出國報告（出國類別：其他）

2013 年度 SEACEN 研究計畫
「評估系統性金融市場基礎設施之分析架構」

服務機關:中央銀行

姓名職稱： 陳娟娟(一等專員)

蔡依琳(辦事員)

出國地區：馬來西亞吉隆坡

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摘要

本研究計畫「評估系統性金融市場基礎設施之分析架構」是 2013 年度東南亞中央銀行研訓中心（SEACEN）年度專案研究計畫之一，由會員國選派代表參與，撰寫英文報告。主要目的在於為各國金融市場基礎設施（FMI）提供分析架構，並探討 2008 年金融危機對其金融市場基礎設施的可能影響。經由各國成員經驗分享與交換意見，有助於國內金融市場基礎設施之發展，以及建立與 SEACEN 會員國間有關金融市場基礎設施之聯繫管道。

有關本國研究，除介紹國內金融市場基礎設施概況，說明我國支付與清算系統監管架構，主要內容著重於分析國內大額支付系統（即中央銀行同業資金調撥清算作業系統）交易額，探討其與連結系統及金融市場之相互依存關係，並分析 2008 年金融危機的可能影響。

目次

附件：本國研究報告英文版全文－“Analytical Framework in Assessing Systemic Financial Market Infrastructures in Taiwan”

壹、前言

本研究計畫係 2013 年度東南亞中央銀行研訓中心（The South East Asian Central Banks, SEACEN）之年度專案研究計畫之一，由各會員國共同合作之方式進行專案研究，撰寫英文研究報告。每項研究計畫設有一位計畫主持人，並由各國選派代表共同參與；各國代表負責撰寫該國研究報告，計畫主持人則負責彙整各國研究報告後，研提完整之研究報告。

本研究計畫係為評估金融市場基礎設施（Financial Market Infrastructure, FMI）提供分析架構，參與國家除我國外，尚包括印度、印尼、韓國、菲律賓、緬甸、尼泊爾、巴布亞新幾內亞、斯里蘭卡及越南等國。由計畫主持人擬定研究綱要與報告章節架構，並舉行兩次研討會，研討會議程重點如次：

一、第一次研討會於 102 年 3 月 12 至 16 日舉行

（一） 由計畫主持人說明研究計畫之背景、目的、研究綱要及報告章節架構。

（二） 主要議程係由各國學員先分組討論並比較各國金融市場基礎設施相關發展情況，再由個別學員簡報該國金融市場基礎設施發展概況。

（三） 討論報告內容、格式、時程及研究方法。

二、第二次研討會於 102 年 9 月 23 至 27 日舉行

（一） 由計畫主持人綜合說明各國報告初稿第 1 至 3 章內容。

（二） 各國代表簡報第 4 章與第 5 章內容，並由計畫主持人評論。

（三） 綜合討論報告內容，並決定最後提交報告日期。

本研究計畫主持人（Dr. Nephil Matangi Maskay，尼泊爾央行高級官員），經與各國成員討論後，因各國金融市場基礎設施發展程度差異甚大，許多國家並無相關資料可供分析，故本研究報告主要採敘述性方式撰寫，並分析國內市場（如貨幣市場、證券市場及外匯市場等）對大額支付系統之影響；另研究期間則以近 10 年（2003-2013）大額支付系統之年（月）交易資料為主，並著重分析 2008 年金融危機對各國大額支付系統運作之影響。

以下介紹本研究計畫之研究背景、架構及時程，並摘要說明本國研究報告（英文版）重點內容。有關本計畫綜合報告，計畫主持人將彙整分析各國經驗後撰擬綜合報告，完整呈現各會員國情況，預計於 2013 年年底前完成，並發布於 SEACEN 網站。

貳、研究背景、架構及時程

一、研究背景

金融市場基礎設施在各國金融體系與經濟活動中扮演重要角色，依現今全球金融市場基礎設施之發展趨勢來看，系統與金融機構間彼此連結成複雜網絡，因而產生直接或間接相互依存關係，使得金融市場基礎設施一旦發生失序事件，金融體系將可能面臨骨牌效應風險，進而引發系統性危機。因此，金融市場基礎設施的順暢運作將是金融穩定的必要條件。

2008 年全球金融危機影響深遠，亦喚起國際上對於金融體系穩定的關注。國際清算銀行（BIS）支付暨清算系統委員會（CPSS）於 2008 年 6 月發布「支付清算系統間之相互依存關係（The Interdependencies of Payment and Settlement Systems）」報告書，率先提出支付與清算系統間的相互依存特性，以及其所衍生之風險與挑戰，並於 2012 年 4 月與國際證券管理組織（IOSCO）共同發布「金融市場基礎設施準則（Principles for Financial Market Infrastructures）」，提供一套金融市場基礎設施設計、營運及監管的共同標準。惟現今仍缺乏針對金融市場基礎設施相互依存關係的基礎分析架構，故本研究計畫旨在提供有關金融市場基礎設施之分析架構，並探討 2008 年金融危機對 SEACEN 會員國國內金融市場基礎設施的可能影響，且就分析結果進行綜合評估，並期望經由經驗分享與交換意見，能提出具體看法，對各國金融市場基礎設施之發展有所助益。

二、研究架構

本研究計畫共包括二部分：第一部分由由計畫主持人綜合分析，並比較各國金融市場基礎設施發展概況；第二部分由各國代表，根據計畫主持人所研擬之內容、大綱及架構分別研擬，主要說明各國金融

市場基礎設施發展與監管架構，並分析相關統計資料，以及評估 2008 年金融危機對各國金融市場基礎設施之影響。各國報告章節架構與重點內容如下表：

章次	重點內容
第 1 章　前言	概述研究動機與目的、各國人文地理、經濟概況，以及金融危機前後對國內金融市場基礎設施之影響。
第 2 章　國內金融市場基礎設施概況	說明國內主要金融市場基礎設施、相關監管架構及金融市場基礎設施間之相互依存關係。
第 3 章　敘述性統計分析	以敘述性統計方式，分析重要金融市場基礎設施近 10 年之發展趨勢；並依系統別與市場別分析其相互依存關係；另說明金融發展指標與同資系統營運指標。
第 4 章　研究方法與分析	以計量方法分析金融市場基礎設施間之相互依存度，以及 2008 年金融危機的影響，並說明金融發展指標與主要系統營運指標之相關係數分析結果；另說明國內主要金融市場基礎設施監管架構。
第 5 章　結論與建議	

三、研究計畫相關時程

本研究計畫之重要時程如下表：

2013 年　3 月 13-15 日	第一次研討會（SEACEN 研訓中心）：計畫主持人說明本研究計畫之主旨與架構，並由各國代表簡報各國重要支付清算系統概況與監管方式。
4-9 月	依據計畫主持人研擬之內容大綱，各國代表於回國後研擬報告，並將報告初稿提交計畫主持人。
9 月 24-26 日	第二次研討會（SEACEN 研訓中心）；各國研究計畫代表簡報各國研究計畫內容，並提交研究報告修正初稿與相關資料。
11 月 30 日	各國代表提交完整報告全文。

叁、本國研究報告（英文版）摘要

支付與清算系統（Payment and Settlement Systems, PSSs）、集中交易對手（Central Counterparties, CCPs）及證券集中保管機構（Central Securities Depositories, CSDs）等金融市場基礎設施（Financial Market Infrastructures, FMIs），是一國金融體系與經濟活動之基礎。隨著金融市場基礎設施發展日益成熟，支付與清算系統及金融機構，透過與主要大額支付系統連結，其相互依存關係愈趨緊密。本研究除介紹國內金融市場基礎設施概況，以及我國支付與清算系統監管架構外，主要內容著重分析國內重要大額支付系統（即中央銀行同業資金調撥清算作業系統，以下簡稱「同資系統」）現況，並探討同資系統與其連結系統，以及與金融市場間之相互依存關係。此外，本報告採實證方式分析同資系統與其連結系統間，以及與市場間之相互依存度，並進一步以虛擬變數方法，檢定 2008 年金融危機對同資系統之影響；另採向量自我迴歸模型（Vector Autoregressive, VAR）探討系統間之跨期動態關係。

一、國內金融市場基礎設施概況

依據國際清算銀行支付暨清算系統委員會及國際證券管理組織(Committee on Payment and Settlement Systems-International Organization of Securities Commissions, CPSS-IOSCO)於 2012 年共同發布之「金融市場基礎設施準則」報告書，金融市場基礎設施包括支付系統、證券集中保管機構、證券清算系統、集中交易對手及交易資料保管機構，該等基礎設施有助於金融業務的運作、維持金融穩定與促進經濟成長。

由於金融自由化與科技創新的推波助瀾，近幾十年來國內金融市場基礎設施發展日新月異。國內金融市場基礎設施係以本行同資系統為核心，其他重要的金融市場基礎設施尚包括本行中央登錄債券系統、

財金公司跨行支付結算系統、台灣票據交換所票據交換結算系統、集保結算所、櫃買中心、臺灣證券交易所及臺灣期貨交易所等。

（一）監管政策與法規架構

在金融市場基礎設施之監管與監理方面，本行與金管會共同合作，以確保金融市場基礎設施之安全與效率。而且，本行貨幣政策之執行，有賴於金融市場基礎設施之順暢運作，因此本行要求相關金融市場基礎設施，應依循 BIS-CPSS 所發布之相關準則進行改革，以提高其安全性與效率。

國內如集中交易對手、證券集中保管機構及證券清算系統等機構之主管機關皆為金管會；另一方面，中央銀行肩負支付系統之監管職責，尤其針對該等經由同資系統提供清算作業之支付系統加強監管，以確保整體支付系統能安全且有效率運作。

（二）國內金融市場基礎設施概況

國內金融市場基礎設施重要的營運者包括本行、財金公司、票交所、集保結算所、證交所、櫃買中心及期交所。

本行同資系統為國內具系統重要性之大額支付系統，於民國 84[1] 年 5 月成立，91 年採行即時總額清算(Real-Time Gross Settlement)機制。該系統提供銀行間資金移轉、存款準備部位調整、同業拆款清算、外匯交易新台幣交割及債票券交易之款項交割等服務，並提供如財金公司、票交所及集保結算所等結算機構之最終清算服務。101 年同資系統總交易金額達 388 兆台幣，相當於 GDP 的 28 倍。

再者，本行於 86 年建置中央登錄債券系統，專責政府債券之發

[1] 本(二)節國內金融市場基礎設施概況，有關介紹國內金融市場基礎設施之沿革部分，為利國內讀者閱讀，係採民國紀年。其餘章節則配合英文版報告，仍採西元紀年。

行、移轉及還本付息等業務，97 年並與同資系統連線，達成款券同步(DVP)交割以降低交割風險。

財金公司創立於民國 87 年，透過與同資系統連線，其跨行支付結算系統提供即時之跨行匯款及 ATM 提款、轉帳等服務。該系統 101 年總交易金額為 4 兆美元[2]，相當於 GDP 的 8 倍。

台灣票據交換業務發展基金會於民國 91 年由國內 16 家票據交換所共同捐助成立，該基金會下設台灣票據交換所執行原有票據交換等業務，主要系統為票據交換結算系統，其結算後之應收應付差額再送至同資系統辦理清算。該系統 101 年總交易金額約為 6,170 億美元。

