，這些管道皆在台灣的貨幣政策傳遞機制扮演重要角色。此外，實證結果也顯示台灣易受國際經濟金融情勢的變化影響，符合小型開放經濟體的特性。本文的實證結果與相關文獻結果一致。

參與本次研究計畫，除了檢視台灣的貨幣政策傳遞機制，尚可

與其他參與成員交流討論，藉此瞭解各國的經濟情勢、金融體系、貨幣政策架構與主要傳遞管道，以及各國央行關注的重點。由於各國的經濟發展程度與金融體系各異，各國央行採行的貨幣政策架構及重視的傳遞管道皆不同，故研究重點也各有差異。

例如，根據各國的初步研究成果[12]，汶萊發現該國的匯率轉嫁效果不高；印尼發現信用管道及利率管道對影響該國經濟活動及通膨最為有效；馬來西亞發現過去 10 年來，傳統的利率管道及匯率管道的傳遞效果減弱，資產價格管道及信用管道的傳遞效果則增加；蒙古發現銀行放款管道及利率管道為該國重要的傳遞管道；菲律賓發現該國採通膨目標制度後，匯率轉嫁程度下降，且政策利率可透過對民間部門信用影響經濟活動及通膨；斯里蘭卡以利率管道最為重要，但銀行放款管道的效果仍值得深入探討；泰國則發現對於經濟成長率較高的期間，或資產負債表較為健全的銀行，貨幣政策的傳遞較為有效。

台灣方面，常見的傳遞管道均呈顯著，且同時易受國際經濟金融情勢的變化影響，故國際因素亦為央行決策時的考量重點之一；M2 與物價的相關性高，台灣 CPI 年增率長期保持低而穩定，顯示貨幣政策的架構及操作得宜；此外，台灣的貨幣政策架構妥適且具一致性，亦有助貨幣政策傳遞機制的運作及效果。參與本次研究計畫當有助瞭解台灣的貨幣政策傳遞機制，並可供決策參考。

[12] 係指各國在第 2 次研討會發表的研究成果，與最終成果仍可能有所出入。各國的研究計畫報告預計於 2015 年底完成定稿。

參考文獻

王泓仁、陳南光（2011），「資產價格變動對民間消費支出影響效果之研究」，中央銀行季刊，第 33 卷第 1 期，頁 7–40。

吳中書（2009），「論台灣貨幣需求函數」，經濟論文叢刊，第 37 卷第 1 期，頁 23–52。

吳中書、陳建福（2010），「臺灣信用管道之探討」，臺灣經濟預測與政策，第 41 卷第 1 期，頁 121–153。

吳懿娟（2004），「我國貨幣政策傳遞機制之實證分析」，中央銀行季刊，第 26 卷第 4 期，頁 33–68。

吳懿娟（2006），「我國貨幣需求穩定性之探討」，中央銀行季刊，第 28 卷第 3 期，頁 5–48。

高崇瑋、萬哲鈺（2014），「臺灣之利率轉嫁分析」，臺灣經濟預測與政策，第 44 卷第 2 期，頁 45–101。

張瑞娟、欉清全、吳杰聰（2010），「台灣貨幣政策與銀行信用之非對稱性效果—動態縱橫資料分析」，經濟與管理論叢，第 6 卷第 2 期，頁 229–246。

馮立功（2009），「貨幣政策傳遞之信用管道—來自臺灣股市證據」，第 10 屆全國實證經濟學論文研討會。

陳旭昇、吳聰敏（2010），「台灣貨幣政策法則之檢視」，經濟論文，第 38 卷第 1 期，頁 33–59。

Bernanke, B. S. (1986), "Alternative Explanations of the Money-Income Correlation," *Carnegie-Rochester conference series on public policy*, Vol.25, pp.49-99.

Bernanke, B. S., and A. S. Blinder (1992), "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review*, Vol.82, No.4, pp.901-921.

Blanchard, O. J. and M.W. Watson (1986), "Are Business Cycles All

Alike?" Gordon, R. (Ed.), The American Business Cycle: Continuity and Change. University of Chicago Press, Chicago IL, pp.123-156.

Boivin, J., M. Kiley, F. Mishkin (2010), "How Has the Monetary Transmission Mechanism Evolved Over Time?" NBER Working Paper No.15879.

Christiano, L., M. Eichenbaum and C. Evans (1996), "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds," *Review of Economics and Statistics*, Vol.78, No.1, pp.16-34.

Cushman, D. O. and T. A. Zha (1997), "Identifying Monetary Policy in a Small Open Economy under Flexible Exchange Rates," *Journal of Monetary Economics*, Vol.39, No.3, pp.433-448.

Gordon, D. B., and E.M. Leeper (1994), "The Dynamic Impacts of Monetary Policy: An Exercise in Tentative Identification," *Journal of Political Economy*, Vol.102, No.6, pp.1228-1247.

Huang, C. H. and L. H. Yu (2015), "Bank Lending Behavior and a Credit Channel in Monetary Transmission: Evidence from Taiwan," *Taiwan Economic Review*, Vol.43, No.2, pp.219-242.

Kim, S. (2003), "Monetary Policy, Foreign Exchange Intervention, and the Exchange Rate in a Unifying Framework," *Journal of International Economics*, Vol.60, No.2, pp.355-386.

Kim, S. and N. Roubini (2000), "Exchange Rate Anomalies in the Industrial Countries: A Solution with a Structural VAR Approach," *Journal of Monetary Economics*, Vol.45, No.3, pp.561-586.

Levy, J. and I. Halikias (1997), "Aspects of Monetary Transmission Mechanism under Exchange Rate Targeting: The Case of France," IMF Working Paper No.44.

Mishkin, F. (1995), "Symposium on the Monetary Transmission

Mechanism," *Journal of Economic Perspectives*, Vol.9, No.4, pp.3-10.

Mishkin, F. (2007), "The Economics of Money, Banking, and Financial Markets," 8th Edition, Pearson.

Monticelli, C. and O. Tristani (1999), "What Does the Single Monetary Policy Do? A SAVR Benchmark for the European Central Bank," European Central Bank Working Paper No.2.

Osorio, C., R. Pongsaparn, and D. F. Unsal (2011), "A Quantitative Assessment of Financial Conditions in Asia," IMF Working Paper No.11/173.

Peersman, G and F. Smet (2001), "The Monetary Transmission Mechanism in the Euro Area: More Evidence from VAR Analysis", European Central Bank Working Paper No.91.

Sims, C. A. (1980), "Macroeconomics and Reality," *Econometrica*, Vol.48, No.1, pp.1-48.

Sims, C. A. (1986), "Are Forecasting Models Usable for Policy Analysis?" *Federal Reserve Bank of Minneapolis, Quarterly Review*, Vol.10, No.1, pp.2-16.

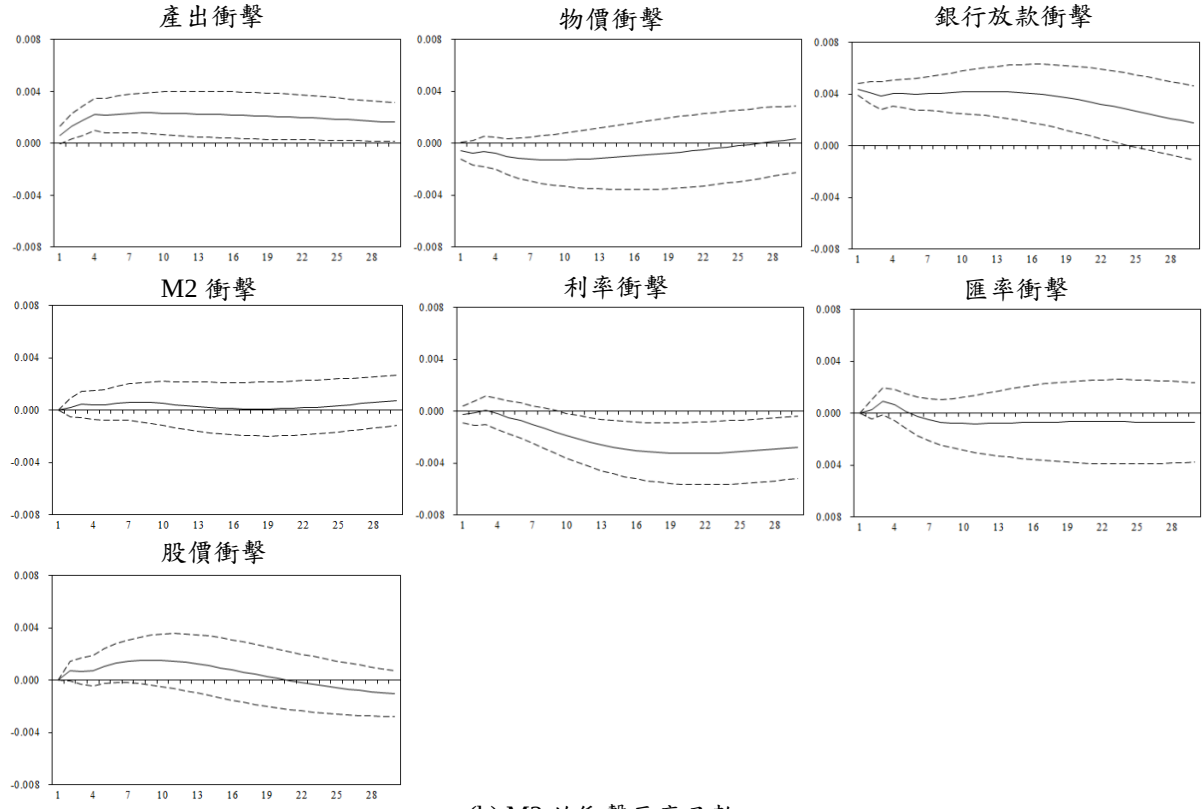
Sims, C. A. (1992), "Interpreting the Macroeconomic Time Series Facts," *European Economic Review*, Vol.36, No.5, pp.975-1011.

Sims, C. A. and T. A. Zha (2006), "Does Monetary Policy Generate Recession?" *Macroeconomic Dynamics*, Vol.10, No.2, pp.231-272.

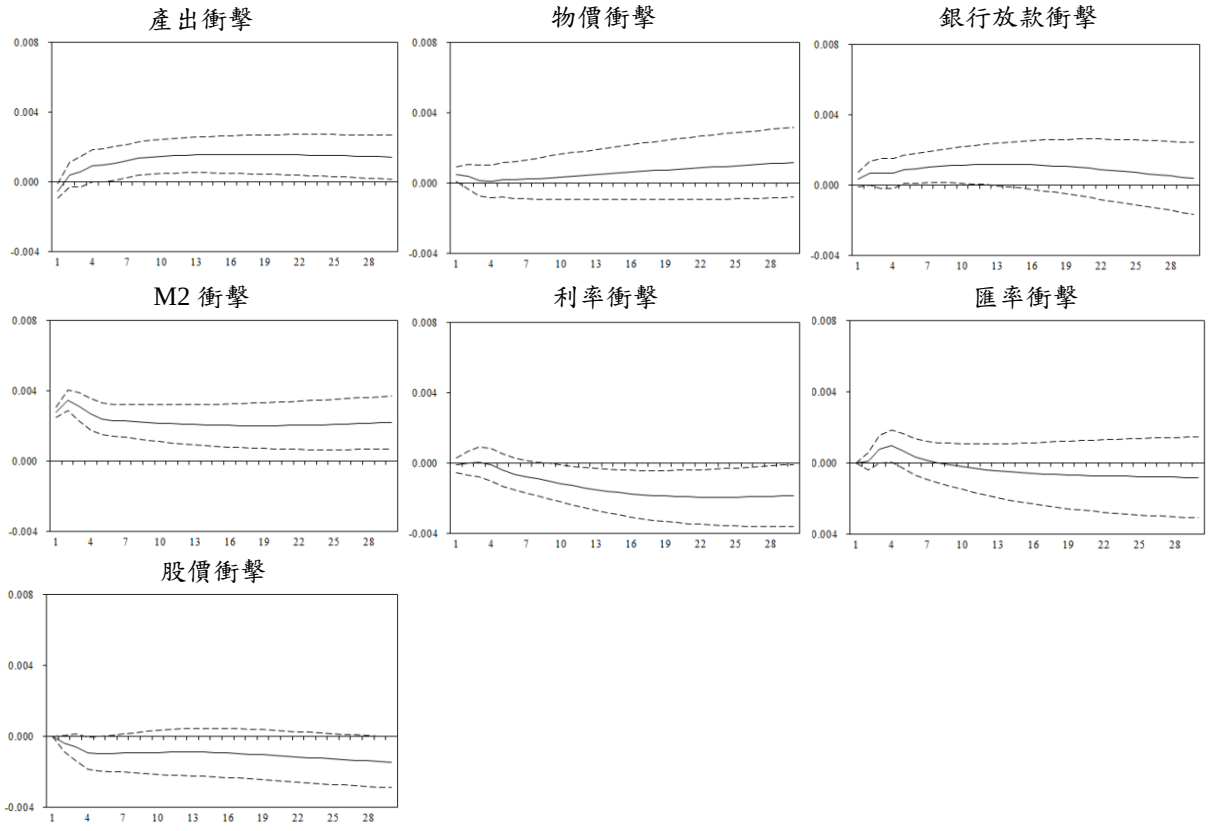
Toda, H. Y. and T. Yamamoto (1995), "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes," *Journal of Econometrics*, Vol.66, No.1, pp.225-250.