臺灣證券集中保管公司，成立於民國 78 年，提供證券交易之帳簿劃撥、結算及交割等服務；台灣票券集中保管結算公司則成立於 93 年，負責提供短期票券之帳簿劃撥、登錄及保管作業，相關款項清算作業則透過同資系統辦理。上述兩家公司業於 95 年合併成為臺灣集中保管結算所股份有限公司，整合權益證券與固定收益證券之集中保管、帳簿劃撥及結清算作業，且因其所提供之登錄、保管及帳簿劃撥等服務，使得多數證券已無實體化或不移動化。

證交所於證券集中交易市場擔任集中交易對手之角色，臺灣證券集中保管公司成立後，採行新的帳簿劃撥交割機制。自民國 84 年起，市場投資人於證券市場進行交易前，應同時持有可供帳簿劃撥之有價證券帳戶及金融機構存款帳戶。該機制採行當日結算，並以多方淨額結算方式計算應收應付之股數與款項，交割周期為成交日後第二天（T+2 日）。

另一方面，為提供店頭市場交易及金融商品之發行與交易等服務，中華民國證券櫃檯買賣中心於民國 83 年成立，除了針對上櫃股票提

[2] 本報告為與其他會員國報告計價單位一致，應計畫主持人要求，報告所用計價單位一律使用美元。

供一集中化之電腦交易系統外，並就興櫃股票、政府債券、公司債及衍生性商品等提供店頭交易平台。此外，為提高店頭市場資訊透明度，並提供主管機關相關監理資訊，金管會委託櫃買中心建置店頭衍生性金融商品交易資訊儲存庫，自 101 年 4 月起上線啟用，並於 102 年 7 月全面適用。

臺灣期貨交易所自民國 87 年開始提供衍生性商品之集中市場交易服務，目前提供交易之商品包括臺指期貨與選擇權、公債期貨、股票選擇權、個股期貨及黃金期貨等。為供期貨與選擇權商品交易，該交易所設立一電子交易系統，並由其結算部自行辦理相關結清算作業，民國 101 年期貨及選擇權契約總交易量約為 1 億 5,673 萬口。

依據「金融市場基礎設施準則」報告書對該等基礎設施之分類，本報告將國內重要金融市場基礎設施分為以下 5 類，茲列如表 1：

表 1 國內重要金融市場基礎設施分類

類型	**金融市場基礎設施**
支付系統	同資系統、財金公司跨行支付結算系統、票交所票據交換結算系統
證券集中保管機構	集保結算所
證券清算系統	中央登錄債券系統、集保結算所
集中交易對手	證交所、櫃買中心、期交所
交易資料保管機構	櫃買中心*

*此指櫃買中心之店頭衍生性金融商品交易資訊儲存庫。

（三）監管及監理機關

依據金融監督管理委員會組織法第 2 條：「本會主管金融市場及金融服務業之發展、監督、管理及檢查業務……；但金融支付系統，

由中央銀行主管。」；因此，金融市場之監理係由金管會主導，惟本行仍為支付系統之主管機關。

此外，依據中央銀行法第 32 條後段：「票據交換及各銀行間劃撥結算業務管理之辦法，由本行定之」可知，本行為票據結算系統之主管機關。

綜上，金管會肩負證交所、櫃買中心、集保結算所及期交所等集中交易對手、證券集中保管機構及證券清算系統之監理職責，惟實務上，由於財金公司跨行支付結算系統、台灣票據交換所票據交換結算系統及集保結算所票保結算系統等重要金融市場基礎設施之款項係經由本行同資系統進行清算，因而納入本行監管範圍。本篇報告因此將該等系統視為重要支付系統，因該等系統若發生問題，可能損及同資系統之健全運作，衝擊國內金融市場與經濟活動，進而可能引起系統性風險。表 2 以表列方式說明國內監理與監管現況：

表 2 金融市場基礎設施之監理與監管架構

序號	類別	基礎設施	監管機關	監理機關
1	支付系統	同資系統	中央銀行	中央銀行
2	支付系統	跨行支付結算系統	中央銀行/金管會	金管會
3	支付系統	票據交換結算系統	中央銀行	中央銀行
4	證券清算系統	中央登錄債券系統	中央銀行	中央銀行
5	證券集中保管機構/證券清算系統	集保結算所	金管會/中央銀行	金管會
6	集中交易對手	證交所	金管會	金管會
7	集中交易對手	櫃買中心	金管會	金管會
8	集中交易對手	期交所	金管會	金管會

（四）金融市場基礎設施間之相互依存關係

國內重要支付系統係以本行同資系統為核心，對內連結本行中央登錄債券系統，對外連結財金公司跨行支付結算系統、票交所票據交換結算系統、集保結算所票保結算系統、櫃買中心債券等殖成交系統及證交所證券劃撥結算系統。

根據 BIS-CPSS 於 2008 年出版之「支付與清算系統間之相互依存關係」報告書，支付與清算系統間之相互依存關係，可歸納為三大類:(1)源自直接的跨系統關係者(以系統為主之相互依存關係);(2)源自一家金融機構在二個以上系統之活動者(以機構為主之相互依存關係);(3)源自更廣泛之共用性者，包括使用共同的服務提供者(以外圍環境為主之相互依存關係)。

以國內同資系統為例，上述與其連結之系統屬以「系統為主」之相互依存關係；以「機構為主」之相互依存關係，則存在於當某一金融機構同時為同資系統與其他系統之參加者時；以「外圍環境為主」之相互依存關係則可能來自提供同資系統連線服務與電力系統之中華電信與台灣電力公司等。

二、敘述性統計分析

（一）金融市場基礎設施－同資系統資料分析

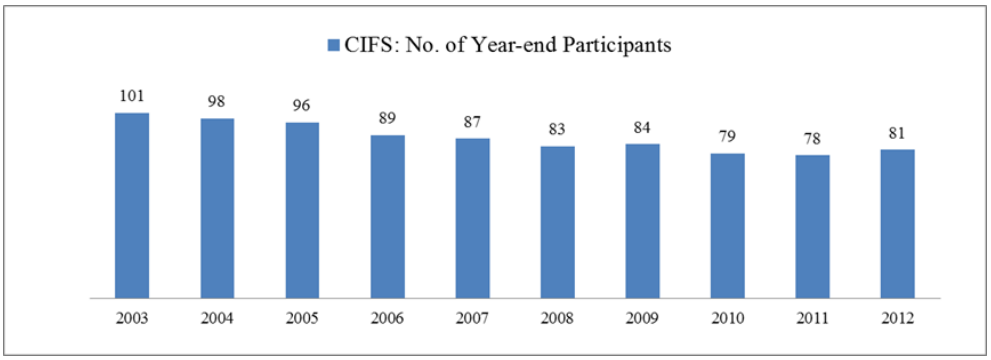
由於同資系統為國內金融市場基礎設施之核心，本節著重討論有關該系統之參加者與交易額等數據，期能對同資系統之運作有更全面的瞭解，且分析其時間序列資料，能對該系統之未來可能發展有更進一步的看法。

1. 參加者

根據「中央銀行同業資金電子化調撥清算業務管理要點」，金融

機構與結算機構得經本行核准，與同資系統連線，辦理轉帳及清算之業務。經核准之機構得申請同資系統帳戶，為利計算，本報告係以同資系統之有效帳戶作為參加者之計算基礎，截至 2012 年底，持有同資系統有效帳戶者計有 81 家（如圖 1），包含 70 家銀行、8 家票券金融公司及 3 家結算機構[3]。統計期間同資系統參加者家數逐年微幅減少，主要為金融機構合併及外國銀行退出等原因所致。

圖 1 同資系統參加者家數(2003-2012)



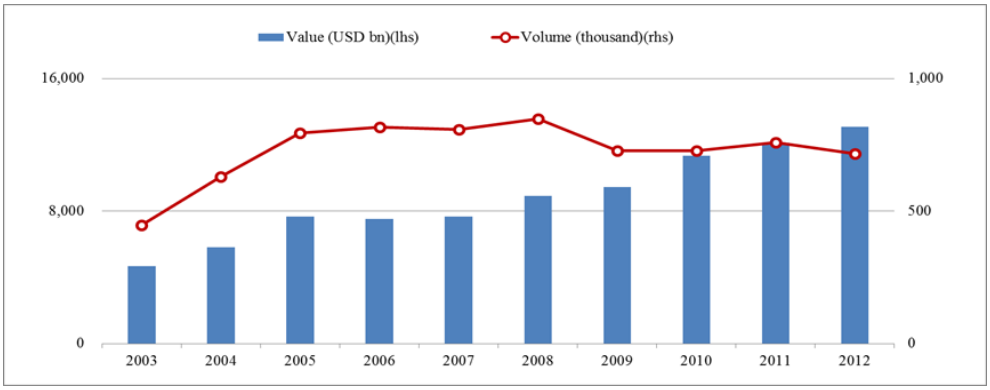
資料來源：CBC。

2. 交易金額

另一方面，同資系統的年交易額則從 2003 年 4.67 兆美元，增至 2012 年將近 13 兆美元（如圖 2）。主要係因為 2004 至 2008 年間納入集保結算所票保結算系統、證交所證券劃撥結算系統、櫃買中心債券等殖成交系統及本行中央登錄債券系統之款項清算，以及財金公司跨行支付結算系統之交易金額成長所致。

[3] 係指財金公司、證交所及櫃買中心；另集保結算所與票交所於統計期間並未開立同資系統結算帳戶，惟票交所已於 2013 年 2 月 25 日開立同資系統結算帳戶。

圖 2 同資系統年交易金額(2003-2012)　　單位：10 億美元



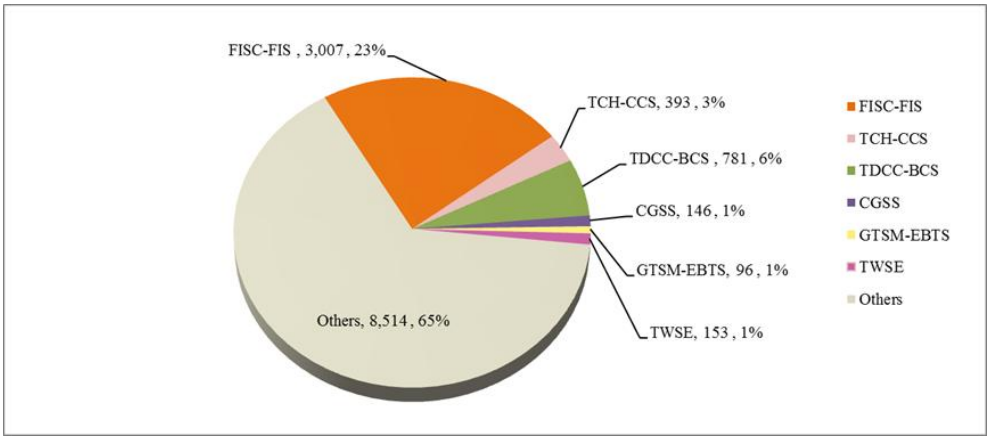
資料來源：CBC。

3. 系統別分析

本節試圖以 2012 年同資系統之系統別交易金額（圖 3），以及 2005-2012 年各結算系統經由同資系統清算之交易金額（圖 4），瞭解同資系統與相連結系統間之相互依存關係概況，以及該等關係之消長趨勢。

圖 3 顯示，2012 年約 35%之同資系統交易額係來自各結算系統，其中以財金公司跨行支付結算系統（FISC-FIS）占 23%居首，其次為集保結算所票保結算系統（TDCC-BCS）占 6%，以及票交所票據交換結算系統（TCH-CCS）之 3%。

圖 3 以系統別分析同資系統交易額(2012)　　單位：10 億美元

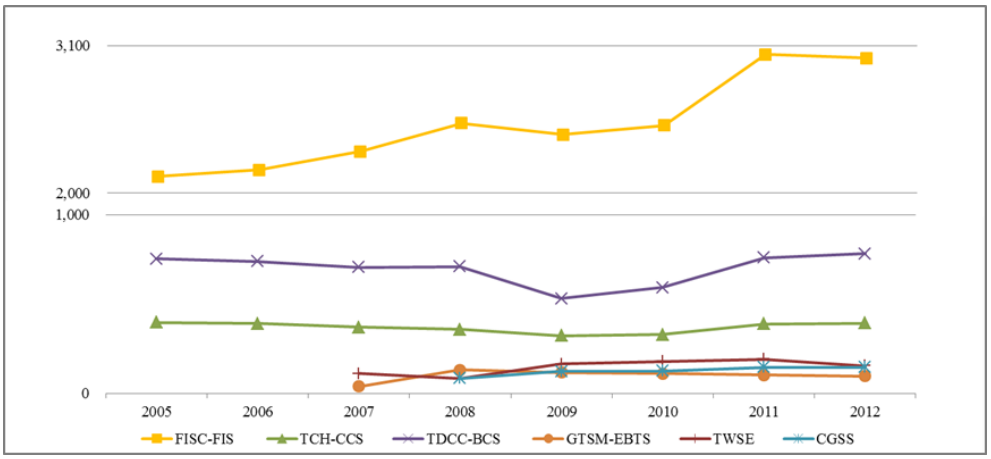


資料來源：CBC。

另一方面，由圖 4 可知，各結算系統透過同資系統處理清算交易之金額，於統計期間內互有消長，其中財金公司跨行支付結算系統之交易額明顯呈現上升趨勢，其他系統（除集保結算所票保結算系統於 2008-2009 年間交易額減少外）則維持穩定。

圖 4 經由同資系統處理之系統別年交易金額趨勢(2005-2012)

單位：10 億美元

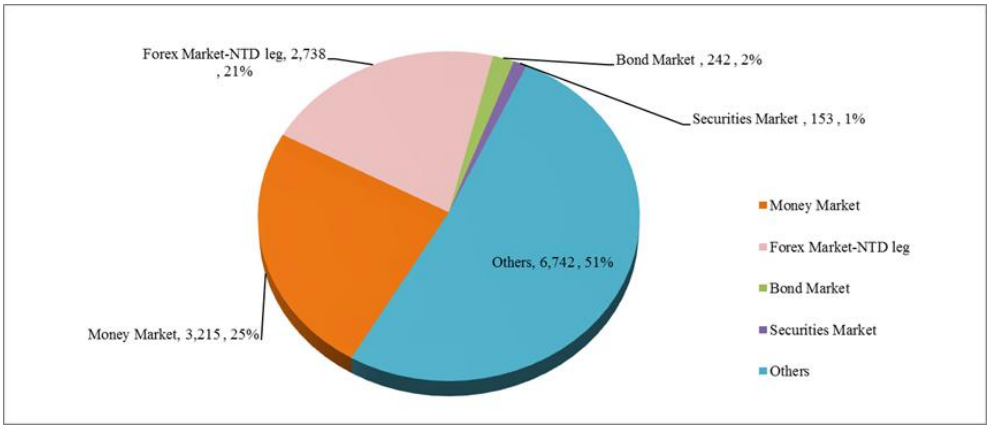


資料來源：CBC。

4. 市場別分析

另依市場別觀察同資系統與金融市場間之關係，圖 5 顯示約有 49%之同資系統交易可被歸類為源自金融市場之交易，其中以貨幣市場占 25%為最高，其次為外匯市場之 21%、債券市場之 2%，以及證券市場之 1%。

圖 5 以市場別分析同資系統交易額(2012) **單位：10 億美元**

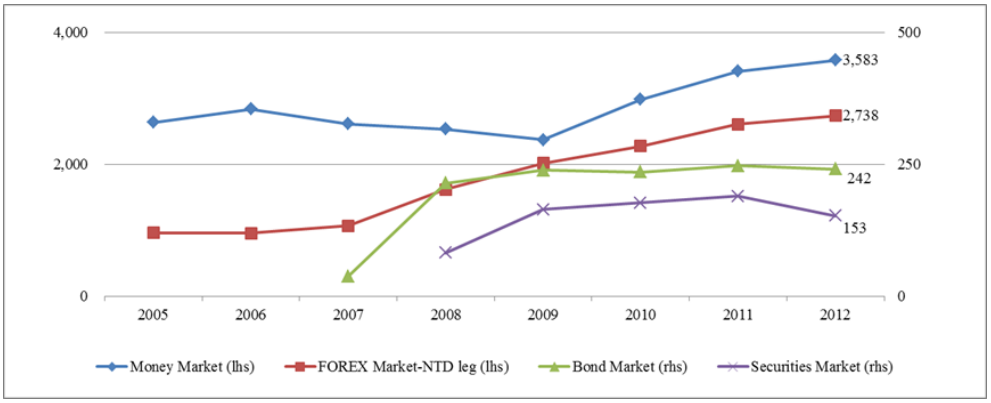


資料來源：CBC。

圖 6 則顯示從 2005 年至 2012 年，同資系統所處理之市場交易，以貨幣市場交易比重最高，且其重要性亦不斷升高，其次為外匯市場（新台幣端），且其交易金額亦逐年增加，至於債券與證券市場所占比重極微，並呈穩定趨勢。

圖 6 經由同資系統處理之市場別年交易金額 (2005-2012)

單位：10 億美元

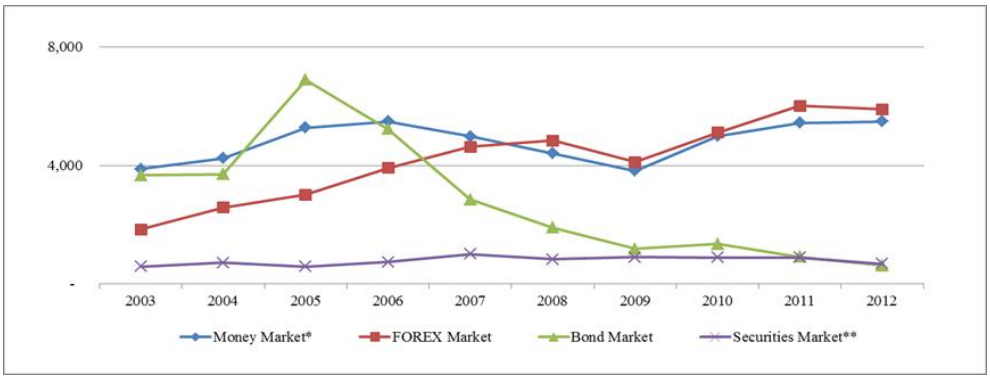


資料來源：CBC。

（二）金融市場

2003-2012 年國內金融市場交易金額如圖 7，其中外匯市場交易量持續成長，僅 2009 年呈現減少，其原因“除了反映外貿衰退及國內外資金移動規模縮減外，受金融海嘯影響，各國紛採寬鬆貨幣政策，造成貨幣間利差縮小，亦促使第三種貨幣交易量減少”(民國 98 年中央銀行年報第 73 頁)。另一方面，債券市場交易量於 2005 年攀至高峰後，自 2006 年起逐漸減少，其原因如民國 100 年金融穩定報告第 65 頁所述，“債券市場之運作已臻成熟，整體市場交易量則有逐漸下降趨勢，加以國內金融體系資金充沛，金融機構大幅加碼債券並窖藏，導致市場流通籌碼不足，供需嚴重失衡，且借券成本大幅波動，影響市場交易意願，並使公債殖利率曲線失真，成為債券市場發展瓶頸最關鍵因素之一。”

圖 7 各金融市場年交易金額(2003-2012) **單位：10 億美元**



資料來源：CBC。

三、實證分析

本研究先以迴歸模型分析國內同資系統與其連結系統間，以及與市場間之相互依存度，並進一步以虛擬變數方法，檢定 2008 年金融危機對同資系統之影響；另外，並以向量自我迴歸模型（Vector Autoregressive, VAR）模型檢視相關變數間之動態關聯性。

（一）迴歸分析

由統計分析顯示，同資系統交易額主要來自貨幣、外匯、債券、股票市場，以及財金公司跨行支付結算系統與票交所票據交換結算系統之交易，為進一步分析上述市場與系統對同資系統交易額之影響，本研究之基準迴歸模型設定如式(1)，相關變數資料說明列於表 3。

$$CIFS = \mathrm{c} + \beta_1 FISC + \beta_2 TCH + \beta_3 MMT + \beta_4 FXMT + \beta_5 BMT + \beta_6 SMT + \varepsilon \quad (1)$$

表3 迴歸模型變數說明

資料期間	2003M1-2012M12 月資料
變數	變數說明
CIFS	同資系統交易額（新台幣，百萬）
FISC	財金公司跨行支付結算系統交易額（新台幣，百萬）

TCH	票交所票據結算系統交易額（新台幣，百萬）
MMT	國內貨幣市場（包括短期票券市場買進與賣出交易量、附買/賣回債票券市場及拆款市場）交易額（新台幣，百萬）
FXMT	國內外匯交易淨額（美金）(乘以每月美金兌新台幣平均匯率，新台幣，百萬）
BMT	國內債券市場交易額（新台幣，百萬）
SMT	國內股票集中市場交易額（新台幣，百萬）

資料來源：CBC。

迴歸分析結果如式(2)：

$$\widehat{CIFS} = 8.21*10^6 + 1.27FISC - 5.57TCH + 0.95MMT + 0.56FXMT$$
(se)[4] $(2.22*10^6)$*** (0.41)*** (1.03)*** (0.24)*** (0.16)***
$$- 0.32BMT - 1.05SMT \qquad \bar{R}^2 = 0.84, \quad Prob(\text{F-stat}) = 0.00 \qquad (2)$$
(0.07)*** (0.40)***

與統計分析結果一致，所有解釋變數對同資系統交易額之影響均呈顯著（顯著水準 1%下），模型之調整後可解釋係數($\bar{R}^2$)為 0.84。由式(2) 解釋變數對同資系統均有顯著影響的結果，可說明同資系統與金融市場及其連結系統（即票交所票據交換結算系統與財金公司跨行支付結算系統）間具有緊密之依存關係。

再者，為瞭解 2008 年金融危機對同資系統的影響，本研究以虛擬變數分析，檢視同資系統交易額在 2008 年前後是否存在結構性改變。依 Quandt-Andrews 檢定，虛擬變數（DUMMY）在 2008M10～2012M12 期間設定為 1，其餘時點則設定為 0。

迴歸分析結果如式(3)：

$$\widehat{CIFS} = 1.38*10^6 + 6.91*10^6\text{DUMMY} + 1.05FISC - 2.67TCH$$
(se) $(1.57*10^6)$ $(0.47*10^6)$*** (0.25)*** (0.72)***
$$+0.72MMT + 0.46FXMT \qquad \bar{R}^2 = 0.93, Prob(\text{F-stat}) = 0.00 \qquad (3)$$
(0.12)*** (0.10)***

[4] 「*」表示達 10%顯著水準，「**」表示達 5%顯著水準，「***」表示達 1%顯著水準。

式(3)結果顯示，虛擬變數 DUMMY 呈現顯著（顯著水準 1%下），其他解釋變數 FISC、TCH、MMT 及 FXMT 亦呈顯著相關，與式(2)相同；另外，SMT 及 BMT 則變為不顯著。模型之調整後可解釋係數($\bar{R}^2$)較式(2)之 0.84 提升為 0.93。