附圖：銀行放款、M2 與股價的衝擊反應函數

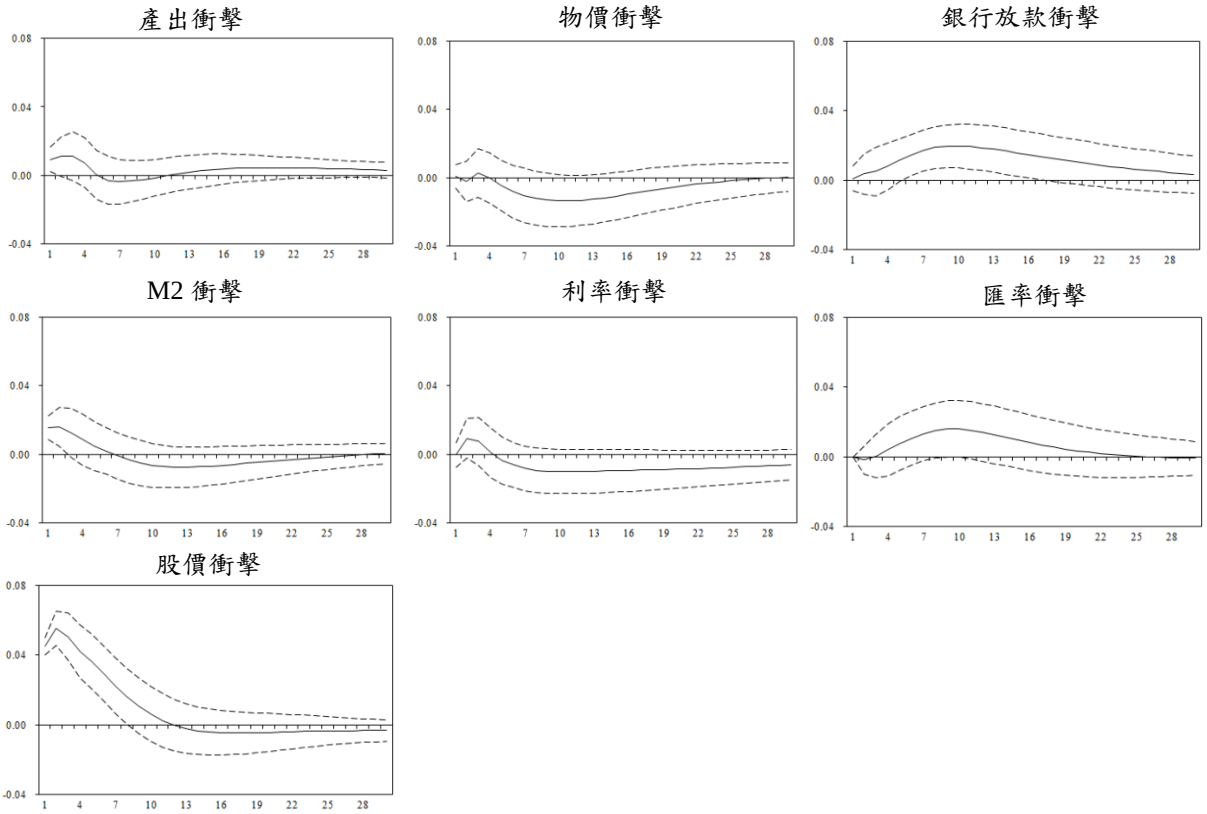
(a) 銀行放款(L)的衝擊反應函數



(b) M2 的衝擊反應函數



(c) 股價(SP)的衝擊反應函數



說明：1. 衝擊大小為 1 個標準差；
2. 虛線為 95%信賴區間。

附件

Monetary Transmission in Taiwan

Chang, Tien-Huei
Chu, Hao-Pang
Central Bank of the Republic of China (Taiwan)

October, 2015

Abstract

This paper empirically investigates the effectiveness of monetary policy transmission mechanism in Taiwan over the past 15 years. Our analysis is based on a structural vector autoregressive model which is imposed with the minimal structural restrictions and is better to depict the variables' contemporaneous relationships. The results first show that the policy instrument could better affect the intermediate target through the operating target and therefore show the monetary policy is implemented effectively in Taiwan. Then, we comprehensively investigate the effects of various transmission channels, which is fairly different from relevant literature in Taiwan. Estimation results provide evidence that bank lending channel, interest rate channel, exchange rate channel, and balance sheet channel shed light on the role that monetary policy transmission plays in Taiwan.

Keywords: Monetary Policy; Transmission Mechanism; SVAR
JEL Classification: E41, E51, E52

1. Introduction

Monetary transmission mechanism is a complicated and interesting topic because there is not one, but many channels through which monetary policy operates. The channels of monetary transmission commonly include interest rate, exchange rate, inflation expectations, credit channels, etc. However, there is no clear evidence showing the exact operation and the relative importance of these channels (Mishkin, 1995).

Since the mid-1980s, Taiwan has adopted a framework of monetary targeting. Over the last thirty years, there have been dramatic changes in the way financial markets operate in Taiwan, for example, the emergence of financial globalization, rapid-developed domestic financial conditions, the rise of direct financing, the complexity of financial innovation and derivatives, etc. The link between monetary policy and the economy has also changed over time. As a result, understanding how monetary policy affects the economy is essential for policymakers with pertinent insight for better decision-making.

There are lots of empirical studies of Taiwan's monetary transmission channels. Wu and Chen (2010) verify the existence of narrow and broad credit channels in Taiwan. Ferng (2009) investigates the channels of transmission of interest rate and credit and concludes that monetary policy shock does affect stock markets through these two channels. In another study, Huang and Yu (2015) emphasize the role of bank loans on monetary transmission and confirm the effectiveness of a credit channel in Taiwan's monetary transmission. Chen and Wang (2011) find no strong statistical evidence of wealth effect. However, all these papers focus on specific channels. Neglecting the dynamic interactions among macroeconomic variables may lead to biased estimate of the overall monetary policy transmission. There is only one but a little earlier research, Wu (2004), which gives a comprehensive analysis of the effects of different transmission channels. In addition, as we mentioned above, the monetary transmission mechanism evolved over time. It is necessary for us to reconsider an integrated approach to estimate the effect of monetary policy transmission.

In this paper, we are interested in the effectiveness of monetary policy implementation, the channels of monetary transmission mechanism, how large the

effects are, and how quickly they work. Our analysis is structured around two approaches. The first is to examine the effectiveness of monetary policy implementation. Instead of relying on the recursive Choleski approach to identify model parameters, we propose a structural vector autoregressive (SVAR) model that imposes restrictions on the variables' contemporaneous relationships to estimate the linkage between the monetary target (M2 as the intermediate target, reserve money as the operating target) and the policy instrument (open market operation). We provide evidence that policy instrument could better affect the intermediate target though the operating target and thus, the monetary policy is implemented effectively in Taiwan.

Subsequent to this analysis, we then present a structural analysis of monetary transmission channels by using the SVAR model. Specifically, we exhaustively investigate the effects of different transmission channels, which is much different from relevant literature in Taiwan. Estimation results find that bank lending channel, interest rate channel, exchange rate channel, and balance sheet channel shed light on the role of monetary policy transmission in Taiwan.

The rest of the paper is organized as follows. Section 2 overviews the monetary policy framework and main monetary transmission channels in Taiwan. We also briefly highlight the stability of money demand and the relationship between money demand and macroeconomic variables. Section 3 provides literature reviews on empirical studies of monetary transmission in Taiwan. Data and the methodology are described in section 4. Based on a simple open economy model, section 5 and section 6 report the empirical results about the effectiveness of monetary policy implementation and monetary transmission channels, respectively. Finally, section 7 concludes.

2. Monetary Policy Framework and Transmission Channels

2.1 An Overview of Monetary Policy Framework in Taiwan

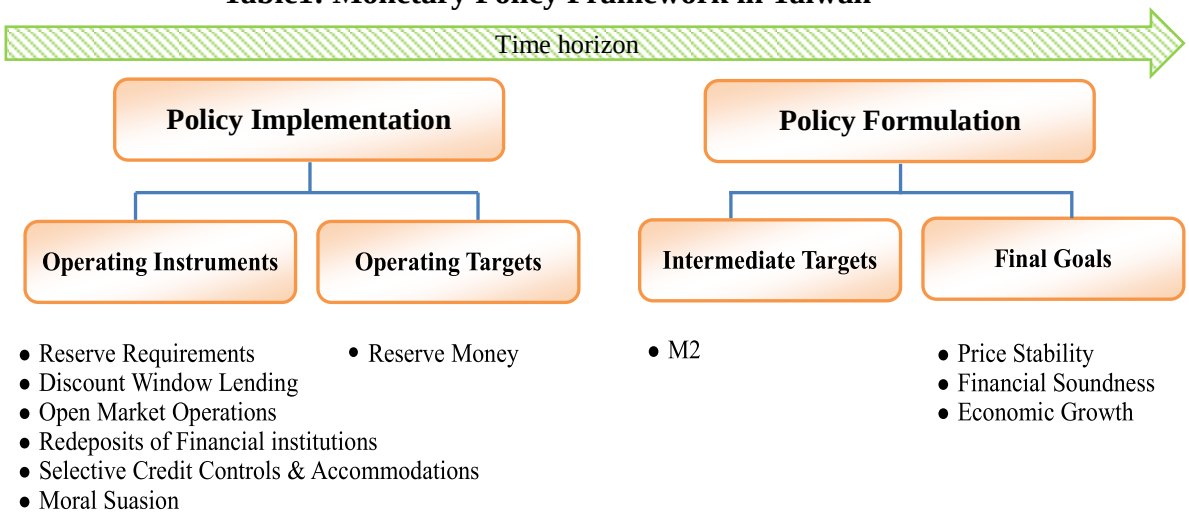
Taiwan has adopted a framework of M2 targeting and been publishing intermediate targets on a yearly basis since 1992. In the framework of monetary targeting, the final goals of monetary policy are price stability, financial soundness and economic growth. However, transmission mechanism of monetary policy has considerable time lags. If the central bank waits until policy effects become evident to

adjust its policy, it will lose the accurate assessment of the timing and effect to achieve its objectives. Therefore, the *Central Bank of* the Republic of China (Taiwan) (hereafter, the CBC) adopts operating instruments to achieve operating targets in the short run and in turn measures intermediate targets to assess its final policy goals.

For policy formulation, the CBC selects the M2 monetary aggregate as the intermediate target and estimates money demand function to derive M2 target zone. Every year, the staff of the CBC uses econometric methods to estimate money demand in order to determine the target zone of M2 growth for the coming year. Explanatory variables used to estimate money demand include real GDP, expected inflation rate, the opportunity cost of holding money, etc. The CBC then gathers some professors and experts to discuss the estimation results. The Board of Directors reviews the recommendations and decides the appropriate annual target zone. The final target zone settings and related explanations are announced in the *Quarterly Bulletin, Central Bank of the Republic of China (Taiwan).*

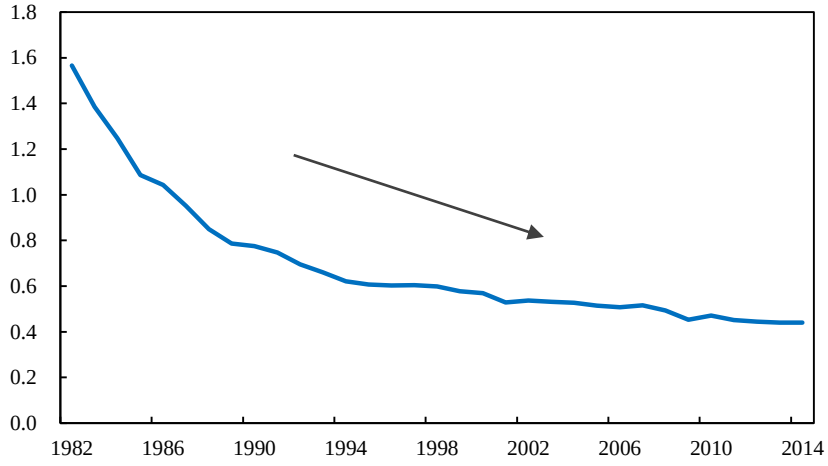
The target zone serves as a guide for monetary policy operation, leading changes in real money supply to the target zone. For policy implementation, the CBC chooses reserve money as the operating target for its daily operations. This variable is directly managed through tools of monetary policy and is closely related to the intermediate target. At the beginning of each month, the CBC determines the monthly target for reserve money. Policy instruments are used to keep reserve money within the target range. In recent years, open market operation has been the most important and active tool of monetary policy. Other operating instruments are reserve requirements, discount windows, financial institution redeposit, selective credit controls and accommodations and moral suasion. Around the middle of the year, the CBC examines whether the growth of monetary aggregate M2 has stayed within the target zone. If not, it will identify the cause and adopt corrective measures. Table 1 describes the monetary policy framework in Taiwan.

Table1: Monetary Policy Framework in Taiwan



A stable money demand function linking real balances, real income and interest rates is essential to many macroeconomic models and to monetary policy. Therefore, whether money demand function is stable affects significantly the accuracy and reasonability of M2 target zone settings. From the perspective of equation of exchange ($MV = PY$, in which M is money, V is the income velocity of money and $P \times Y$ is aggregate nominal GDP) based on quantity theory of money demand, if the income velocity of money is constant (i.e. $\overline{V}$), the demand for money is solely a function of nominal GDP, not directly affected by interest rates. Chart 1 shows the income velocity of money. From 1980s, the velocity of M2 declined sharply, reflecting financial deepening and the growing exposure to capital inflows (Wu, 2006; Wu, 2009) in Taiwan. In recent years, decreases in the velocity of M2 have been moderate, and thus it might become more stable.

Chart 1: The Velocity of M2



Furthermore, the relationship between money demand function and macroeconomic variables is another critical issue. Again from the equation of exchange, we take natural log and derivative of both sides and find that $\hat{M} + \hat{V} = \hat{P} + \hat{Y}$. Chart 2 describes M2 growth rate and economic activities (economic growth and inflation rate). From Chart 2, we could find that since 1991, M2 growth rates have fluctuated with inflation rate (the blue line and orange bar) and the income velocity of money in Taiwan appears quite stable as we discussed earlier. Therefore, when the income velocity of money is stable (V is constant, so $\hat{V} \approx 0$), then the growth rate of money may equal inflation rate plus economic growth rate ($\hat{M} \approx \hat{P} + \hat{Y}$). Since M2 was selected as the intermediate target for monetary policy, M2 growth rate has displayed a similar pattern as economic growth rate plus inflation rate, except the periods during the Asian financial crisis of 1997-1998, the Dotcom bubble of 1999-2001, and the global financial crisis of 2007-2009 (Chart 2). Overall, there is sufficient liquidity to sustain economic growth.