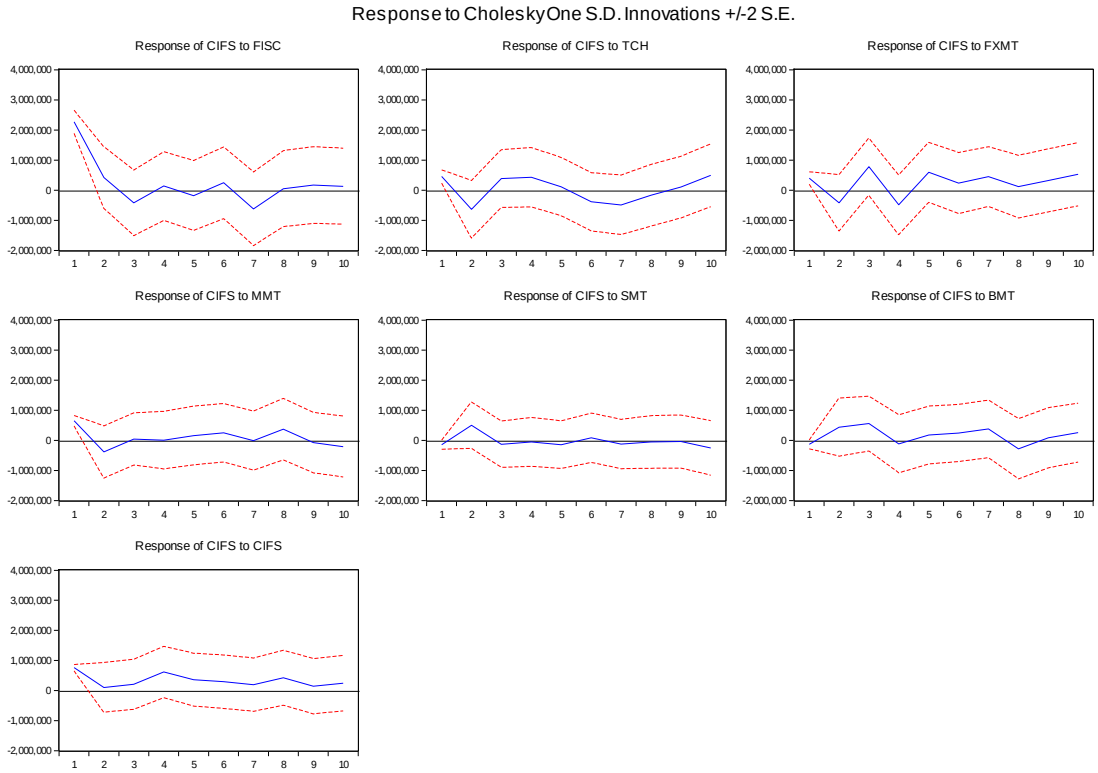
虛擬變數係數為顯著正數，亦即同資系統交易額於 2008 年前後期間存在正向結構性增長。此結果顯示，雖然 2008 年發生金融危機，對國內部分金融市場交易造成短暫衝擊，然而，其對同資系統之影響似乎極為有限。分析交易額成長之主因為（1）同資系統交易主要源自貨幣市場、外匯市場及財金公司跨行支付結算系統，而上述市場與系統在 2008 年後，交易額均呈現顯著正向成長；以及（2）同資系統在 2007 與 2008 年，將證交所證券劃撥結算系統、櫃買中心債券等殖成交系統及中央登錄債券系統之交割款項納入清算。

（二）向量自我迴歸（VAR）模型分析

本項分析係以表 3 之變數建構 VAR 模型，以觀察變數間之跨期動態關係。依據 AIC 判斷準則，VAR 最適落後期數選擇為 12 期。透過 VAR 模型，利用衝擊反應函數（impulse response function）探討各變數跨期間的跨期動態效果，有助於瞭解當相關變數發生自發性衝擊時，對其他變數造成影響；另以變異數分解（variance decomposition），分析同資系統交易額的變異程度，可由其本身或其他變數解釋的程度。

由衝擊反應函數（圖 8）得知，CIFS 因應 FISC 與 MMT 變動衝擊的反應，初期呈現明顯正向反應，並逐漸遞減至零附近微幅變動；另外，CIFS 因應其他變數變動衝擊的反應則較不顯著，長期而言均維持於零附近起伏。

圖8　衝擊反應函數



資料來源：CBC。

表4　變異數分解

Variance Decomposition of CIFS							
Period	FISC	TCH	FXMT	MMT	SMT	BMT	CIFS
1	78.53	3.14	2.47	6.49	0.31	0.27	8.79
2	67.24	7.71	4.29	7.24	3.45	2.66	7.41
3	59.66	8.20	10.31	6.24	3.14	5.64	6.82
4	54.93	9.35	11.78	5.72	2.91	5.30	10.00
5	52.13	8.94	14.38	5.64	2.95	5.30	10.66
6	50.45	9.90	14.25	5.95	2.89	5.59	10.96
7	49.39	11.03	14.71	5.45	2.77	6.31	10.35
8	47.65	10.87	14.29	6.37	2.69	6.72	11.40
9	47.21	10.80	14.91	6.33	2.67	6.69	11.39
10	44.66	11.96	16.12	6.28	2.98	6.81	11.19
Cholesky Ordering: FISC TCH FXMT MMT SMT BMT CIFS							

資料來源：CBC。

由變異數分解（表 4）實證結果顯示，FISC 對於 CIFS 變異程度有較高的解釋能力（44.66%~78.53%），其解釋能力隨時間經過而減少。另外 FXMT 與其本身 CIFS 對於其變異，亦具有某種程度的解釋能力，並隨著時間經過，解釋能力愈高，最高分別可達到 16.12%與 11.19%。

綜合所述，FISC、FXMT 以及 MMT 在解釋 CIFS 變異程度扮重要角色。亦即財金公司跨行支付結算系統、外匯市場及貨幣市場交易額對於同資系統營運量的變動具相當程度的影響力，此結果與前述統計資料分析及迴歸分析之結果一致。

（三）相關係數分析[5]

為檢視同資系統營運量與國內金融指標間的關聯性，本研究將金融指標分為兩組：金融發展指標與股票市場發展指標。相關指標說明如下：

1. 金融發展指標：

(1) *Liqliab*（貨幣總計數 M2 除以名目 GDP）：金融體系流動性負債指標，衡量一國金融深化程度。

(2) *Commbank*（存款貨幣機構國內資產占全體貨幣機構國內資產的比率）：衡量存款貨幣機構或中央銀行分配信用的程度。

(3) *Bankcred*（全體金融機構對民間部門的債權占 GDP 比率）：衡量金融機構對私部門分配信用的程度。

2. 股票市場發展指標：

(1) *MktCap*（上市公司股票總市值占 GDP 比率）與 *ValTrade*（股票

[5]為分析與比較各會員國大額支付系統與該金融發展程度之相關程度，本研究由各國代表以其國內金融相關指標與主要支付系統營運量指標進行相關係數分析，再由計畫主持人進行比較分析。

市場成交金額占股票總市值的比率)：用以衡量股票市場規模，與股市流動性大小。

(2) *Turnover*（股市周轉率）：衡量股市的波動程度。

3. 同資系統營運指標（同資系統交易額占 GDP 比率）。

相關係數分析結果列於表 5。同資系統營運指標（CIFS/GDP）與金融發展指標之相關係數均為正數，顯示金融發展程度與同資系統營運指標間有顯著正向關係，但與股票市場發展指標則無一致方向。

表5　相關係數分析（2003-2012）

相關係數 (t 統計量)	CIFS/GDP	金融發展指標			股票市場發展指標		
		Liqliab	Commbank	Bankcred	MktCap	ValTrade	Turnover
CIFS/GDP	1.00 -----						
Liqliab	0.77 (12.99)***	1.00 -----					
Commbank	0.38 (4.43)***	0.47 (5.75)***	1.00 -----				
Bankcred	0.74 (12.07)***	0.90 (22.65)***	0.25 (2.84)***	1.00 -----			
MktCap	0.50 (6.32)***	0.38 (4.52)***	0.14 (1.51)	0.52 (6.69)***	1.00 -----		
ValTrade	0.03 (0.34)	-0.08 (-0.89)	-0.06 (-0.73)	-0.08 (-0.87)	0.40 (4.71)***	1.00 -----	
Turnover	-0.26 (-2.94)***	-0.29 (-3.30)***	-0.10 (-1.07)	-0.39 (-4.57)***	-0.15 (-1.65)	0.83 (16.37)***	1.00 -----

註: 「*」表示達10%顯著水準， 「**」表示達5%顯著水準，「***」表示達1%顯著水準。
資料來源： CBC；FSC。

四、結論與建議

國際清算銀行（BIS）發布的「支付清算系統間之相互依存關係」（2008）與「金融市場基礎設施準則」（2012）報告書，為本研究報告之基礎。為瞭解國內金融市場基礎設施與同資系統間的相互依存關係，本研究試圖分析國內具系統重要性之大額支付系統(即同資系統)，

並以同資系統內之交易額，依據系統別與市場別，並透過敘述性統計分析與實證分析，瞭解同資系統與其他相連結系統間，以及與市場間之相互依存度。本研究報告主要結論與建議如下：

（一）結論

1. **同資系統與財金公司跨行支付結算系統、貨幣市場、外匯市場間之相互依存度較高**

依據統計結果，占同資系統交易額比重最高者為貨幣市場(25%)、財金公司跨行支付結算系統（23%）及外匯市場（21%），此結果亦在某種程度上，顯示同資系統與其他系統與市場間之相互依存度；另以實證方法所作之迴歸分析與 VAR 分析，亦顯示相似的結果。

2. **2008 年金融危機對同資系統交易額的影響，極為有限**

依統計數據顯示，近十年來，同資系統交易額呈現穩定成長的趨勢，且由虛擬變數分析結果亦顯示，其交易額在 2008 年後仍持續顯著增長，顯示本次金融危機之影響，極為有限。分析其交易額成長主因，包括來自市場（貨幣、外匯市場）與系統（財金公司跨行支付結算系統)的交易額均持續成長，以及同資系統在 2007 年至 2008 年間，將證交所證券劃撥結算系統、櫃買中心債券等殖成交系統及中央登錄債券系統之交割款項納入清算之故。

（二）建議

1. **加強本行與金管會間之合作及資訊分享**

由本研究分析結果可知，財金公司跨行支付結算系統與同資系統間之以系統為主之相互依存度最高，因此，本行應特別關注該系統之健全運作。考量本行雖肩負監管該系統之責，惟其監理職權仍屬金管會，且本行目前與金管會已就重要支付系統之監管進行定期會議與資

訊分享等方面之合作，惟為確保同資系統運作之健全與效率，擬建議本行與金管會就特定議題(例如重要金融市場基礎設施之自我評估作業等)，加強合作與資訊分享。

2. **強化同資系統資料庫**

由於同資系統部分交易資料仍以原始資料格式呈現，該等資料需先經過處理、分類或計算，方能進行後續分析作業。因此，建議強化本行同資系統資料庫，以利後續研究分析。

肆、結語

此次參與 SEACEN 研訓中心年度專案研究計畫，基本上各會員國之間由於經濟發展程度，以及金融環境相差甚大，雖共同研討相關議題，惟因各國金融市場基礎設施之現況存在極大差距，故討論時多聚焦實務議題，數據資料分析方面則略顯困難。然而，參與本研究計畫仍有部分收穫，除可瞭解與會各國金融市場基礎設施之發展程度外，並期望藉由經驗分享，有助於國內金融市場基礎設施之發展，並建立與 SEACEN 會員國間有關金融市場基礎設施之聯繫管道。謹將參與此次研究計畫心得略述如下：

一、藉由參與此次研究計畫，可加強與各會員國代表交流，有助瞭解各國相關金融市場基礎設施之發展現況，整體而言，我國金融市場基礎設施現況與其他與會國家相較，仍屬先進。

二、本次研究主題之一，為觀察 2008 年金融危機對各國金融市場基礎設施之衝擊程度。經與各國代表交流意見後獲致之共識為，雖然各國金融市場之交易可能受到某種程度的影響，惟相關金融市場基礎設施普遍未受到相對衝擊，相關運作仍屬順暢。

三、觀察各國對國內金融市場基礎設施之監管與監理現況，由於多涉及央行與其他機關之主管業務，因此加強各機關間之聯繫與合作，建立適當之合作機制，如利用定期會議建立溝通管道，或設置資訊分享機制等，皆屬與會國家現階段亟待解決之議題。

四、有關衡量相互依存關係作為監管基礎乙節，部分與會代表表示，該國央行曾與學者共同合作，研發風險衡量模型。在本行人力資源有限之前提下，此類與學術界合作發展量化模型之作法，似可作為本行之參考。

此外，參與本研究計畫期間，承蒙本行內部主管與相關同仁之協

助，本研究報告方可順利完成，在此一併表達誠摯的謝意。

謹將本次參與 SEACEN 之研究報告（英文版）隨附於後。

附件

Analytical Framework in Assessing Systemic Financial Market Infrastructure in Taiwan

By Chung-Chung Chen & Yilin Tsai
Central Bank of the Republic of China (CBC), Taiwan

Content

1. Introduction

The financial market infrastructures (FMIs)—involving payment systems (PSs), security settlement systems (SSSs), central counterparties (CCPs), central securities depositories (CSDs) and trade repositories (TRs)—facilitate the functioning of financial market and support the economic growth. FMIs also help the market participants to better manage their exposures. Accordingly, any malfunction and inappropriate design of the FMIs may expose the participants to systemic risks and endanger the financial stability. As payment and settlement systems have evolved significantly, there is a need to study the interdependencies among systems. In this regard, the following sections lay out the motivations and research objectives of this paper as well as a brief introduction about Taiwan's economy.

1.1 Motivations of the Study

Among the FMIs, the CBC Interbank Funds Transfer System (CIFS) is the most important Payment System in Taiwan. It provides final settlement services for funds transferring related to call-loan, foreign exchange and securities transactions. In the study, we focus on the analysis of interdependencies between the CIFS and the other domestic systemically important FMIs. Moreover, as the 2008 financial crisis had spread around the world, caused liquidity squeeze in the global asset-backed securities market and introduced higher volatilities among securities market in Taiwan, this paper would also investigate the global financial crisis' impacts on the CIFS.

1.2 General Information about Taiwan[1]

Consisting of the Taiwan island, the Penghu, Kinmen and Matsu archipelagoes, and numerous outlying islets, with areas summing to around 36,000 km^2, Taiwan is circumscribed by coasts, with the Taiwan Strait to its west, where across the strait lies the Mainland China, the East China Sea to the north, the Philippine Sea to the east, the Luzon Strait to the south and the South China Sea to the southwest. Moreover, the Tropic of Cancer (23.5°N) spans across the southern Taiwan Island and the still active plate tectonic movements carve its landscapes into rich geological features—more than 40% covered by mountains as well as varied climate zones, nourishing biodiversity to a great extent. The population is over 23 million people, mostly living in urban cities, such as Taipei, Taichung and Kaoshiung.

Taiwan has undergone phases of industrial transitions in the past three decades.

[1] For more information about Taiwan, please refer to the "The Republic of China Yearbook 2012" at: http://www.ey.gov.tw/en/cp.aspx?n=575A019C0A39897D.

In 1980s, its economy was able to catch up with the trend of global economic growth, proceeding to a more capital-intensive and export-oriented economy. The "Hsinchu Science Park[2]", established in 1980, has become one of the most famous regions for manufacturing semiconductor, serving as the dominant drive to boost the economic momentum. As of 2012, the economy's GDP per capita reached US$ 20,386. In the same year, while the service sector contributed to 69.15% of GDP, the manufacturing sector accounted for 28.95% of GDP, slightly declining from the previous year as a result of the weak external demand after 2010. On the other hand, the inflation rates were benign over time (see Table 1).[3]

Table 1
Economic Profile of Taiwan

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	AVG
GDP(USD, bn)	311	340	365	376	393	400	378	428	464	474	393
GDP per capita (USD)	13,773	15,012	16,051	16,491	17,154	17,399	16,359	18,503	20,006	20,386	17,113
Economic Growth (%)	3.67	6.19	4.7	5.44	5.98	0.73	-1.81	10.76	4.07	1.32	4.11
Inflation rate (%)	-0.28	1.61	2.30	0.60	1.80	3.52	-0.86	0.96	1.42	1.93	1.30
Exchange rate (USD/NTD)	34.42	33.43	32.18	32.53	32.84	31.54	33.06	31.65	29.47	29.62	32.07
Yearly average											

Source: CBC

As for foreign exchange management, since 1987, the CBC has loosened relevant foreign exchange regulations. To date, capital movements are completely liberalized[4]. The New Taiwan dollar (NTD) was 29.62 on average against the US dollar in 2012, and 29.14 at the end of 2012, indicating a 3.96% appreciation from the end of 2011. Foreign exchange reserves arrived at US$403.17 billion, increasing by US$17.67 billion at the end of 2012.

For the year ahead, the National Statistics estimated a steady 2.40% GDP growth in 2013 compared with the previous year's 1.32% growth. Following the 2008 financial crisis, the European debt problem also poses a risk to the global economy, and the global economic outlook remains somewhat obscure. However, concerning the long-term national development, the Executive Yuan[5] has mapped out the

[2] Please visit its official site at http://www.sipa.gov.tw/english/index.jsp for more information.
[3] Also see Appendix 1 for a summary of Taiwan's economic indicators in 2012.
[4] Please see http://www.cbc.gov.tw/ct.asp?xItem=857&CtNode=481&mp=2 for relevant information.
[5] The Executive Yuan is the executive branch of the Republic of China (ROC) government. Please see http://www.ey.gov.tw/en/cp.aspx?n=95097CAF31185CC1.

"Economic Power-Up Plan"[6] earlier this year to solve the current structural imbalances and seize the upgrading chances to stimulate the economy progress even further. Meanwhile, in World Bank's Knowledge Economy Index (KEI), Taiwan was ranked top in Asia and 13th worldwide in 2012, showing Taiwan's economic vitality and competitiveness in relation to knowledge economy.

1.3 The Impact of Global Financial Crisis on Major FMIs in Taiwan

Following the bankruptcy of Lehman Brothers, the financial crisis in 2008 has spread around the world. For central banks, since FMIs play an important role in maintaining financial stability, a recent concern is raised on whether a financial stress, such as the 2008 financial crisis, would invoke contagion risks and what the potential impacts on FMIs would be as they become more and more interconnected. Accordingly, this paper aims to shed some light on how the impact of 2008 financial crisis could be translated to the FMIs in Taiwan. In 2008, though the market transaction value contracted, the annual transactions of domestic payment systems as well as the Taiwan Depository and Clearing Corporation (TDCC, a CSD) have been stably increasing since then. As for the Electronic Bond Trading System of the GreTai Securities Market (GTSM-EBTS), the transaction values have reduced since 2007, mainly owing to the decreasing security trades in the bond markets. The stock transactions in the Taiwan Stock Exchange (TWSE), on the other hand, were affected by the global financial crisis; its annual transaction volume had contracted as the investors became more cautious[7]. (See Appendix 2 for transaction data of major FMIs).

1.4 Research Objectives

The research objectives are twofold. Firstly, we analyze the interdependencies between the CIFS and other associated clearing institutions. In Section 2, we begin with the current framework of systemically important FMIs in Taiwan—the CIFS and the other systemically important systems jointly comprise the fundamental network of Taiwan's payments and settlement systems. In Section 3, the level of interdependencies is shown by mapping the transaction linkages between CIFS and the other FMIs and financial market. We would also briefly discuss domestic regulations and oversight practices.

Secondly, from the transaction values, we investigate how the 2008 financial

[6] For further information, please refer to the newsletter released by the Council for Economic Planning and Development at http://www.cepd.gov.tw/encontent/m1.aspx?sNo=0017911.

[7] Please refer to the CBC (2008) "Financial Stability Report", Issue No. 2.

crisis influenced the major domestic payment systems and how the impacts on the markets and retail transactions transmitted to the CIFS. In Section 4, we conduct an empirical statistical analysis to examine the transmission effects of the 2008 financial crisis and the interactive relationships among the concerned variables. In addition, we also present a correlation matrix showing the relationships between the ratio of the CIFS to GDP and related financial indicators. Finally, Section 5 provides a summary and concluding remarks.

2. Financial Market Infrastructures in Taiwan

Financial Market Infrastructures (FMIs), according to the "Principles for Financial Market Infrastructures" published by the Bank for International Settlements (BIS) and the International Organization of Securities Commissions (IOSCO) in 2012, include payment systems, central securities depositories (CSDs), securities settlement systems (SSSs), central counterparties (CCPs) and trade repositories (TRs), which facilitate the functioning of financial activities, maintain financial stability and promote economic growth.

In Taiwan, owing to the development of financial liberalization and innovative technology, FMIs have evolved significantly over recent decades. The CBC Interbank Funds Transfer System (CIFS) plays a significant role in domestic FMIs. Besides the CIFS, the Central Government Securities Settlement System of the CBC (CGSS), the Financial Information System of the Financial Information Service Corporation (FISC-FIS), the Check Clearing System of the Taiwan Clearing House (TCH-CCS), the Taiwan Depository and Clearing Corporation (TDCC), the GreTai Securities Market (GTSM), the Taiwan Stock Exchange Corporation (TWSE), and the Taiwan Futures Exchange (TAIFEX) are major FMIs.

2.1 General Policy and Regulation Framework

The CBC coordinates with the Financial Supervisory Commission (FSC) on the oversight and supervision of FMIs to ensure the safety and efficiency of FMIs. Furthermore, the CBC relies on the sound operation of FMIs to implement monetary policy effectively. The CBC has been dedicated to complying with the requirements of global principles and recommendations published by the BIS-CPSS in reforming these FMIs to enhance their safety and efficiency.

In Taiwan, some FMIs, such as the CCP, CSD and SSS, are under the supervision of the FSC. On the other hand, the payment systems, particularly those which have their payments settled in the CIFS, are overseen by the CBC to ensure the safe and efficient operation of the CIFS.

2.2 Stylized Facts of FMIs in Taiwan

The important operators of FMIs in this country are the CBC, the FISC, the TCH, the TDCC, the TWSE, the GTSM and the TAIFEX.

The CBC-operated CIFS plays the core role among important FMIs. The CIFS, a systemically important Large Value Payment System, launched in May 1995, has adopted the Real-Time Gross Settlement (RTGS) mechanism since 2002. It provides

transferring services for interbank funding, reserves requirement adjustment and settlement for call loans, the NTD leg of foreign currency trades, and the payment leg of bond and bill trades. In addition, the CIFS provides services for clearing institutions such as TCH, FISC, TDCC and TWSE. The transaction value of the CIFS reached NT$388 trillion (US$13 trillion) in 2012, around 28 times of the GDP.