Chart 2: M2 Growth and Economic Activities

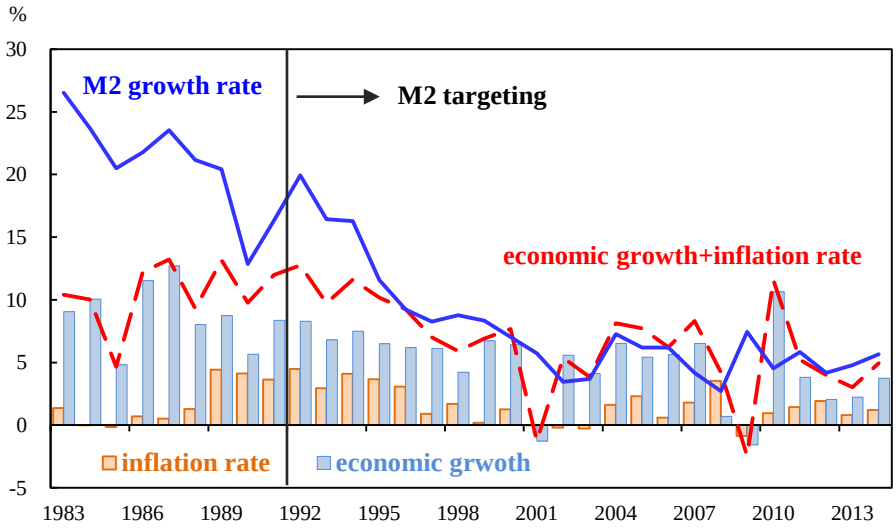
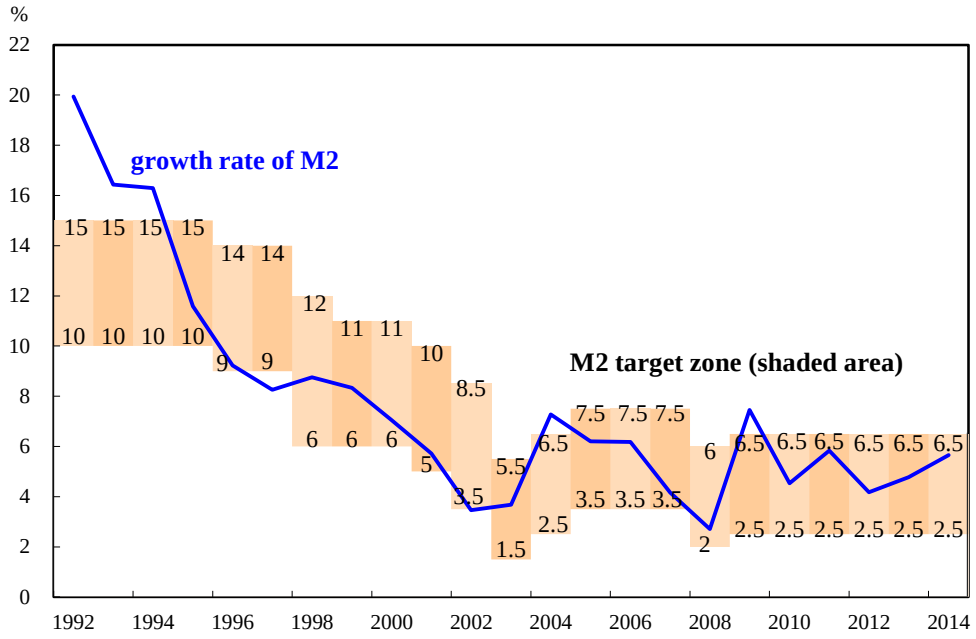


Chart 3 displays M2 growth rate and its target zones. The target zones for M2 growth were between 10%-15% from 1992 to 1995 and 9%-14% in 1996 and 1997, and the range of the target zone was widened from 5 to 6 percentage points in 1998 in response to the uncertainties caused by the Asian financial crisis. Thus the zone was set at 6%-12% in 1998 and at 6%-11% in 1999 and 2000. In 2001, demand for money decreased as the economy slowed down and the zone was lowered to 5%-10%.

Subsequently, it was lowered again to 3.5%-8.5% in 2002 and 1.5%-5.5% in 2003. In 2004, when the economy picked up, the zones increased to 2.5%-6.5%, and to 3.5%-7.5% from 2005 to 2007. In 2008, the financial crisis triggered by the US subprime mortgage debacle led to an international economic slowdown. As a result, the zone was adjusted down to 2%-6%. The target zones for M2 growth were between 2.5%-6.5% from 2009 to 2014.

Chart 3: M2 Growth Rate and Its Target Zones



The framework of monetary policy described above helps the CBC's policy be consistent with its goals. However, factors such as financial globalization, the establishment of new banks and financial innovation increase the complexity of conducting monetary policy and can detract the CBC from fulfilling its objectives. Monetary policy challenges related to the above mentioned factors included:

(1) Establishment of new banks

Before 1991, more restrictions were imposed on the banking sector and there were only 24 domestic banks in Taiwan. In 1991, the Taiwanese government started to liberalize and deregulate the financial markets and allowed 16 private commercial banks to be established around 1992. Therefore, the growth of bank loans and investments increased sharply, which caused uncertainties in M2 and led M2 growth rate to go beyond the target zone in the early 1990s.

(2) Financial innovation

Since 2003, bond funds, which are similar to money market funds in nature, have grown rapidly at the expense of bank deposits. The amount of bond funds in 2003 reached NT$ 2,400 billion, accounting for 10% of the amount of M2 that year. As a result, the CBC had once adopted a new target variable—M2 plus bond funds—in 2003 and 2004. In 2003, the zones for the dual target system were 3%-7% for the growth of M2 plus bond funds and 1.5%-5.5% for the growth of M2. In 2004, the zones increased to 4%-8% and 2.5%-6.5% respectively.

(3) Financial globalization and abnormal capital flows

One of the main characteristics of financial globalization is the increase in capital flows. When cross-border capital flows are large and acute, exchange rate may become unstable and can lead to large swings in asset prices, financial markets and monetary growth. During the periods of the Asian financial crisis and the global financial crisis, abnormal capital flows induced M2 growth rate beyond the target ranges.

2.2 Main Monetary Policy Transmission Channels

The definition of monetary policy transmission channel is how changes in the monetary policy variables affect inflation and output. Effective monetary policy influences economic activity mainly by affecting the cost of money and credit and depending on the economic structures. As the framework of monetary policy mentioned above, the interbank overnight rate is determined by the interaction between the CBC's control of the supply of bank reserves and the banking system's demand for reserves. Thus, there are some channels of monetary transmission in Taiwan and the effect of monetary policy is transmitted to total output and prices. There are many channels of monetary transmission mechanism,[1] but we will explain here four channels that provide the theoretical background for our empirical analysis. The channels are exchange rate, interest rate, wealth, and credit channels. The following paragraphs describe how an expansionary monetary policy affects economic activity through various transmission channels.

(1) Interest rate channel: The interest rate channel is the primary mechanism at work

[1] For more comprehensive discussions of monetary transmission channels, see Mishkin (1995) or, more recently, Mishkin (2007, Chap. 23) and Boivin et al (2010).

in conventional macroeconomic models. From the "money view," an increase in the money supply leading to a decrease in the interest rate triggers investment/consumption and ultimately GDP. Accordingly, when the central bank conducts an expansionary monetary policy, nominal interest rates such as interbank overnight rate drop, which may reduce the cost of investment, making more projects profitable and stimulating consumption and spending.

(2) Credit channel: The credit channel comprises the bank lending channel and the balance sheet channel. An expansionary monetary policy influences bank credit in two ways: (i) increasing bank funds available for making loans (the bank lending channel), and (ii) improving borrowers' financial positions (an increase in firms' net worth), making banks more willing to lend (the balance sheet channel). We will explain each in turn. The bank lending channel operates through quantity of loans available. An expansionary monetary policy increasing supply of loans, which leads to an increase in borrowing, generates economic activities through enhanced consumption and investment and thus GDP. The balance sheet channel is performed as follows. Expansionary monetary policy, which causes a rise in stock prices, raises the net worth of firms and so leads to an improvement in the cash flow of borrowers, and banks become willing to lend because of the decrease in adverse selection and moral hazard risks. This subsequently boosts higher investment spending and aggregate demand.

(3) Wealth channel: An expansionary monetary policy may raise asset prices, such as stock prices and housing prices and consequently increase the wealth of the general public and consumer spending.

(4) Exchange rate channel: In a smaller and more open economy and especially after financial globalization, exchange rate channel assumes more important. In this channel, the monetary policy affects economic activities mainly through net exports. Thus, lower interest rates reduce the attractiveness of domestic assets, depressing the value of the currency and increasing net exports.

An expansionary monetary policy brings domestic interest rates down as it adds to the appeal of foreign fixed income assets relative to domestic ones, which weakens the domestic currencies yet improves export competitiveness improves, thereby promoting exports. Osorio et al. (2011) echoed that exchange rate channel

is relatively important in Taiwan.

3. Literature Review

In this section, we are going to review related literature of monetary transmission in Taiwan. First of all, whether the central bank can affect market retail rates is the first step in typical transmission channels, so it is an important linkage between monetary policy variable and the economy. Kao and Wan (2014) research interest rate pass-through in Taiwan, and they find that the change in interbank overnight interest rate, which represents the change in monetary policy, would pass through to commercial banks' deposit rates and lending rates. It means that the central bank is able to affect the market retail rates in Taiwan.

Next, on the existence of various monetary transmission channels in Taiwan, there are lots of empirical researches. The following are reviews of some recent empirical studies. Wu (2004) uses quarterly data during 1982-2003 to comprehensively analyze the effects of different transmission channels with vector autoregressive (VAR) model. She finds that most transmission channels, including interest rate channel, bank lending channel, balance sheet channel and exchange rate channel, are significant in Taiwan. However, wealth effect channel is insignificant in her empirical results.

To examine the existence of interest rate channel and credit channel, Ferng (2009) utilizes daily data during 1989-2008 to investigate the effect of monetary policy shock on daily stock returns. The proxy of monetary policy shock is interbank overnight rate's orthogonal innovations extracted from a SVAR model. According to his regression results, interest rate channel does exist, and it is more effective on industrial sectors which are capital intensive or cyclical. Furthermore, credit channel also exists, and it has a stronger effect on firms that are financially constrained.

To analyze the role of credit channel in Taiwan's economy, Wu and Chen (2010) use quarterly data to build a large-scale macro-econometric model. Their empirical results show that an increase in reserve money would affect bank loans and private investment; a decrease in interbank overnight rate would affect bank loans, the stock and housing markets, and thus domestic demand. The former indicates that narrow credit channel exists, and the latter illustrates that broad credit channel also exists.

Moreover, they also find that deterioration in international economic conditions would impact Taiwan's economy negatively.

Chang et al. (2010), who collect monthly data of Taiwan's commercial banks from Jan. 1993 to Jun. 2008, employ a panel GMM model to examine the asymmetric effect of monetary policy on loan supply. They use interbank overnight rate as a proxy of monetary policy. The empirical results show that the bank lending channel is operative in Taiwan, and the degree of the asymmetric policy effect depends on bank balance sheet characteristics, such as asset size and liquidity strength. Moreover, a contractionary monetary policy has a stronger effect on bank credits.

To investigate wealth effect in Taiwan, Chen and Wang (2011) apply aggregate data covering 1992Q1-2009Q3 and household survey data covering 1996-2006 to estimate the effect of changes in asset wealth on private consumption expenditure. According to their estimation results, stocks wealth effect is significant but less effective in aggregate, and it is significant for middle and older households at the household level. Housing wealth effect is insignificant at both the aggregate and household levels, and an increase in housing prices has a negative impact on consumption expenditure of younger households and renters.

In addition, Osorio et al. (2011), who employ the weighted-sum and principal-component approaches, construct a financial conditions index (FCI) for 13 Asian economies to capture the linkages between financial conditions and economic activity during 2001Q1-2010Q2. They find that exchange rate channel is relatively important in Taiwan like other export-dependent economies, such as Hong Kong and Singapore.

Recently, Huang and Yu (2015) apply VAR models to study the existence of bank lending channel in Taiwan with data covering 1997M1-2011M5. They find that after a monetary tightening, business and secured loans increase yet consumer and unsecured loans decline, which resulted from bankers' decision on loan supply rather than customers' decision on loan demand. Accordingly, the role of credit channel in Taiwan's monetary transmission is confirmed.

In light of the aforementioned researches, we can make a summary as Table 2. We can know that: First, the change in policy rate could pass through to the market rates (Kao and Wan, 2014), so the central bank is able to affect the market retail rates

in Taiwan. Second, most transmission channels are significant in Taiwan, which includes interest rate channel (Wu 2004; Ferng 2009), bank lending channel (Wu 2004; Wu and Chen 2010; Chang et al. 2010; Huang and Yu 2015), balance sheet channel (Wu 2004; Ferng 2009; Wu and Chen 2010) and exchange rate channel (Wu 2004; Osorio et al. 2011). On the other hand, wealth effect channel is insignificant or less effective (Wu 2004; Chen and Wang 2011).

Table 2: A Summary of Recent Monetary Transmission Literature

Literature	Estimation Methods	Sample Periods	Main Conclusions
Wu (2004)	VAR	1982Q1-2003Q4	Interest rate, exchange rate, and credit channels are significant in Taiwan.
Ferng (2009)	OLS	1989/1/1 -2008/12/31	Monetary policy shock would affect stock markets through interest rate and credit channels.
Wu and Chen (2010)	Macro-econometric model	-2008Q2	Narrow and broad credit channels exist in Taiwan.
Chang et al. (2010)	Panel GMM	1993M1-2004M6	Bank lending channel is operative, and the degree of the asymmetric policy effect depends on bank balance sheet characteristics.
Osorio et al. (2011)	The construction of FCI (weighted-sum/principal-component approach)	2001Q1-2010Q2	Exchange rate channel is relatively important in Taiwan.
Chen and Wang (2011)	OLS/2SLS/VECM/ random-effect model	1992Q1-2009Q3/ 1996-2006	Wealth effect is insignificant or less effective.
Kao and Wan (2014)	ARDL (threshold/ cointegration model)	1980s-2011	The change in the interbank overnight interest rate would pass through to commercial banks' deposit and lending rates.
Huang and Yu (2015)	VAR	1997M1-2011M5	Monetary policy shock would affect bankers' decision on loan supply.

Compared with the other channels, wealth effect is not so important since it is insignificant or less effective. Therefore, our empirical study will focus on the other channels, which are more effective and more important in Taiwan's monetary transmission.

4. Model, Data and Estimation Methods

4.1 SVAR model

The VAR model has been extensively used in the literature to measure the response of output and price to the shocks in the monetary policy transmission. The use of VAR for the pioneer study on monetary policy started with the seminal work of Sims (1980). Nonetheless, Cushman and Zha (1997) point out that the recursive Choleski approach of VAR, although widely used in the literature, may be appropriate for large and relatively closed economies, but is likely to be problematic for small open economies. The authors suggest that instead of relying on reduced form equations and the recursive Choleski techniques, a SVAR approach is better to describe the variables' contemporaneous relationships, since it allows more flexible imposition of restrictions in identifying model parameters. Therefore, in order to analyze the impact of monetary policy actions on macroeconomic variables (i.e. output and price), we construct a structural form model to identify the effects of monetary policy on output and price, and the model is imposed with the minimal structural restrictions. In addition, we also compute the impulse response function and forecast error variance decomposition.

Let us begin with a general specification. A SVAR model with *k* endogenous variables and *p* lags can be specified as:

$$\boldsymbol{A}\boldsymbol{y}_t = \sum_{i=1}^{p} \boldsymbol{A}_i L^i \boldsymbol{y}_t + \boldsymbol{e}_t,$$

where $\mathbf{y}_t$ is a $k \times 1$ vector, $\mathbf{A}$ and $\mathbf{A}_1, \cdots, \mathbf{A}_p$ are $k \times k$ matrices, L^i is the lag operator, and $\boldsymbol{e}_t$ is a vector of white noise residuals with

$$\mathrm{E}[\boldsymbol{e}_t \boldsymbol{e}_t'] = \mathbf{D},$$

whilst **D** is a positive definite matrix with $\mathrm{E}[e_{it} e_{jt}] = 0$ and $i \neq j$.

Since matrix **A** specifies the contemporaneous relationships between the variables, the econometric identification of the model is obtained through restrictions on **A**, that is, imposing restrictions on variables' short-run relationships. A common means of orthogonalising the shocks in an SVAR system is to assume a recursive (Cholesky) ordering of variables. In a recursive model, **A** is specified as a lower triangular matrix, which implies that y_{it} would influence y_{jt} contemporaneously

for $i < j$, but the converse is not true. Consequently, the ordering of variables in the recursive model gives rise to certain economic interpretations of the variables used in the model. Although the recursive SVAR is just-identified and relatively easy to estimate, any orderings of variables are not always plausible. To avoid this criticism, Blanchard and Watson (1986), Bernanke (1986), Sims (1986), and Sims and Zha (2006) suggest a generalized method, SVAR, using non-recursive structure while imposing restrictions only on contemporaneous structural parameters.

The first issue we have to mention is whether that should be used in level or difference. The literature holds divergent views. There are three different ways to specify the VAR model: (i) make the variables stationary by taking the difference, (ii) follow the Sims (1980) and Christiano et al. (1996) by displaying a SVAR in levels, and (iii) use Vector Error Correction Model (VECM) by applying cointegration technique. The choice of any of them remains debatable.[2] All three choices mentioned above in the text have their own pros and cons. There is no clear-cut guideline whether stationarity should be forced on the data or VAR in level should be preferred. Thus, there are different ways presented in the literature. For example, Bernanke and Blinder (1992), Sims (1992), Levy and Halikias (1997), Peersman and Smet (2001) estimate VAR in level, Kim and Roubini (2000) use SVAR in level, while Monticelli and Tristani (1999) use stationary variables in the SVAR model.

On top of that, Toda and Yamamoto (1995) pointed out that tests for unit roots have arbitrarily low power in finite samples and as the cointegration test depends on the order of the VAR, the cointegration test is not always reliable. As a result, the VAR model based on taking the difference or cointegration relationship may suffer pretest biases. In brief, this study will estimate SVAR in level. Needless to say that differencing brings the loss in information.

Another issue of interest is about lag selection. Selection of lag lengths (p) for the SVAR model is usually ad hoc in the relative literature. For example, Cushman and Zha (1997) choose 12 lag lengths, whilst Gordon and Leeper (1994), Kim and Roubini (2000) and Kim (2003) estimate models with 6 lags; nevertheless, neither do they explain their lag selection procedures. Consequently, we employ the

[2] Hamilton (1994) provided a comprehensive and technical discussion of the various multiple time series methods (among VAR and SVAR).

lag-augmented VAR approach suggested by Toda and Yamamoto (1995). They adopt a $(p + d_{max})$th-order for non-stationary series, where p is the order chosen by general lag selection criterions and d_{max} is the maximal order of integration.

4.2 Data Description

The data span from Jan, 2000 to Dec, 2014, and the descriptions and the sources are summarized in Table 3. For real economic activities, as monthly GDP is not available, we use index of industrial production as a proxy of output (Y) and price (P) are represented by consumer price index. Both of these series use 2011 as base year.

Table 3: Data Source and Description

Variable	Description	Source
Y	Index of Industrial Production	Industrial Production Statistics Monthly
P	Consumer Price Index	Price Statistics Monthly
L	Loans and Investments of Monetary Financial Institutions–Claims on Private Sector	Financial Statistics Monthly
NCD	Negotiable Certificates of Deposit	Financial Statistics Monthly
RM	Reserve Money	Financial Statistics Monthly
M2	Monetary Aggregate M2	Financial Statistics Monthly
R	Interbank Overnight Interest Rate	Financial Statistics Monthly
ER	Spot Exchange Rate of NT$ against US$	Financial Statistics Monthly
SP	Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX)	Financial Statistics Monthly
OIL	Crude Oil (Petroleum), Simple Average of Three Spot Prices	IMF

Bank lending (L) is represented by the variable "loans and investments of monetary financial institutions–claims on private sector."[3] Note that this variable

[3] In addition to banks, "monetary financial institutions" include other credit-creating institutions, such as credit cooperative associations, and the credit departments of farmers' or fishermen's associations.

consists of not only loans, but investment.[4] Owing to these two reasons: (i) investments of monetary financial institutions include corporate bonds, and corporate bond is another way that businesses finance their investment or operations, and (ii) the change in investments of monetary financial institutions could affect M2,[5] investments of monetary financial institutions could be related to real economy and monetary aggregate M2. Thus, it's more reasonable to utilize "loans and investments" rather than "loans".

About the other variables, Interbank Overnight Interest Rate (R) is the proxy of monetary policy. It is considered that each interest rate has a corresponding money supply and money demand equates to money supply to clear the money market. The foreign exchange rate (ER) is the exchange rates of NT$ against US$. The stock price index, Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX), is the proxy of the performance of stock market (SP). For a small open economy, foreign influences cannot be ignored. We take world crude oil price (OIL) as an exogenous controlled variable to capture this effect.

To check the effectiveness of monetary policy implementation, we would like to estimate the connection between the monetary target and the policy tool. The monetary target includes M2, the intermediate target, and reserve money (RM), which is the operating target for daily operations. Since open market operation is the most important and active tool of monetary policy and the Negotiable Certificates of Deposit (NCD) is the most frequently used open market instrument, the amount of NCD is taken as the policy tool variable.

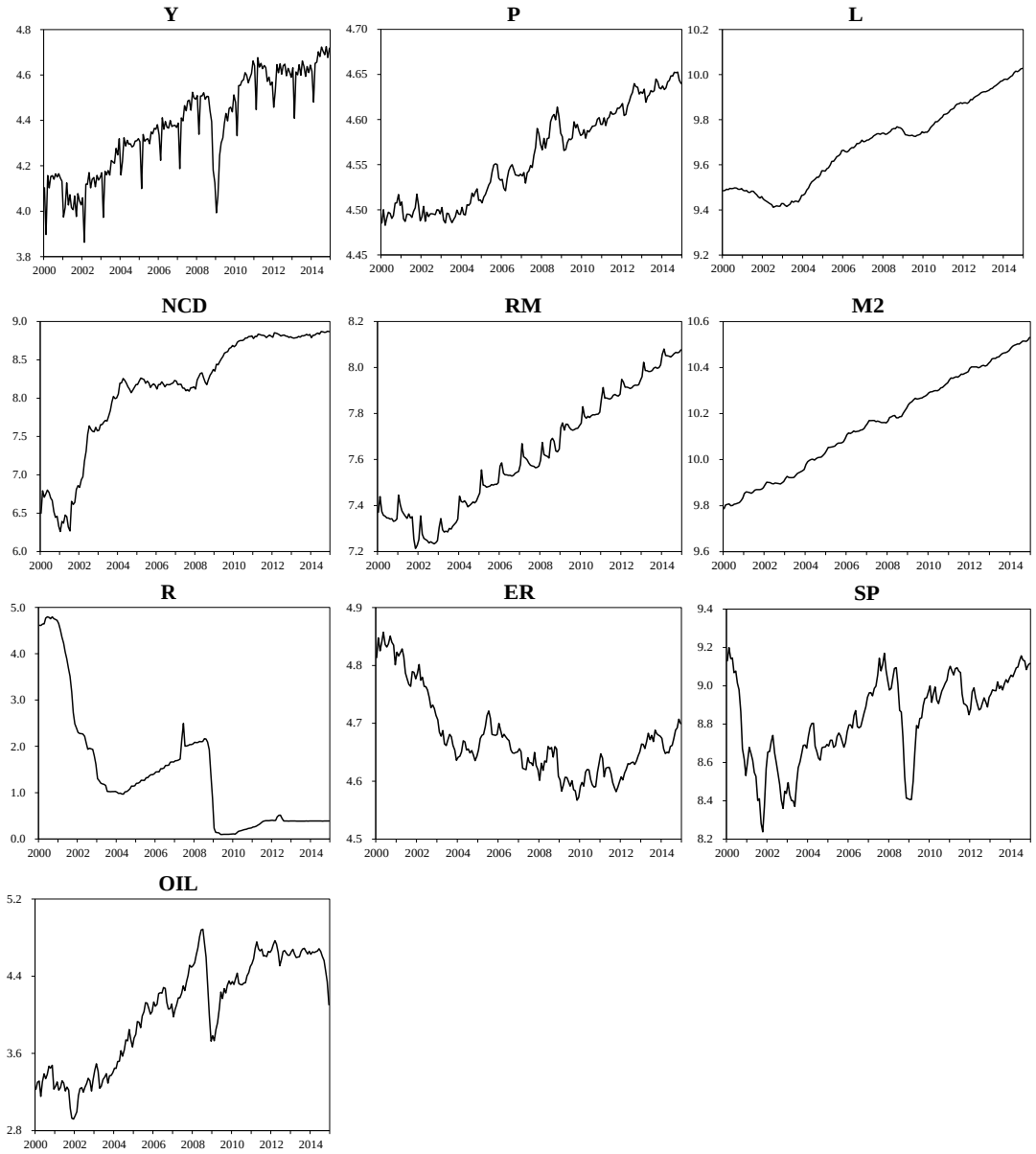
All variables are taken natural log except interest rate, and the data patterns are plotted in Chart 4. We can see that Y sharply drops during the financial crisis of 2008, and the pattern of P is correlated with OIL, especially for mid-2007 to 2008. There are two sharp decreases in R during mid-2001 to 2003 and the 2008 financial crisis, which is to react to the economic recession and the slowdown in domestic demand. The amount of NCD increases a lot during mid-2001 to 2003 and mid-2008 to 2010, and its outstanding balance is NT$ 7,106.3 billion at the end of 2014. RM has an

[4] During the sample period, "loans" account for 88%-96% of bank lending.

[5] For robustness check, we also use "loans of all banks–claims on private sector" to substitute "loans and investments of monetary financial institutions–claims on private sector," and the result does not change. See the discussion in 6.3.

evident seasonal pattern, which results from a temporary seasonal surge in money demand during the Chinese Lunar New Year holidays.

Chart 4: Time Series Plots



5. Effectiveness of Monetary Policy Implementation

5.1 Identification

First, we would like to check the effectiveness of monetary policy implementation. We construct an SVAR model to estimate the link between the monetary target and policy instruments. The data vector contains four endogenous variables: {NCD, R, RM, M2} in our first model. NCD is the policy instrument, and R and RM represent price and quantity in the market for reserves. M2 is the intermediate target.

The following is the identification scheme of the SVAR model for monetary policy implementation:

$$\mathbb{A}\mathrm{y}_t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ \mathbb{a}_{21} & 1 & 0 & 0 \\ \mathbb{a}_{31} & 0 & 1 & 0 \\ 0 & \mathbb{a}_{42} & \mathbb{a}_{43} & 1 \end{bmatrix} \begin{bmatrix} \mathrm{NCD}_t \\ \mathrm{R}_t \\ \mathrm{RM}_t \\ \mathrm{M2}_t \end{bmatrix} = \sum_{i=1}^{p} \mathbb{A}_i L^i \mathbb{y}_t + \begin{bmatrix} \mathrm{e}_t^{\mathrm{NCD}} \\ \mathrm{e}_t^{\mathrm{R}} \\ \mathrm{e}_t^{\mathrm{RM}} \\ \mathrm{e}_t^{\mathrm{M2}} \end{bmatrix}.$$

For the checking of the effectiveness of monetary policy implementation, we would like to know whether or not NCD affects M2 and the market for reserves as well as M2. The first equation assumes that NCD, the policy instrument, is not related to other variables contemporaneously. The second and third equation describe that the issuance of NCD would affect price and quantity in the market for reserves, so R and RM are assumed to react to NCD contemporaneously. RM is also the operating target. The fourth equation assumes that the intermediate target, M2, is related to R and RM contemporaneously, so M2 is affected by NCD indirectly.

In addition, several exogenous variables are considered in the SVAR model: monthly dummy variables, lunar calendar holiday regressor,[6] and the 2008 financial crisis dummy.[7]

If the estimated result shows that NCD could affect R and RM, and RM could affect M2, it means the policy instrument could affect policy variables, so the implementation of monetary policy is effective in Taiwan.

---

[6] The lunar calendar holiday regressor is generated from the Genhol program. For more details, see the manual of U.S. Census X-12.

[7] The period is from Sep 2008 to Aug 2009.

5.2 Empirical Results

To estimate the SVAR model, we choose the lag length based on AIC (Akaike information criterion). AIC statistics yields p=7. We assume d_{max}=1 because the possible maximal order of integration of macroeconomic variables are usually regarded as 1. Thus, we obtain lags=8.

Table 4 reports the estimated coefficients that indicate contemporaneous effects between the variables, and the impulse response of R, RM and M2 are shown in Chart 5. We can see that the overnight interest rate and reserve money could affect monetary aggregate M2 immediately. M2 increases as interest rate decreases ($a_{42} > 0$) and reserve money increases ($a_{43} < 0$). Although the contemporaneous coefficients of NCD on R and RM are insignificant, R increases and RM decreases in response to NCD shocks. Besides, RM shock has a positive and persistent effect on M2, and M2 decreases in response to R shocks at a 10% significance level.

Table 4: The Contemporaneous Coefficients (Model 1)

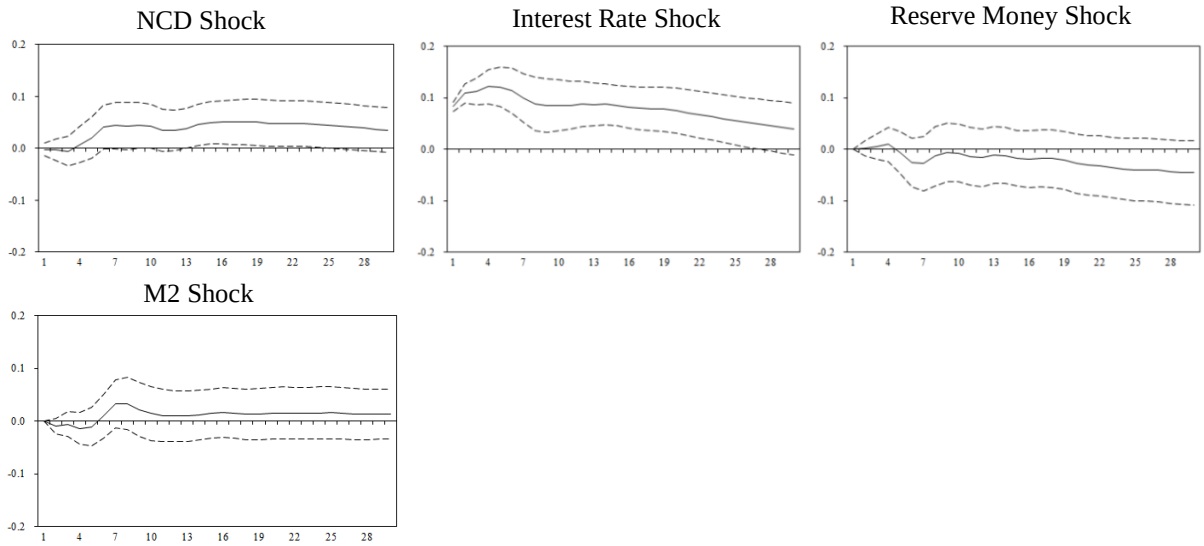
	coefficient	standard error	*t*-statistics	*p*-value
a_{21}	0.056	0.151	0.374	0.708
a_{31}	0.053	0.034	1.564	0.118
a_{42}	0.005*	0.003	1.798	0.072
a_{43}	-0.073***	0.012	-6.262	0.000

Note: ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively.