Furthermore, the CGSS was introduced by the CBC in 1997 for the operation of issuance, transfer, redemption, and interest payment of government securities. Through the linkage of the CGSS and the CIFS in 2008, the delivery versus payment (DVP) mechanism has been installed to eliminate the settlement risk.

The FISC, established in 1998, through the linkage of its on-line interbank network with the CIFS, provides the service of a real-time interbank funds transfer system (FISC-FIS) for cash withdrawals and funds transfers via Automated Teller Machines (ATMs) and interbank remittance services. The transaction value of the FISC-FIS is US$4 trillion in 2012, around 8 times of the GDP.

In 2002, 16 domestic check clearinghouses donated their properties and instituted the “Taiwan Payments Clearing System Development Foundation”. Under the Foundation, the TCH was founded to carry out the check clearing operation. The main system operated by the TCH is the Check Clearing System (TCH-CCS), under which the net accrued balances payable or receivable after clearing are sent to the CIFS for settlement. In 2012, the transaction value of the TCH-CCS amounted to US$617 billion.

The Taiwan Securities Central Depository Co., Ltd. (TSCD) was founded in 1989 to provide book-entry, clearing and settlement of securities transactions. In 2004, the Debt Instruments Depository and Clearing Co., Ltd. Taiwan (DIDC) was established and provided the services of custody, registry and short-term bill’s book-entry operation with their funds settled through the CIFS. In 2006, the TDCC was established after the merger of the DIDC and the TSCD. The TDCC promotes the integration of settlement, clearing and central depository platforms for both equity and fixed income securities. It provides the services such as registration, custody and book-entry operations, which makes immobilized or dematerialized form possible for most securities.

The TWSE acts as a CCP for all the trades executed in the central Securities Exchange Market. The settlement mechanism has been changed since the TSCD was established which enabled the new book-entry settlement mechanism to be feasible. Since 1995, all investors have been required to have both a book-entry securities

depository account and a bank account before they trade in the Exchange. The TWSE also adopts a same-day clearing method and uses multilateral netting for the calculation of shares and funds receivables and payables with T+2 settlement cycle.

On the other hand, the GTSM was established in 1994 to deal with over-the-counter trading and provide financial trading services for the issuance and exchange of financial products. The GTSM provides a centralized electronic trading system for the trading of GTSM-listed stocks. Moreover, the GTSM offers over-the-counter trading mechanisms for the GTSM emerging stocks, government and corporate bonds, and derivatives. Instructed by the FSC, the GTSM set up the OTC Derivatives Trade Repository, which has been effective since April 2012 and broadly adopted since July 2013 to provide more transparency for the market and information for the supervisory authority.

The Taiwan Futures Exchange (TAIFEX) has started trading since July 1998. Currently the TAIFEX provides trading for futures and options on major Taiwan stock indices, government bond futures, equity options, single stock futures and gold futures. The TAIFEX provides the services of TAIFEX Electronic Trading System (TAIFEX-ETS) for the trading of futures and options contracts. The TAIFEX conducts clearing and settlement through its Clearing Department. In 2012, the trading volume in futures and options totaled 156,731,912 contracts.

According to the definition depicted in the "Principles for Financial Market Infrastructures" (BIS, 2012), this paper attempts to divide the important FMIs into five types as shown in Table 2.

Table 2
FMI Type of Major FMIs in Taiwan

SN	FMI Type		FMIs
1	Payment System		CIFS, FISC-FIS, TCH-CCS
2	Capital Market-related FMIs	CSD	TDCC
3		SSS	CGSS, TDCC
4		CCP	TWSE, GTSM, TAIFEX
5		TR	GTSM*

*Here it refers to the OTC Derivatives Trade Repository of the GTSM.

2.3 Oversight and Supervisory Authority in Taiwan

Pursuant to the Article 2 of the Organic Act Governing the Establishment of the

Financial Supervisory Commission, "The FSC shall be the competent authority for development, supervision, regulation, and examination of financial markets and financial service enterprises…the Central Bank shall be the competent authority in charge of the financial payment system," the financial markets are under the regulation of the FSC. However, the CBC is the authority of payment systems.

In addition, pursuant to the Article 32 of the Central Bank of the Republic of China (Taiwan) Act, "Regulations governing checks clearance and settlement of accounts among banks shall be stipulated by the (Central) Bank," the check clearing system is under the regulation of the CBC.

Therefore, CCP, CSD and SSS, such as the TWSE, GTSM, TDCC and TAIFEX, are supervised by the FSC. However, in practice, some important FMIs, such as the FISC-FIS, TCH-CCS and TDCC-BCS, which have their payment legs settled through the CIFS are overseen by the CBC and are regarded as the systemically important payment and settlement systems in the study. The reason is that any failures of these systems could harm the sound operation of the CIFS, and hence trigger disruptions in or transmit shocks across the domestic financial markets and economic activity, and thus create potential systemic risk. However, the FSC remains the regulatory authority of the FISC, TDCC, TWSE, GTSM and TAIFEX.

Table 3

The Overview of the Supervisory Entities in Taiwan

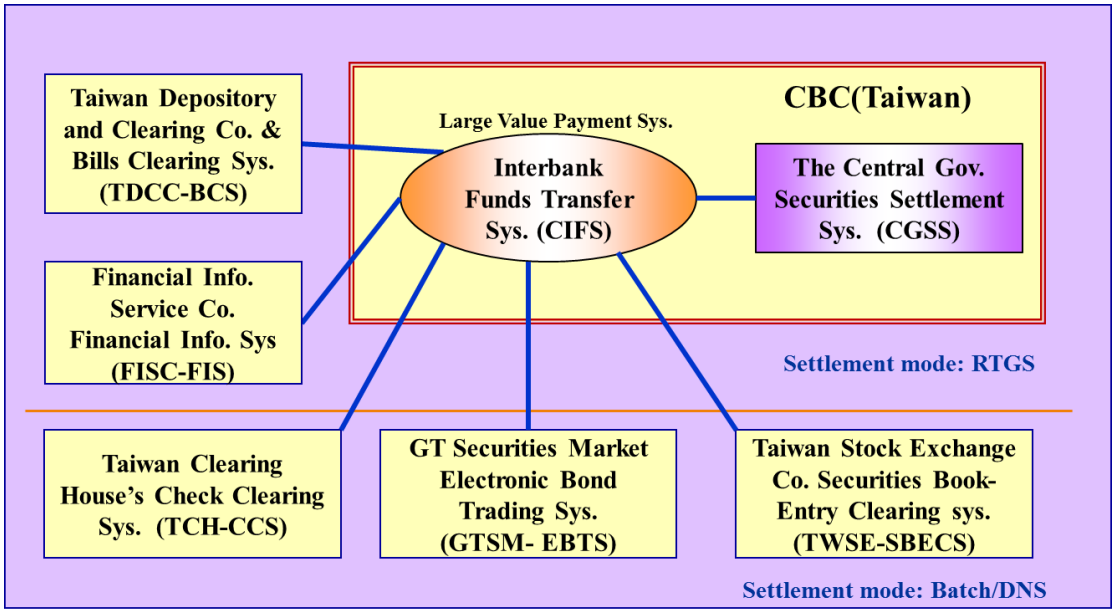
SN	FMI Type	Ownership/ Sponsorship	FMI (name)	Authorization, Designation, or Licensing	Oversight	Supervision	Onsite Inspection
1	PS	Public	CIFS	CBC	CBC	CBC	CBC
2	PS	Private	FISC	FSC	CBC/FSC	FSC	FSC
3	PS	Private	TCH	CBC	CBC	CBC	CBC
4	SSS	Public	CGSS	CBC	CBC	CBC	CBC
5	CSD/ SSS	Private	TDCC	FSC	FSC/CBC	FSC	FSC
6	CCP	Private	TWSE	FSC	FSC	FSC	FSC
7	CCP	Private	GTSM	FSC	FSC	FSC	FSC
8	CCP	Private	TAIFEX	FSC	FSC	FSC	FSC

2.4 The Interdependency of FMIs in Taiwan

As the hub of domestic payment systems, the CIFS links with the FISC-FIS and the TCH-CCS which enables these payment systems to be in use of central bank money for settlement to ensure their sound and efficient operation.

In addition, to enhance the efficiency and safety on the payment leg of securities settlement, the CIFS linked with TDCC-BCS [8] in 2004, TWSE-SBECS and GTSM-EBTS in 2007, and CGSS in 2008. These actions also make contribution to the TDCC-BCS and CGSS for the adoption of delivery versus payment (DVP) basis. Due to different necessity of these FMIs, the payments from these FMIs that settled by the CIFS are in the mode of real-time, deferred-netting or other mechanisms permitted by the CBC, the connection map are depicted in Chart 1.

Chart 1
The Framework of Important Payment and Settlement Systems in Taiwan



Source: CBC, "The Payment and Settlement Systems in the Republic of China (Taiwan)", Oct. 2010.

Undoubtedly, the above-mentioned linkage among FMIs would promote the efficiency of liquidity, and ensure more safety and integrity. However, some risks may be derived from interdependencies which have been outlined from the report "The Interdependencies of Payment and Settlement Systems" published by the Committee on Payment and Settlement Systems, Bank for International Settlements, in 2008.

Most domestic FMIs are not globally active payment and settlement

[8] The TDCC used to be the DIDC in 2004 (see p.4).

infrastructures, though some connection might exist. Therefore, these FMIs may have less potential to be infected by any disruptions originated from global FMIs. Nevertheless, disruptions or risks originated from some domestic important FMIs may still be harmful for the reason that they are linked with the CIFS, and may pose risks to the CIFS and then spread the risks to other FMIs or other system participants in financial markets.

The BIS-CPSS (2008) has presented three forms of interdependencies, i.e. system-based, institution-based and environmental interdependencies which arise from "direct relationships between systems, indirect relationships arising from the activities of large financial institutions in multiple systems and broader commonalities have led to a complex web of interconnections among numerous payment and settlement systems" (BIS-CPSS, 2008, p.7).

In Taiwan, the CIFS, as an example, in addition to the system-based interdependencies as previously mentioned in the direct relationships between the CIFS and other FMIs, the institution-based interdependencies may also arise from the indirect relationships when the financial institutions are both the participants of the CIFS and other FMIs. In addition, the environmental interdependencies arise from the entities which provide connection (line) or electricity services to the CIFS, such as the Chunghwa Telecom and the Taiwan Power Company.

Foreign Exchange Market may be composed of two parts, the customer market and the interbank market. This paper focuses on the interbank market. In this market, there are two domestic brokers, the Taipei Forex Inc. started in 1994 and the Cosmos Foreign Exchange International Co. Ltd started in 1998.

To enhance the efficiency and safety of the FMIs in the interbank Foreign Exchange Market, the CBC assisted the FISC to establish a foreign currency clearing platform which has put the USD clearing into operation on 1st March, 2013 and the RMB clearing on 30th September 2013. This platform may link with different settlement banks for respective currencies. For example, the Mega International Commercial Bank is chosen as the USD settlement Bank. Each settlement bank therefore implements settlement of respective currencies through the linkage with foreign settlement system.

The overview of domestic FMIs in financial markets is depicted in Table 4.

Table 4
The Overview of Domestic FMIs in Financial Markets

SN	Markets	Clearing or Securities Settlement	Settlement
1	Money Market	GTSM / TDCC	CIFS
2	Bond Market	CGSS / GTSM / TDCC	CIFS
3	Forex Market	FISC	Settlement Banks
4	Securities Market	TWSE / GTSM / TDCC	CIFS

3. Financial Statistics

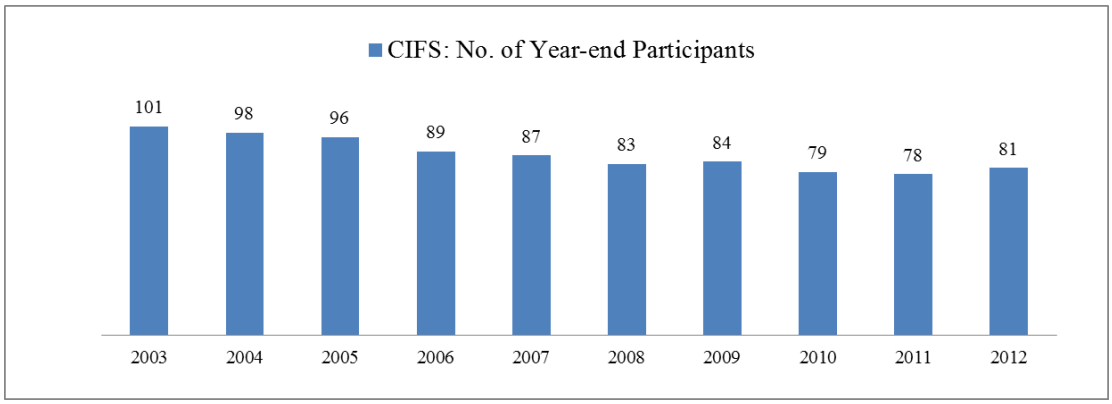
FMIs are indispensable for a nation to sustain financial activities. On the other hand, financial development has substantial impacts on the operation of FMIs as well. The interaction between FMIs and financial markets forms a main part of our discussion. Therefore, this section tries to collect the statistics of the FMIs and the financial markets with the purpose to trace the tendency of both and the correlation in between to support this paper with comprehensive data resources. To interpret the operation of the CIFS more precisely, Section 3.1 focuses on the statistics of the CIFS. Moreover, since financial market transaction value can provide a comparison basis with CIFS market-wise transaction value, and Section 3.2 adds the statistics of financial market. Also, Section 3.3 calculates some financial related development indicators to portray the financial progresses in Taiwan. In short, this section hopes to provide an inclusive indication on the CIFS and financial market progress since it may therefore provide the basis for analysis on Section 4 which discusses the relationship between FMIs and financial markets activities.

3.1 Financial Market Infrastructures Statistics - CIFS

As the hub of domestic FMIs, the CIFS forms the center of the following discussion with the statistics of its participants and transaction value. Through the following discussion, the overview of the CIFS operation may be described more thoroughly. Moreover, time-series graphics of the CIFS are displayed to give the outline of this LVPS' tendency.

3.1.1 CIFS Participants

Chart 2
The CIFS Participants from 2003-2012



*Number of Participants: the CIFS' active accounts at the end of the year. Source: CBC

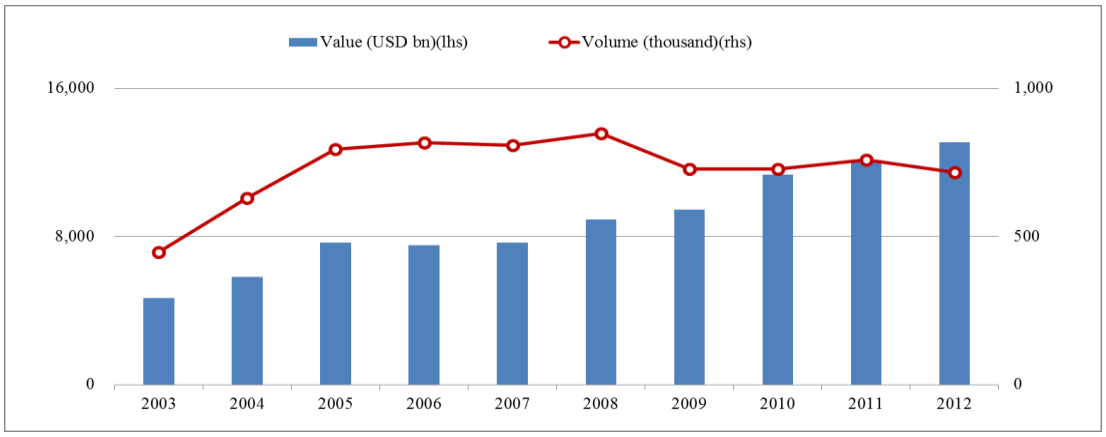
Pursuant to the "Directions for the Central Bank of the Republic of China (Taiwan) to Govern Electronic Interbank Funds Transfer and Settlement", financial institutions and clearing institutions have to get the approval from the CBC to establish a computer connection with the CIFS. The clearing institutions refer to the institutions which operate clearing systems carrying out the clearance of check, electronic payments or securities between financial institutions. The approved institutions may hold an account in the CBC and thereby conduct funds transferring. To facilitate the calculation of the CIFS participants, the holder with an effective account in the CIFS is regarded as the CIFS participant[9].

At the end of 2012, there were 81 effective accounts within the CIFS. These accounts belonged to 70 banks, 8 bills finance companies and 3 clearing institutions[10]. The effective accounts of the CIFS seemed decreasing in a mild tendency from 2003 to 2012 (Chart 2), mainly due to the mergers of domestic financial institutions or the exits of foreign banks during 2005-2008.

3.1.2 CIFS Transaction Value

Though effective accounts decreased as mentioned previously, the annual transaction value of the CIFS increased significantly at the same period (Chart 3). In 2003, its annual transaction value was US$4.67 trillion. Ten years later, the transaction value in 2012 reached US$13 trillion, around 2.8 times of 2003. The most important reasons may be the inclusion of the payment legs from the TDCC-BCS, TWSE-SBECS, GTSM-EBTS, and CGSS in 2004, 2007, 2007 and 2008, respectively, and the increasing settlement value from the FISC-FIS.

Chart 3
The Annual Transaction Value of the CIFS



9 In this regard, though the TCH and the TDCC have their clearing balances settled through the CIFS, these 2 clearing institutions are excluded in the calculation on the CIFS participants for holding no accounts of the CIFS. By the way, the TCH opened an account in the CIFS since 25th Feb. 2013.

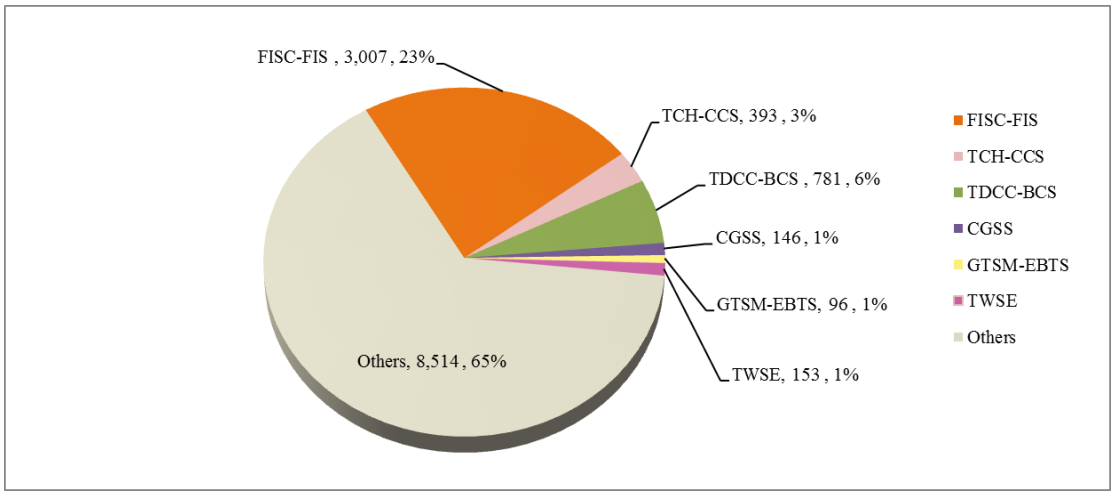
10 They are the FISC, the TWSE and the GTSM.

3.1.3 System-based Statistics

As mentioned in 3.1.1, the clearing systems carry out the clearance of checks, electronic payments or securities between financial institutions. Therefore, the statistics of the clearing systems such as the CGSS, FISC-FIS, TCH-CCS, TDCC-BCS, TWSE-SBECS and GTSM-EBTS, which have their payments settled through the CIFS, were collected and calculated to facilitate further discussion and analysis for the CIFS.

In addition, for the purpose to monitor both the intensity of interdependencies and the trends of the relationship between each clearing system and the CIFS, the settlement value[11] of the CGSS, FISC-FIS, TCH-CCS, TDCC-BCS, TWSE-SBECS and GTSM-EBTS which had been put into the CIFS to settle their transactions either in gross or netting mode, are displayed and discussed in the following sections.

Chart 4
System-based CIFS Transactions Breakdown in 2012 (US$, bn)



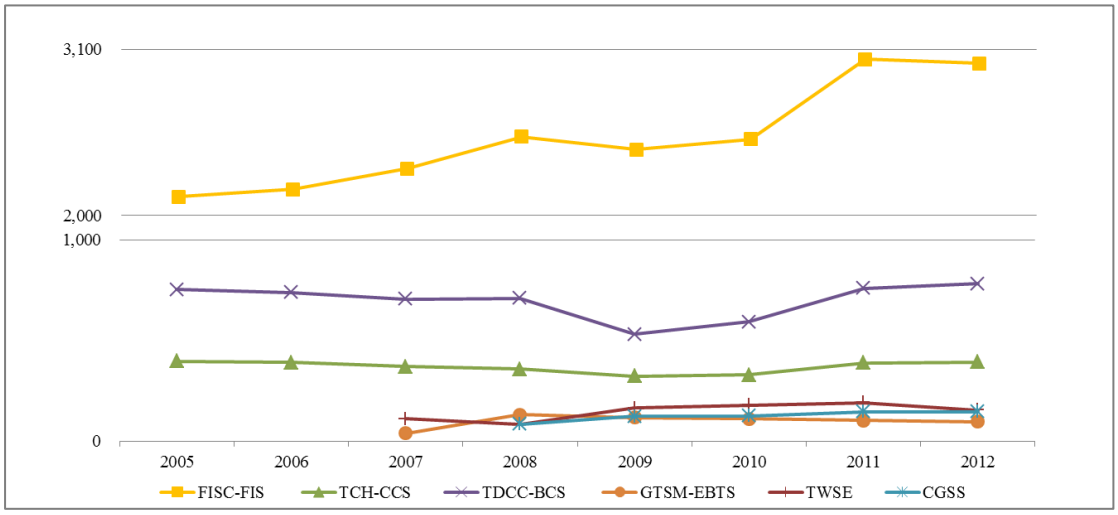
In this regard, an system-based transaction breakdown (disaggregated by the clearing systems) in 2012 of the CIFS is shown in Chart 4. It illustrates that all clearing systems accounted for 35% of CIFS trasaction value in 2012 upon which the FISC-FIS occupied the highest share of 23%, with the TDCC-BCS ranking the second, 6%, and the TCH-CCS ranking the third, 3%.

On the other hand, the trends of system-based CIFS transaction value for each clearing system are varied (Chart 5). It appears obviously that the FISC-FIS trended upwards from 2005 to 2012, while the other clearing systems were in a stable movement except the descending trend of the TDCC-BCS during 2008-2009.