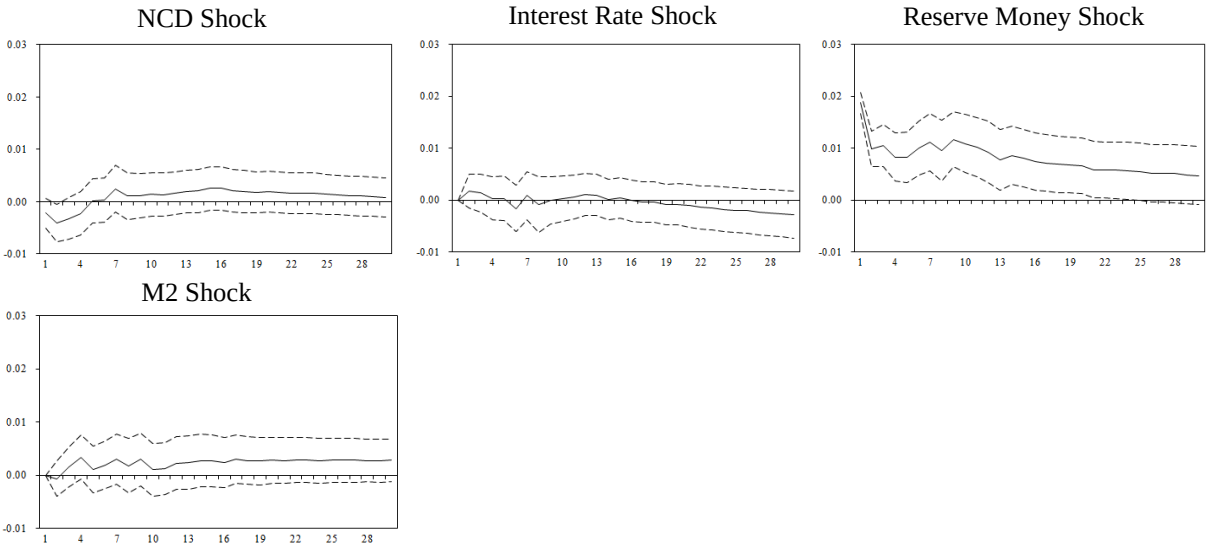
Accordingly, the issuance of NCD could affect interest rate and reserve money through absorbing excess liquidity, and M2 would be affected by a change in reserve money. Thus, the estimated result shows that the policy instrument could affect the intermediate target through the operating target, so the implementation of monetary policy is effective in Taiwan.

Chart 5: Impulse Response to Different Shocks (Model 1)

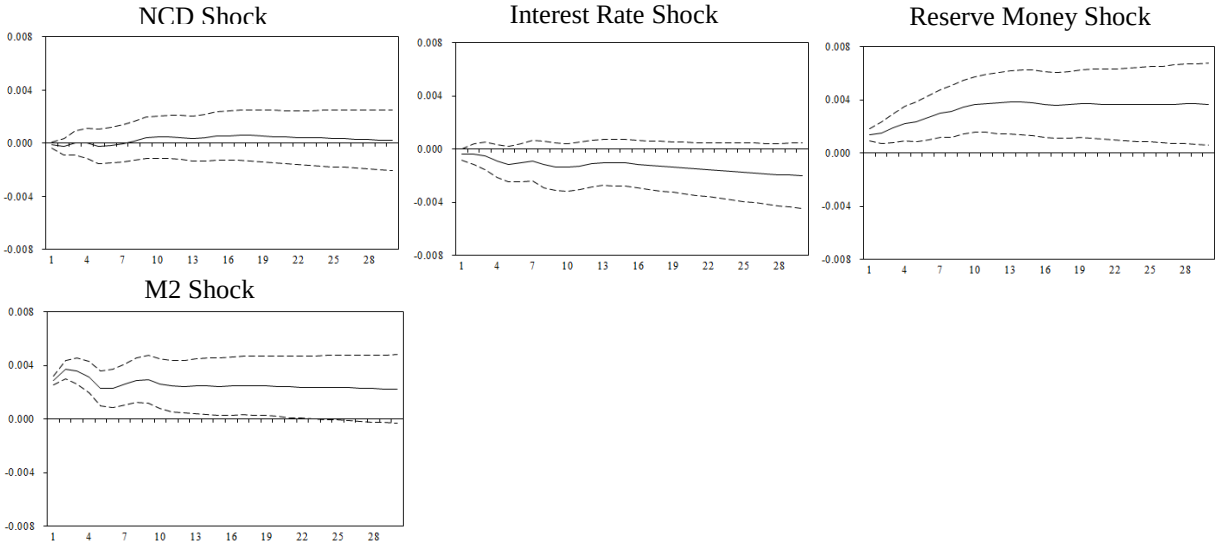
(a) Impulse Response of Interest Rate (R)



(b) Impulse Response of Reserve Money (RM)



(c) Impulse Response of M2



Notes: 1. Response to One Standard Deviation.
2. The dotted line indicates 95% confidence interval.

6. Channels of Monetary Transmission

6.1 Identification

The main objective of the study is to investigate the importance of transmission channels in Taiwan, so in our second model, the data vector is {Y, P, L, M2, R, ER, SP}. The first two variables—industrial production index (Y) and consumer price index (P) are target variables; to check the relative strength of transmission channels, we need intermediate variables. Each intermediate variable represents a certain transmission channel. Our intermediate variables are bank lending (L), overnight interest rate (R), exchange rate (ER) and stock price (SP). These variables represent bank lending channel, traditional interest rate channel, exchange rate channel and balance sheet channel, respectively.[8] Since R could be affected by the central bank through open market operations, it could be used to represent monetary policy stance. As Taiwan adopts a framework of M2 targeting, we also include the monetary aggregate M2 (M2), as usually done in studies of similar subjects.

Referring to empirical literature we discussed earlier, we set the identification scheme of the SVAR model for Taiwan's monetary transmission as follows:

$$\boldsymbol{A}\boldsymbol{y}_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & a_{35} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & a_{45} & 0 & 0 \\ a_{51} & a_{52} & 0 & 0 & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & a_{67} \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \mathrm{Y}_t \\ \mathrm{P}_t \\ \mathrm{L}_t \\ \mathrm{M2}_t \\ \mathrm{R}_t \\ \mathrm{ER}_t \\ \mathrm{SP}_t \end{bmatrix} = \sum_{i=1}^{p} \boldsymbol{A}_i L^i \boldsymbol{y}_t + \begin{bmatrix} \mathrm{e}_t^{\mathrm{Y}} \\ \mathrm{e}_t^{\mathrm{P}} \\ \mathrm{e}_t^{\mathrm{L}} \\ \mathrm{e}_t^{\mathrm{M2}} \\ \mathrm{e}_t^{\mathrm{R}} \\ \mathrm{e}_t^{\mathrm{ER}} \\ \mathrm{e}_t^{\mathrm{SM}} \end{bmatrix}.$$

The first two equations describe real economic activity, including output and price. Because of contract restrictions or adjustment costs, the adjustments of output and price are sluggish, so both of them are assumed not to contemporaneously react to the other economic and financial variables.

There is a time lag in signing a contract, so loans are quasi-rigid. The third

[8] We do not consider wealth effect channel in our empirical analysis here based on our earlier discussions on the papers of Wu (2004) and Chen and Wang (2011).

equation describes that when the banking sector makes a lending decision to the private sector, it takes macroeconomic conditions and the central bank's monetary policy stance into consideration. Hence, the variables Y, P and R have contemporaneous effects on bank lending. The fourth equation states the determinants of the monetary aggregate M2. Based on the quantity theory of money, money demand is dependent on output, price and interest rate. On the other hand, an increase in bank lending and investment will also expand the monetary aggregate, so M2 is assumed to react to Y, P, R, and L contemporaneously. The fifth equation describes that the central bank takes output and price as its policy targets, so R reacts to Y and P immediately.

The last two equations assume that all the economic and financial variables have contemporaneous effect on exchange rate and stock price. Because foreign exchange rate and stock price are forward-looking asset prices, they react to real and nominal shocks immediately. However, stock price has a contemporaneous effect on exchange rate, but not vice versa. The reason is that the performance of stock market might induce capital flows, so exchange rate could be affected.

In addition, we also consider several exogenous variables in our SVAR model: monthly dummy variables, lunar calendar holiday regressor, the 2008 financial crisis dummy, and the world crude oil price.

6.2 Empirical Results

In this section, we discuss the empirical results of monetary policy transmission in Taiwan. For estimating the SVAR model, we choose the lag length based on AIC again, and it yields p=2. Then, we assume d_{max}=1 because macroeconomic variables are usually regarded as I(1), and obtain lags=3 as a result.

Table 5 shows the estimated coefficients of the SVAR model. The coefficients indicate contemporaneous effects between the variables. The statistic and its significance level of the likelihood ratio (LR) test for the null hypothesis of over-identifying restrictions are χ^2 (1) = 1.918 and 0.166, respectively, so the identification of the SVAR model is reasonable.

Table 5: The Contemporaneous Coefficients (Model 2)

	coefficient	standard error	*t*-statistics	*p*-value
a_{31}	-0.018**	0.009	-2.021	0.043
a_{41}	0.014**	0.006	2.375	0.018
a_{51}	-0.559***	0.152	-3.676	0.000
a_{61}	0.015	0.019	0.781	0.435
a_{71}	-0.322***	0.095	-3.387	0.001
a_{32}	0.102*	0.060	1.695	0.090
a_{42}	-0.098**	0.039	-2.540	0.011
a_{52}	0.547	1.051	0.521	0.603
a_{62}	0.253**	0.126	2.009	0.045
a_{72}	0.377	0.632	0.595	0.552
a_{43}	-0.074	0.048	-1.547	0.122
a_{63}	-0.122	0.155	-0.788	0.431
a_{73}	0.181	0.778	0.232	0.816
a_{64}	0.447*	0.255	1.756	0.079
a_{74}	-5.563***	1.211	-4.593	0.000
a_{35}	0.003	0.004	0.714	0.475
a_{45}	0.001	0.003	0.455	0.649
a_{65}	-0.011	0.009	-1.217	0.224
a_{75}	-0.004	0.044	-0.079	0.937
a_{67}	0.079***	0.015	5.303	0.000

Note: ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively.

For the statistically significant coefficients, most of their signs are as expected. According to the estimation results, we can see that an increase in output will raise the demand of bank lending ($a_{31} < 0$). Although output has a negative contemporaneous effect on M2 ($a_{41} > 0$), the impulse response of M2 to output is still positive (see Appendix). So an increase in output raises M2 after a time lag. In addition, M2 rises as price rises ($a_{42} < 0$). Interest rate will be raised as output increases ($a_{51} < 0$). However, the effect of price on interest rate (a_{52}) is insignificant. There are two possible reasons: (i) price inflation has been at a low and stable level during sample periods;[9] (ii) the central bank reacts to price inflation in a forward looking way (Chen and Wu, 2010).

[9] From Jan 2000 to Dec 2014, the average of CPI annual change rate is 1.07% and its sample variance is 2.10.

6.2.1 Impulse Response Function

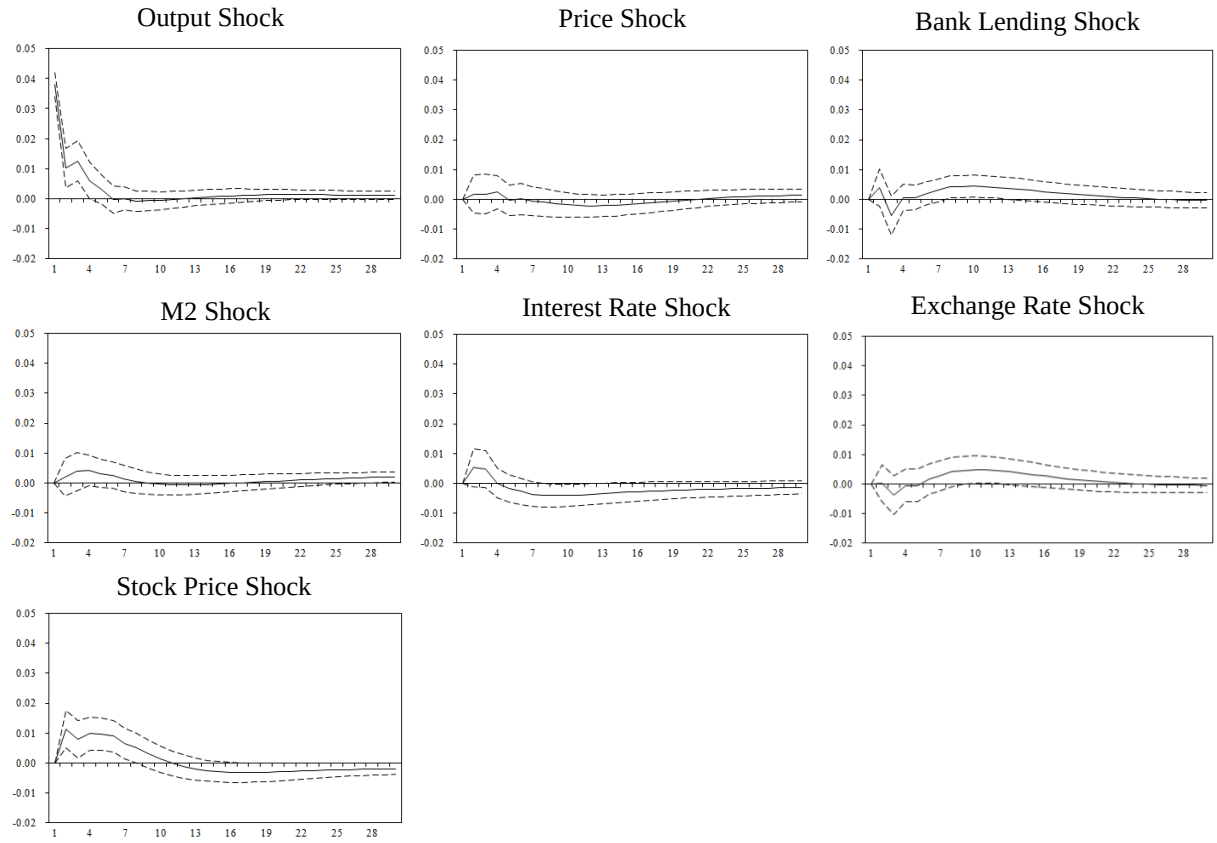
Impulse response functions give visual representation of the behavior of observed series in response to structural shock and are used to measure the effectiveness of policy changes. In this paper, we are particularly interested in the response of output and price to innovations in monetary policy transmission. (For impulse responses of bank lending, M2, and stock price, see Appendix.)

The upper part of Chart 6 displays the response of output to various one-standard-deviation positive shocks. The confidence interval band is 95% bands (over 30 months). As shown and as expected, an increase in interest rate reduces output, though with lag effects. This decline in output is significant starting from the 7th month and the effects last for almost 13 months. Moreover, we also expect that depreciation in exchange rate raises output, which indicates that exchange rate channel plays an important role in monetary policy transmission process given a small open economy of Taiwan. Moreover, an increase in bank lending boosts economic growth, confirming the role of a bank lending channel in Taiwan. The response of output to stock price is also pronounced and statistically significant, which means that the balance sheet channel does exist. After a positive shock in stock price, output increases and reverts back to the initial level after the 9th month. Furthermore, it is worth noting that in addition to the effect of balance sheet channel, stock price shocks might also reflect changes in international economic and financial conditions, or developments in the industrial sector.

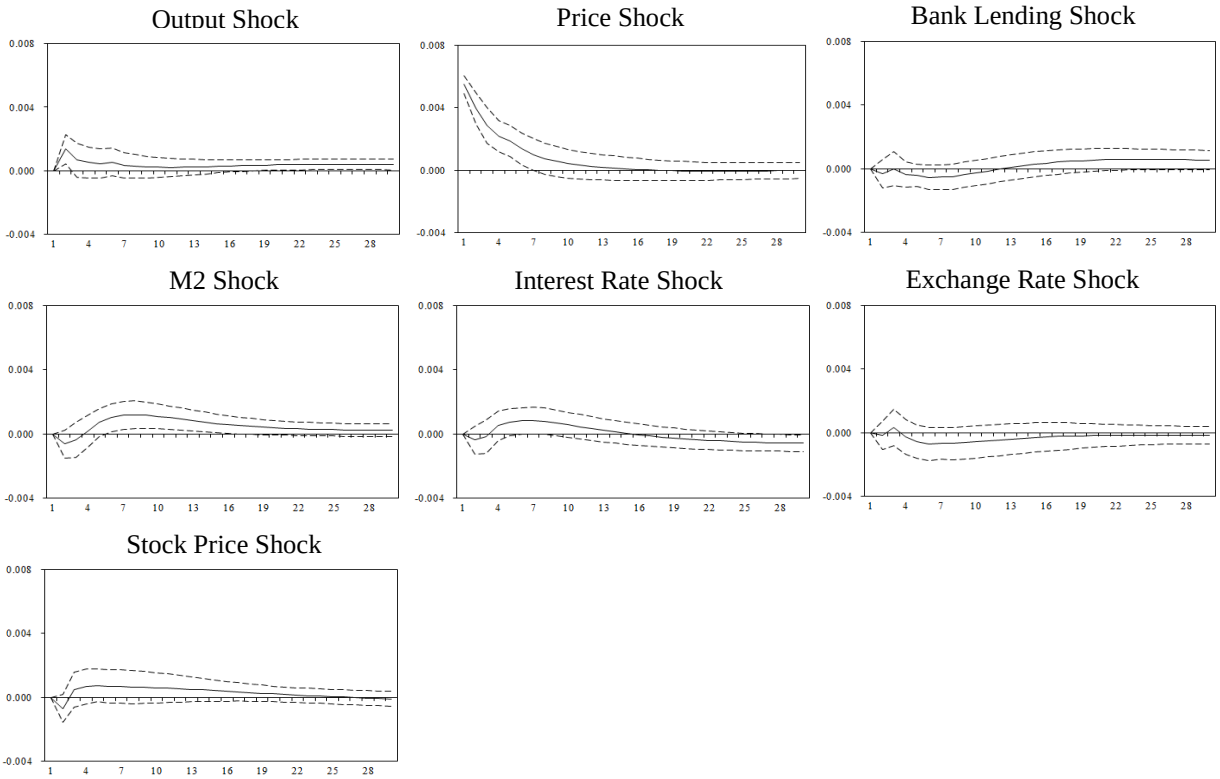
The lower part of Chart 6 shows the response of CPI to various one-standard-deviation positive shocks. An increase in bank lending pushes up CPI with lag effects. This increase in output is significant starting from the 22nd month after the shock and the effects last for 8 months. In response to an interest rate shock, CPI goes up at first, and then decreases after the 24th month. In the case of price to exchange rate shock, depreciation can have controversial impacts on the economy, leading to either an increase or a decrease in inflation. It is complex and depends on the composition of the CPI basket, the behavior of tradables and non-tradables and even the prices of tradable goods and services affected by changes in international prices. In our study, the result is not significant. Moreover, after a positive shock in M2, CPI significantly rises from the 5th month on and lasts for 16 months.

Chart 6: Impulse Response of Output and Price to Different Shocks (Model 2)

(a) Impulse Response of Output (Y)



(b) Impulse Response of Price (P)



Notes: 1. Response to One Standard Deviation.
2. The dotted line indicates 95% confidence interval.

6.2.2 Ranking of Monetary Policy Transmission Channels—Variance Decomposition

As our target variables are output and price, we show relative importance to monetary transmission channels on the basis of their share in the variation in these target variables. Table 5 reports the results of variance decomposition of output and price respectively.

Table 5: Variance Decomposition for Output and Price (Model 2)

(a) Output (Y)

Step (Month)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00
6	72.84	0.51	2.11	2.21	2.53	0.70	19.10
12	62.39	1.02	5.31	2.03	5.46	4.62	19.18
18	57.84	1.48	6.53	1.91	6.73	6.13	19.39
24	56.30	1.46	6.53	2.02	7.37	6.06	20.26
30	55.20	1.67	6.38	2.55	7.66	5.94	20.60

(b) Price (P)

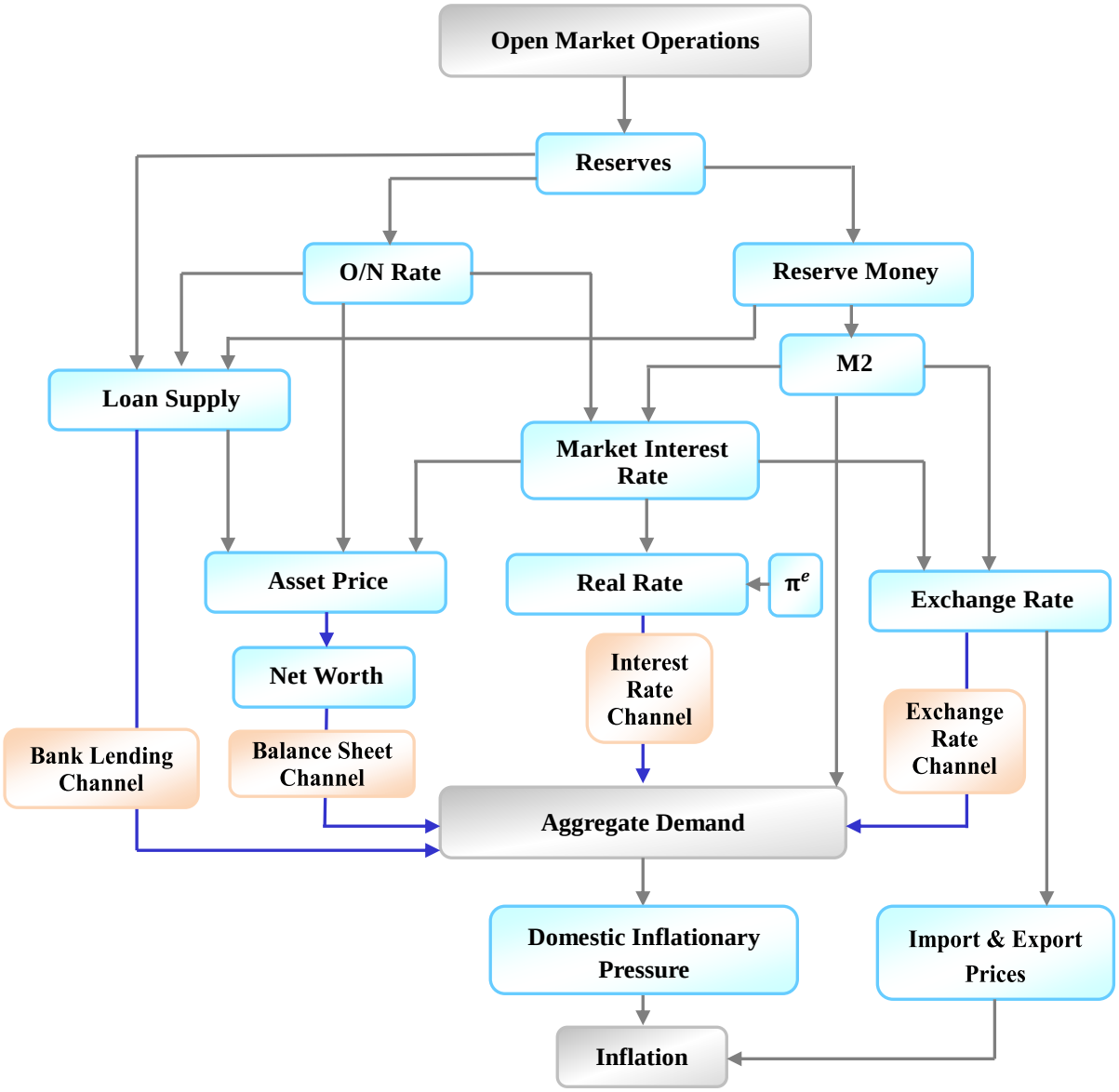
Step (Month)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	0.00	100.00	0.00	0.00	0.00	0.00	0.00
6	4.11	85.68	0.92	2.82	2.20	1.33	2.93
12	3.77	71.91	1.57	10.17	4.47	3.29	4.82
18	4.09	68.00	2.16	12.19	4.34	3.63	5.58
24	4.76	64.87	3.95	12.36	4.94	3.62	5.51
30	5.47	61.72	5.58	12.11	6.30	3.56	5.26

For output, stock price shocks represent a major factor driving the fluctuations, accounting for about 19% of the output variation. As we discussed earlier, in addition to balance sheet channel, stock price shocks could also reflect changes in international economic and financial conditions, or developments in the industrial sector. Taiwan is a small open economy, so output could be easily affected by changes in international economy and finance. Moreover, shocks of bank lending, interest rate and exchange rate jointly explain 19.39%-19.98% of the variations in output since the 18th month.

For price, M2 explains a large fraction of the variance in price. Shocks of bank lending, interest rate, exchange rate and stock prices account for 15.71%-20.7% of the variations in price after 18th months.

To sum up, the impulse response function and variance decomposition suggest that fluctuations in output in Taiwan are largely driven by the key shocks, such as bank lending, interest rate, exchange rate, and stock prices. We find that bank lending channel, interest rate channel, exchange rate channel, and balance sheet channel play important roles in monetary policy transmission in Taiwan. This result is consistent with previous empirical studies. Chart 7 indicates the details about these cardinal monetary policy transmissions in Taiwan.

Chart 7: Monetary Policy Transmission Channels in Taiwan



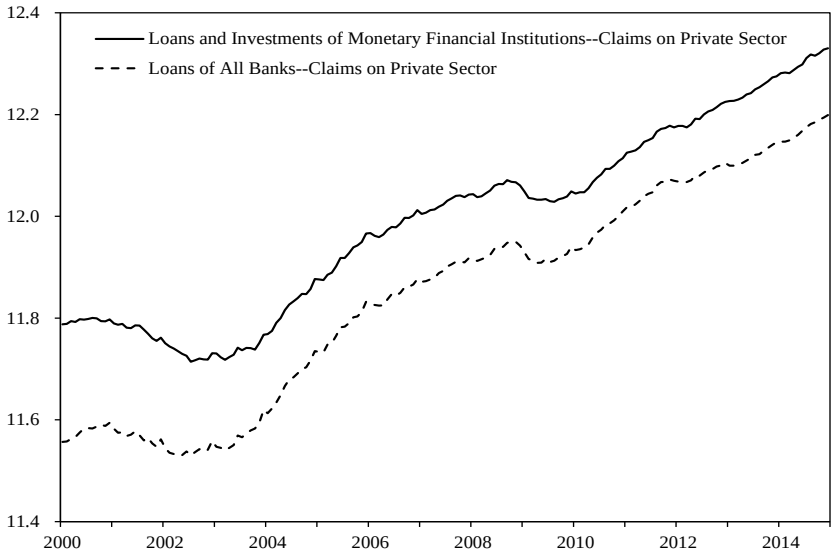
Note: → indicates the channel is significant in our empirical analysis.

6.3 Robustness check

In our empirical work, bank lending is represented by the variable "loans and investments of monetary financial institutions–claims on private sector." However, some works of literature utilize bank loans to investigate the credit channel (Wu and Chen, 2010; Chang et al., 2010; Huang and Yu, 2015). Thus, we replace "loans and investments of monetary financial institutions–claims on private sector" with "loans of all banks–claims on private sector" for robustness check.[10]

The time series plots of these two variables (in natural log) are shown in Chart 8. "Loans of all banks–claims on private sector" accounts for 80%-90% of "loans and investments of monetary financial institutions–claims on private sector" during the sample period, and we can see that their patterns are very similar.

Chart 8: Two Different Variables for Bank Lending

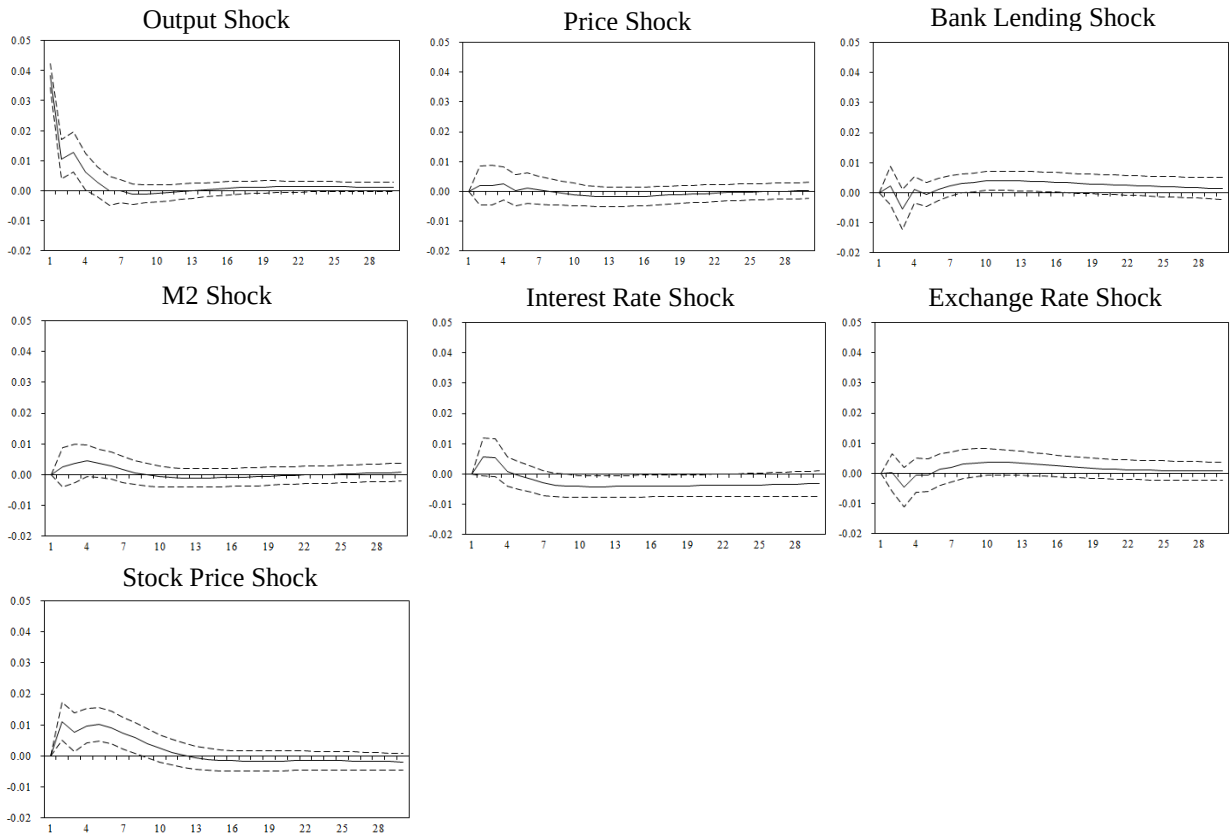


With the different bank lending variable, the responses of output and price are displayed on the upper and lower part of Chart 9 respectively, and the variance decomposition of output and price are reported in Table 6. We can see that the patterns of impulse responses are similar with Chart 6, and the shares of each variable in the target variables' variation are also similar with Table 5. Thus, the result remains unchanged.

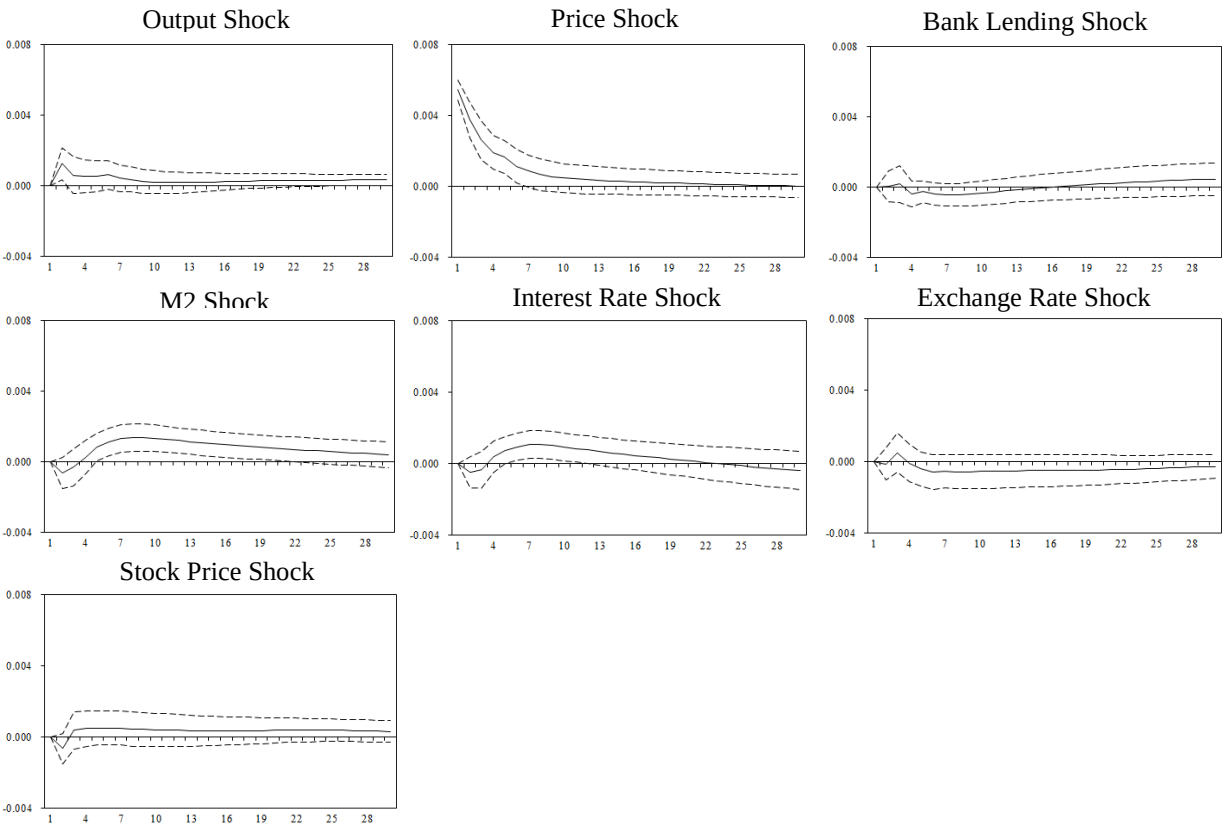
[10] The variable "loans of all banks–claims on private sector" is calculated as "claims on private enterprises" plus "claims on individuals," and the data source is Financial Statistics Monthly as well.

Chart 9: Impulse Response of Output and Price to Different Shocks (Model 2, Changing the Bank Lending Variable)

(a) Impulse Response of Output (Y)



(b) Impulse Response of Price (P)



Notes: 1. Response to One Standard Deviation.
2. The dotted line indicates 95% confidence interval.

Table 6: Variance Decomposition for Output and Price (Model 2, Changing the Bank Lending Variable)

(a) Output (Y)

Step (Month)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00
6	72.80	0.66	1.56	2.50	2.60	0.94	18.94
12	63.77	0.83	3.89	2.38	5.44	3.19	20.51
18	58.67	1.31	5.97	2.36	8.15	4.32	19.22
24	55.99	1.35	6.86	2.25	10.43	4.42	18.71
30	54.24	1.31	7.15	2.22	12.16	4.37	18.56

(b) Price (P)

Step (Month)	Y (%)	P (%)	L (%)	M2 (%)	R (%)	ER (%)	SP (%)
1	0.00	100.00	0.00	0.00	0.00	0.00	0.00
6	4.32	85.57	0.59	3.64	2.85	1.12	1.91
12	3.81	66.85	1.25	14.30	8.33	2.81	2.65
18	3.72	60.24	1.16	18.77	9.04	3.96	3.12
24	4.02	56.82	1.43	20.58	8.62	4.78	3.75
30	4.41	54.34	2.27	21.00	8.61	5.12	4.26

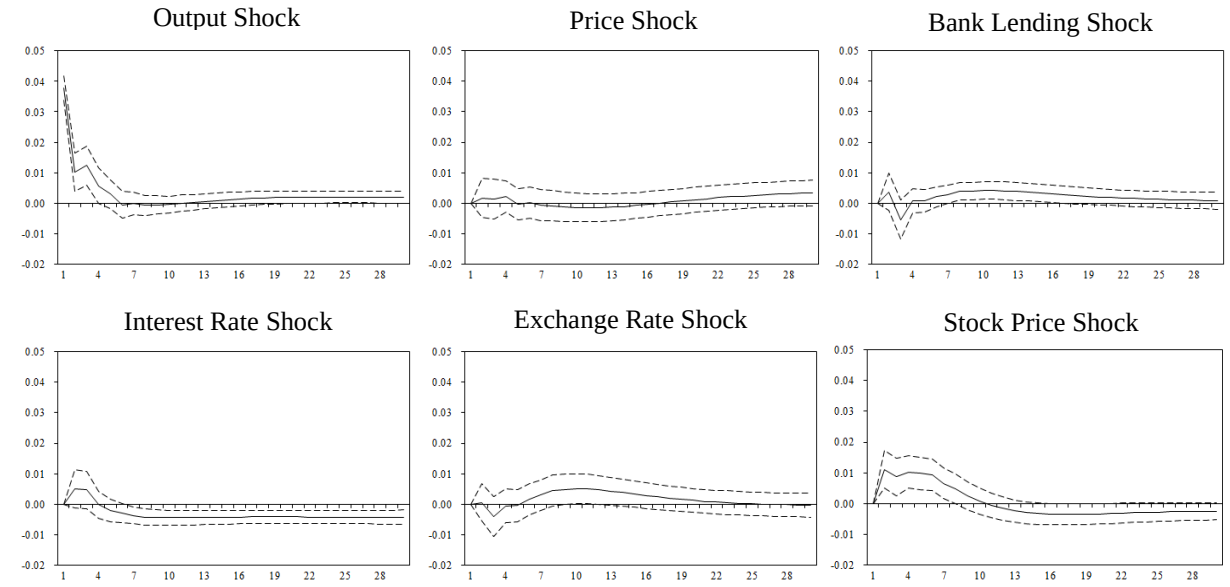
According to the empirical results, we can find that M2 is an important variable in the model, e.g., its direct effect on price. However, M2 is not considered as a "transmission channel" in most literature, because it is usually deemed pivotal within the channel. Therefore, we remove M2 from the SVAR model to check the robustness of other channels.

The SVAR model without M2 is estimated. The impulse responses of output and price are shown in the upper and lower parts of Chart 10 respectively, and we can see that the patterns are still similar to Chart 6. Table 7 reports the variance decomposition. For output, the relative importance of each variable remains unchanged; for price, only output becomes more important, but price itself is still the dominant factor.

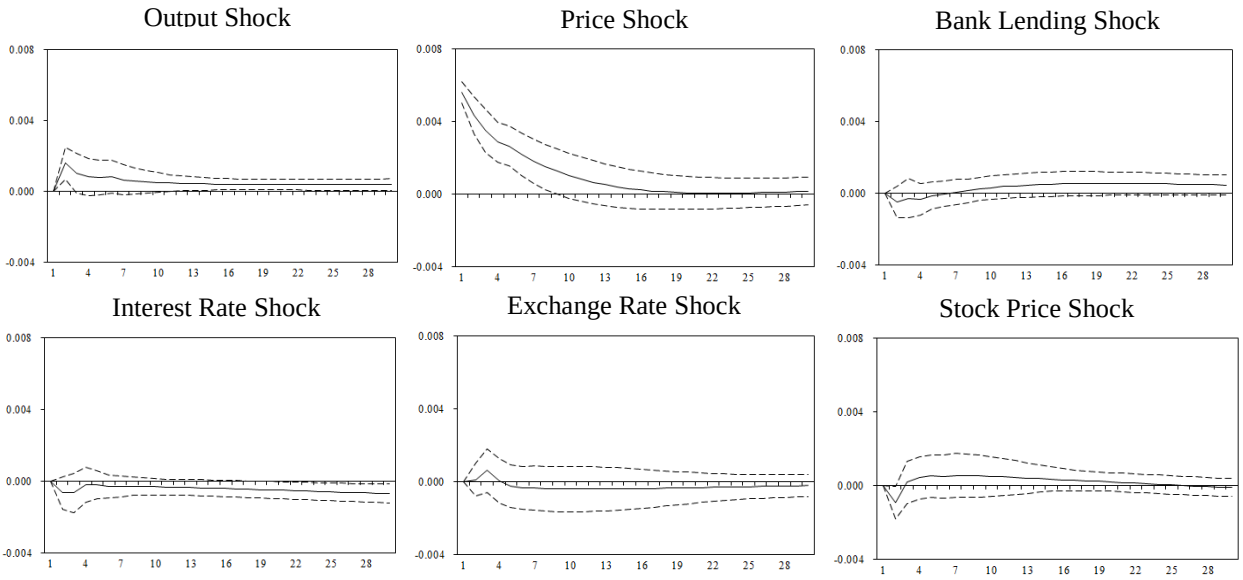
Therefore, using a different variable to represent bank lending or removing M2 from the model will not change the result, proving that our estimation results are robust.

Chart 10: Impulse Response of Output to Different Shocks (Model 2, without M2)

(a) Impulse Response of Output (Y)



(b) Impulse Response of Price (P)



Notes: 1. Response to One Standard Deviation.
2. The dotted line indicates 95% confidence interval.

Table 7: Variance Decomposition for Output and Price (Model 2, without M2)

(a) Output (Y)

Step (Month)	Y (%)	P (%)	L (%)	R (%)	ER (%)	SP (%)
1	100.00	0.00	0.00	0.00	0.00	0.00
6	73.51	0.42	2.06	2.51	0.82	20.69
12	62.59	0.67	5.05	6.01	5.30	20.37
18	56.69	0.73	6.56	8.86	6.82	20.35
24	53.42	1.21	6.73	11.39	6.52	20.72
30	50.56	2.72	6.47	13.64	6.10	20.52

(b) Price (P)

Step (Month)	Y (%)	P (%)	L (%)	R (%)	ER (%)	SP (%)
1	0.00	100.00	0.00	0.00	0.00	0.00
6	6.16	89.93	0.47	1.07	0.63	1.74
12	6.96	86.37	0.88	1.43	1.38	2.98
18	7.54	82.53	2.23	2.17	2.08	3.45
24	7.98	79.03	3.64	3.42	2.49	3.44
30	8.35	75.78	4.67	5.23	2.66	3.31

7. Conclusions

This paper investigates the effective monetary policy transmission channels in Taiwan. We first characterize the framework of monetary targeting and identify the relationship between money demand function and macroeconomic variables in Taiwan. We find that consistent and rigorous monetary policy operations help make monetary policy transmission effective.

We then examine the effectiveness of monetary policy implementation and the effects of key financial and economic variables on output and inflation. Instead of relying on the recursive Choleski approach to identify model parameters, we propose the SVAR model. An SVAR model is estimated which takes into account the interactions between monetary policy and key variables, imposing the minimal structural restrictions and is better to depict the variables' contemporaneous relationships.

In the first estimation, we provide evidence policy instruments (open market operations) could better affect the intermediate target (M2) through the operating target (reserve money) and therefore shows monetary policy is implemented effectively in Taiwan.

In the second part, we reconsider an integrated approach to capture the effective monetary policy transmission. Although lots of empirical studies depict Taiwan's monetary transmission channels, most papers focus on specific channels, and neglecting the dynamic interactions among macroeconomic variables may bias the estimate of monetary policy transmission. Therefore, we demonstrate a structural analysis of monetary transmission channels by using SVAR model. Specifically, we exhaustively investigate the effects of various transmission channels, which is fairly different from relevant literature in Taiwan. Estimation results find that bank lending channel, interest rate channel, exchange rate channel, and balance sheet channel highlight the role that monetary policy transmission plays in Taiwan. In addition, the results also show that as a small open economy, Taiwan could be easily affected by changes in international economy and finance. This is in line with the literature on Taiwan we have mentioned earlier.

References

Bernanke, B. S. (1986), "Alternative Explanations of the Money-Income Correlation," *Carnegie-Rochester Conference Series on Public Policy*, Vol.25, pp.49-99.

Bernanke, B. S., and A. S. Blinder (1992), "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review*, Vol.82, No.4, pp.901-921.

Blanchard, O. J. and M.W. Watson (1986), "Are Business Cycles All Alike?" Gordon, R. (Ed.), The American Business Cycle: Continuity and Change. University of Chicago Press, Chicago IL, pp.123-156.

Boivin, J., M. Kiley, F. Mishkin (2010), "How Has the Monetary Transmission Mechanism Evolved Over Time?" NBER Working Paper No.15879.

Chang, J. C., C. C. Tsong and C. T. Wu (2010), "The Asymmetric Effects of Monetary Policy and Bank Credits in Taiwan Banking Industry-A Dynamic Panel Data Analysis," *Journal of Economics and Management*, Vol.6, No.2, pp.229-246. (in Traditional Chinese).

Chen, N. K. and H. J. Wang (2011), "The Effects of Changes in Asset Prices on Private Consumption," *Quarterly Bulletin*, Central Bank of the ROC (Taiwan), Vol.33, No.1, pp.7-40. (in Traditional Chinese).

Chen, S. S. and T. M. Wu (2010), "Assessing Monetary Policy in Taiwan," *Academia Economic Papers*, Vol.38, No.1, pp.33-59. (in Traditional Chinese).

Christiano, L., M. Eichenbaum and C. Evans (1996), "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds," *Review of Economics and Statistics*, Vol.78, No.1, pp.16-34.

Cushman, D. O. and T. A. Zha (1997), "Identifying Monetary Policy in a Small Open Economy under Flexible Exchange Rates," *Journal of Monetary Economics*, Vol.39, No.3, pp.433-448.

Ferng, L. K. (2009), "The Credit Channel of Monetary Policy Transmission–Evidence from Taiwan stock market," The 10th Annual Conference of Taiwan's Economic Empirics. (in Traditional Chinese).

Gordon, D. B., and E.M. Leeper (1994), "The Dynamic Impacts of Monetary Policy: An Exercise in Tentative Identification," *Journal of Political Economy*, Vol.102, No.6, pp.1228-1247.

Huang, C. H. and L. H. Yu (2015), "Bank Lending Behavior and a Credit Channel in Monetary Transmission: Evidence from Taiwan," *Taiwan Economic Review*, Vol.43, No.2, pp.219-242.

Kao, C. W. and J. Y. Wan (2014), "Retail Bank Interest Rate Pass-through: Empirical Results for Taiwan," *Taiwan Economic Forecast and Policy*, Vol.44, No.2, pp.45-101. (in Traditional Chinese).

Kim, S. (2003), "Monetary Policy, Foreign Exchange Intervention, and the Exchange Rate in a Unifying Framework," *Journal of International Economics*, Vol.60, No.2, pp.355-386.

Kim, S. and N. Roubini (2000), "Exchange Rate Anomalies in the Industrial Countries: A Solution with a Structural VAR Approach," *Journal of Monetary Economics*, Vol.45, No.3, pp.561-586.

Levy, J. and I. Halikias (1997), "Aspects of Monetary Transmission Mechanism under Exchange Rate Targeting: The Case of France," IMF Working Paper No.44.

Mishkin, F. (1995), "Symposium on the Monetary Transmission Mechanism," *Journal of Economic Perspectives*, Vol.9, No.4, pp.3-10.

Mishkin, F. (2007), "The Economics of Money, Banking, and Financial Markets," 8th Edition, Pearson.

Monticelli, C. and O. Tristani (1999), "What Does the Single Monetary Policy Do? A SAVR Benchmark for the European Central Bank," European Central Bank Working Paper No.2.

Osorio, C., R. Pongsaparn, and D. F. Unsal (2011), "A Quantitative Assessment of Financial Conditions in Asia," IMF Working Paper No.11/173.

Peersman, G and F. Smet (2001), "The Monetary Transmission Mechanism in the Euro Area: More Evidence from VAR Analysis", European Central Bank Working Paper No.91.

Sims, C. A. (1980), "Macroeconomics and Reality," *Econometrica*, Vol.48, No.1, pp.1-48.

Sims, C. A. (1986), "Are Forecasting Models Usable for Policy Analysis?" *Federal Reserve Bank of Minneapolis Quarterly Review*, Vol.10, No.1, pp.2-16.

Sims, C. A. (1992), "Interpreting the Macroeconomic Time Series Facts," *European Economic Review*, Vol.36, No.5, pp.975-1011.

Sims, C. A. and T. A. Zha (2006), "Does Monetary Policy Generate Recession?" *Macroeconomic Dynamics*, Vol.10, No.2, pp.231-272.

Toda, H. Y. and T. Yamamoto (1995), "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes," *Journal of Econometrics*, Vol.66, No.1, pp.225-250.

Wu, C. S. (2009), "Researching Taiwan's Money Demand Function," *Taiwan Economic Review*, Vol.37, No.1, pp.23-52. (in Traditional Chinese).

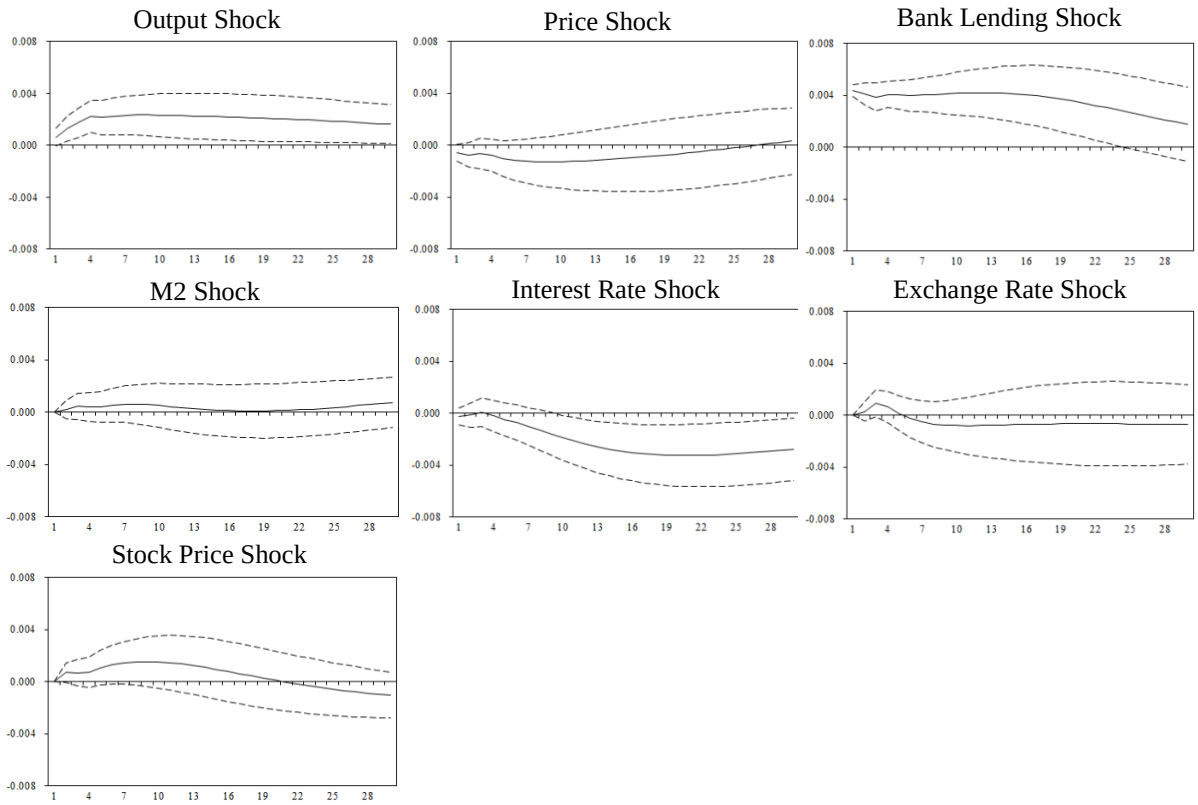
Wu, C. S. and C. F. Chen (2010), "An Analysis of the Credit Channels in Taiwan," *Taiwan Economic Forecast and Policy*, Vol.41, No.1, pp.121-153. (in Traditional Chinese).

Wu, Y. J. (2004), "An Empirical Analysis of Taiwan's Monetary Transmission Mechanism," *Quarterly Bulletin*, Central Bank of the ROC (Taiwan), Vol.26, No.4, pp.33-68. (in Traditional Chinese).

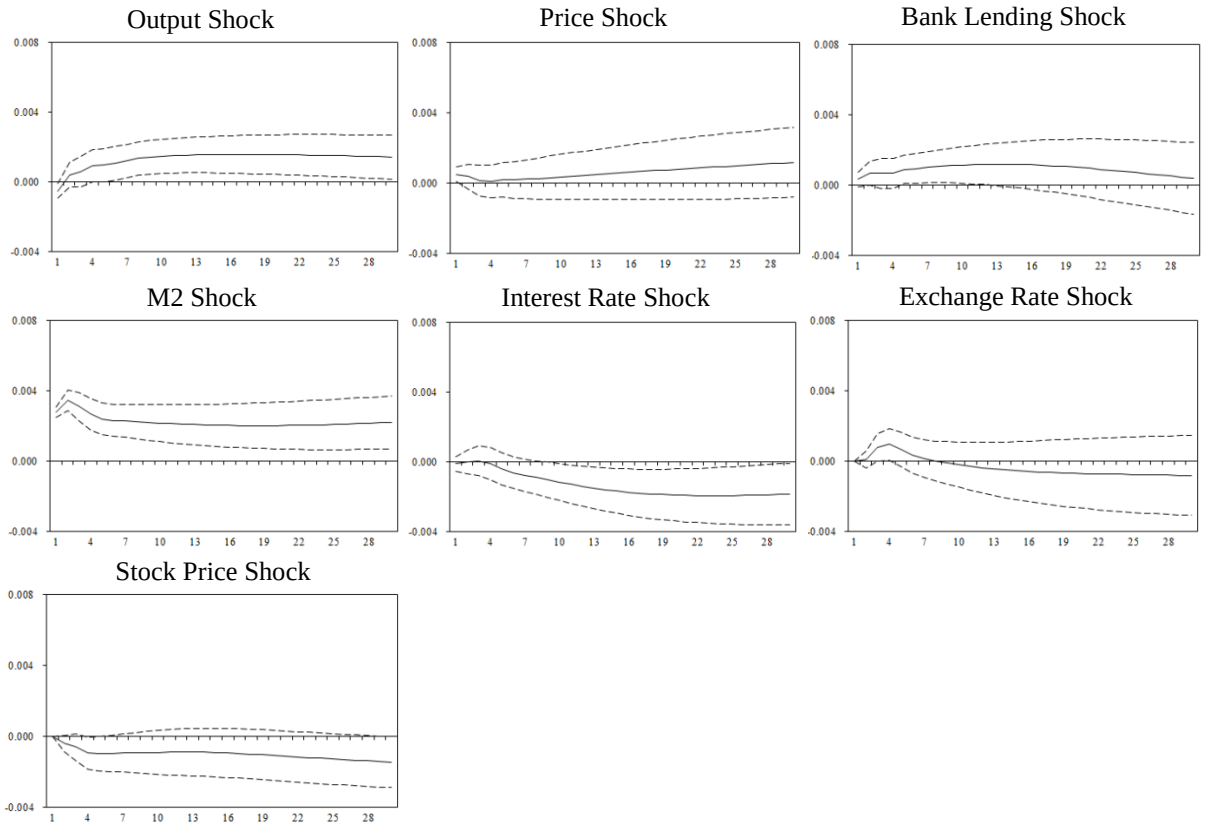
Wu, Y. J. (2006), "The Stability of Money Demand Function in Taiwan," *Quarterly Bulletin*, Central Bank of the ROC (Taiwan), Vol.28, No.3, pp.5-48. (in Traditional Chinese).

Appendix: Impulse Response of Bank Lending, M2, and Stock Price to Different Shocks (Model 2)

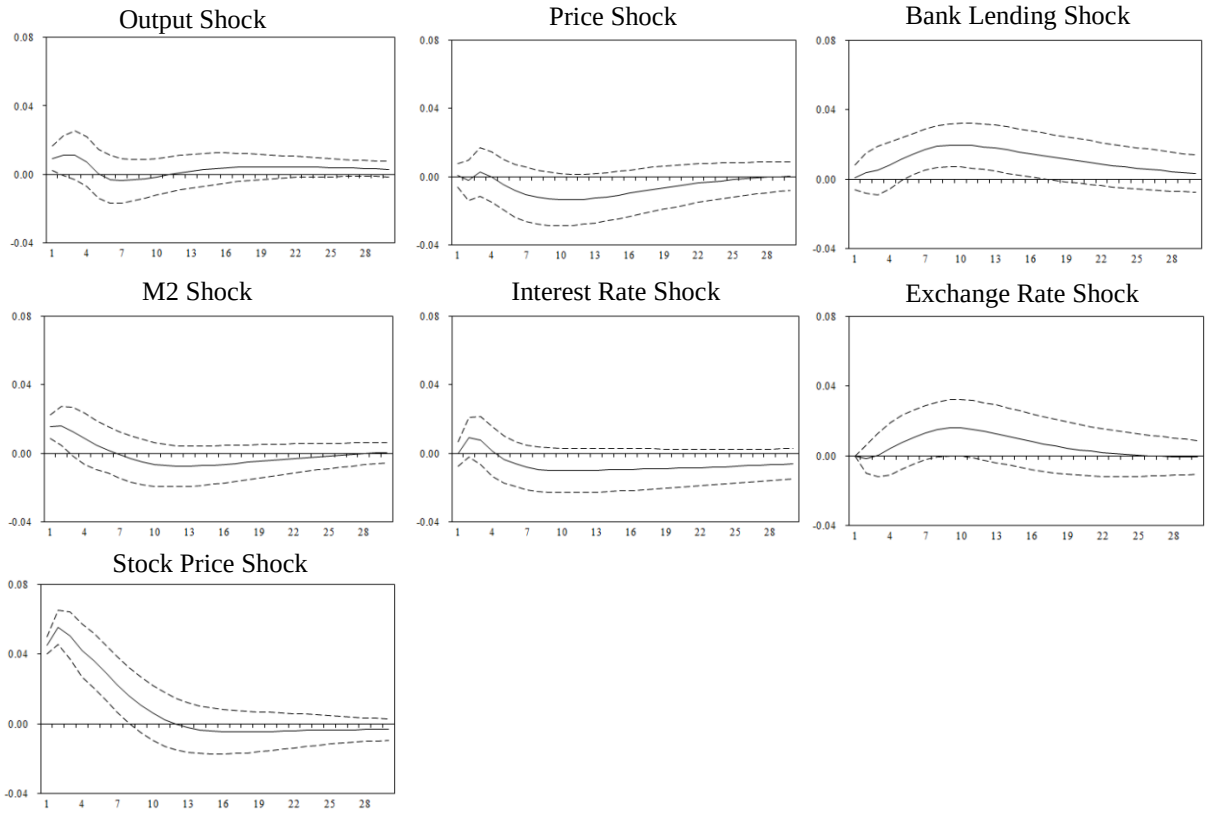
(a) Impulse Response of Bank Lending (L)



(b) Impulse Response of M2



(c) Impulse Response of Stock Price (SP)



Notes: 1. Response to One Standard Deviation.
2. The dotted line indicates 95% confidence interval.