[11] Here it refers to the transaction value after clearing and settled by the CIFS.

Chart 5

System-based CIFS Annual Settlement Amounts (US$, bn)



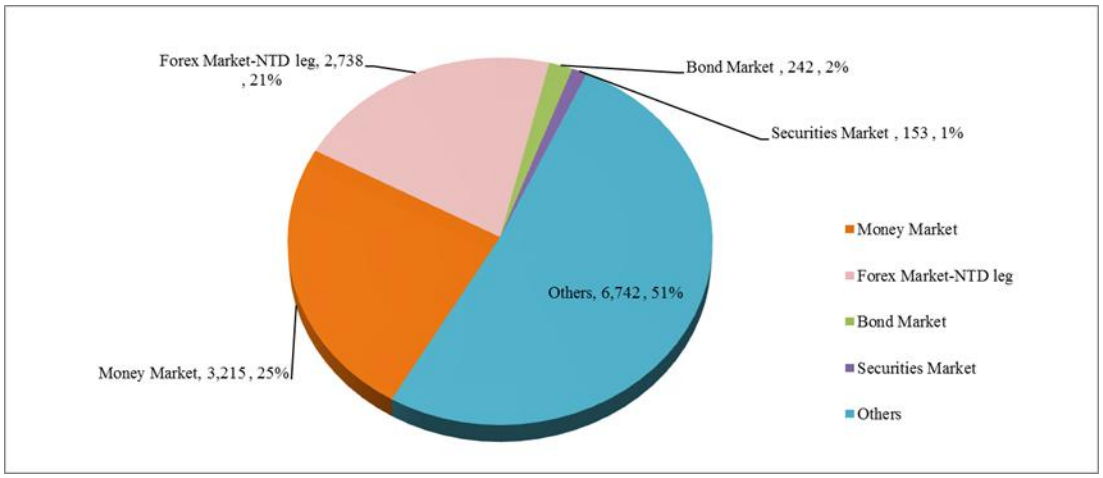
3.1.4 Market-wise Statistics

Further discussion of the CIFS transactions disaggregated by financial markets, i.e. Money Market, Foreign Exchange Market, Bond Market and Securities Market, (hereby named as the market-wise CIFS transactions) would be analyzed in the following sections.

Around 49% of the aggregate CIFS transactions can be identified by its resourcing financial markets with 25% from Money Market, 21% from Foreign Exchange Market[12], 2% from Bond Market and 1% from Securities Market, while the rest 51% transactions were mainly from retail payments, such as the FISC-FIS and the TCH-BCS. The market-wise pie chart of the CIFS are ploted in Chart 6.

Chart 6

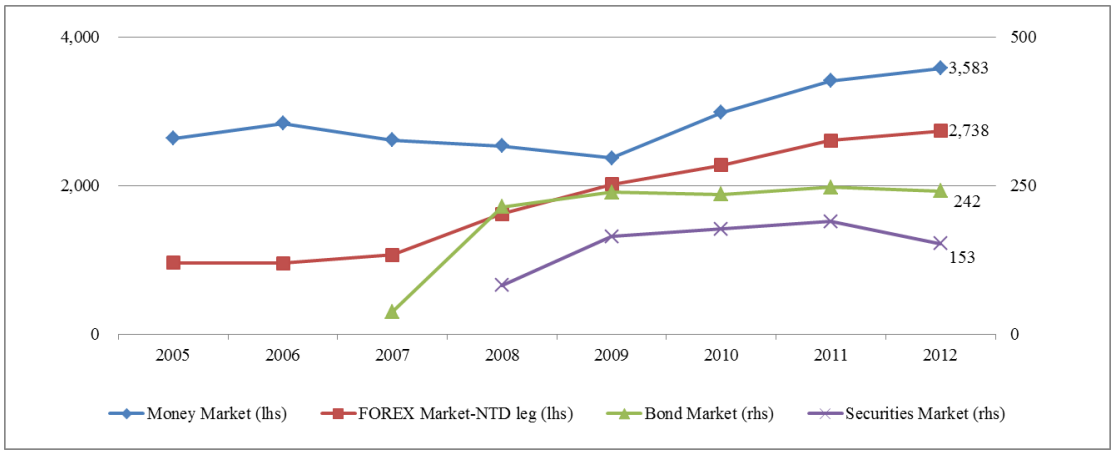
Market-wise CIFS Transactions Breakdown in 2012 (US$, bn)



[12] Since the CIFS deals with NTD settlement only, the Foreign exchange market transactions refer to the NTD leg, i.e. the trades between foreign currencies are not added into calculation.

Moreover, the annual market-wise CIFS settlement transactions from 2005 to 2012 are depicted in Chart 7. This chart shows the trend of each financial market in regard to the CIFS. It seems obvious that the Money Market made up a heavy share and its influence was increasing. The Foreign Exchange Market, to the next, was on an upward trend as well. The other markets, bond and Securities Markets, had trivial impacts on the CIFS and remained stable.

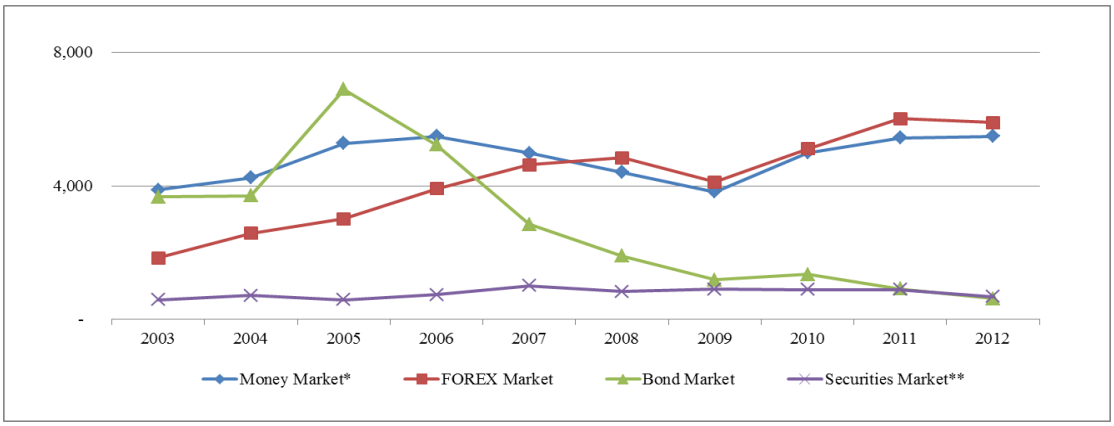
Chart 7
Market-wise CIFS Annual Settlement Amounts (US$, bn)



3.2 Financial Markets Statistics

To compare with market-wise statistics of CIFS, the annual financial market transaction value is plotted in Chart 8[13].

Chart 8
Market Annual Transaction Values (US$, bn)



Notes: * Money Market includes call loan, outright trades for bills and RP/RS for both bills and bonds.

**FOREX Market includes spot transaction, forward transaction, swap transaction, cross currency swap transaction, options transaction and margin trading.

[13] The relevant monthly data are presented in Appendix 3.

Foreign exchange transaction value continued to grow during 2003-2012, except the plunge in 2009 which "mainly reflected a contraction of international trade and diminishing capital movements. Furthermore, transactions in third currencies decreased because major central banks introduced loose monetary policies to tackle the financial crisis, which narrowed the interest rate spreads between currencies" (Annual Report, CBC, 2009, p.63). On the other hand, trading amount in Bond Market expanded in 2005 and then declined during 2006-2012. It seems to reflect the growth in the domestic Bond Market has hit its new high in 2005, and "as Taiwan's bond markets have entered a mature phase, the trading volume has gradually decreased. Furthermore, during this phase, financial institutions bought and hoarded a great deal of bonds due to ample funds at hand, which resulted in an insufficient supply of bonds and an imbalance of supply and demand in the market, and in turn caused distortions of the government bond yield curve. Additionally, high volatility in the cost of bond borrowing also diminished the trading willingness of market participants. All these are crucial factors that have hindered the development of bond markets" (Financial Stability Report, CBC, 2011, p.70).

3.3 Financial Related Development Indicators

The financial related development indicators herein refer to 2 groups of indicators, namely financial development indicators and stock market development indicators. Each group is composed of 3 indicators which will be introduced respectively in the following sections. The financial development indicators are used to gauge the intensity of a country's financial development, while the stock market development indicators are used to assess the progress of a country's stock market development. Furthermore, the level of correlation between these indicators and the CIFS will be demonstrated in next section.

3.3.1 Financial Development Indicators

The financial development indicators are comprised of the following indicators:

1. *Liqliab* (the sum of M2 divided by nominal GDP) is used to gauge the financial intensity of a country.
2. *Commbank* (the sum of total assets of commercial banks divided by combined assets of commercial banks and the central bank) is used to gauge the degree that banks allocate their credit.
3. *Bankcred* (the ratio of total credit of banks to the private sector by nominal GDP) is used to gauge the level which the credit of banks is allocated to the private sector.

As shown in Table 5, the *Commbank* index remained stable during 2003-2012 while the other two indicators showed an upward trend, which gave evidence that financial intensity has been improving in Taiwan.

Table 5
Financial Indicators (2003-2012)

Year	CIFS/GDP	Financial Development Indicators			Stock Market Development Indicators		
		Liqliab	Commbank	Bankcred	MktCap	ValTrade	Turnover
2003	15.03	2.00	0.95	1.40	1.20	1.90	1.91
2004	17.04	2.01	0.94	1.47	1.23	2.10	1.77
2005	20.98	2.08	0.93	1.56	1.33	1.60	1.31
2006	19.98	2.10	0.93	1.60	1.58	1.95	1.42
2007	19.52	2.00	0.93	1.56	1.67	2.56	1.53
2008	22.29	2.20	0.94	1.62	0.93	2.07	1.45
2009	25.03	2.35	0.94	1.65	1.69	2.38	1.78
2010	26.45	2.28	0.96	1.63	1.76	2.08	1.37
2011	26.12	2.37	0.96	1.70	1.41	1.92	1.20
2012	27.61	2.39	0.96	1.76	1.52	1.44	0.97
Avg	22.00	2.14	0.95	1.57	1.35	2.00	1.47

Sources: CBC; FSC.

3.3.2 Stock Market Development Indicators

The stock market development indicators consist of the following indicators:

1. *MktCap* (total market value of stocks in the domestic market divided by GDP) and *ValTrade* (total market value of stocks being traded by GDP) are used to gauge the scale of stock market.
2. *Turnover* (total market value of stocks being traded divided by the total market value of stocks listed in the domestic market) is used to gauge the level of liquidity in the stock market.

As shown in Table 5, *MktCap* was increasing during 2002-2007 and tumbled during the 2008 global financial crisis. Though the index rebounded in 2009, it did not register a positive movement from 2010 to 2012. *ValTrade* also showed a similar trend. *Turnover* seemed to be in a decline during 2003-2012 except a rebound in 2009.

4. Analysis

As described above, the second objective is to investigate the spillover effects of the 2008 financial crisis. While some financial market transactions decreased in 2008, CIFS transactions increased after 2008. The empirical analysis (Section 4.1) shows that the influence on CIFS transactions caused by the domestic Securities Market and Bond Market after the 2008 financial crisis was limited. Following Section 4.1, the discussion in Section 4.2 focuses on the oversight practices and supervisory framework. Finally, a bivariate analysis based on the financial indicators elaborated in Section 3.3 is presented in Section 4.3.

4.1 The Event Analysis and Vector Autoregressive (VAR) Model Approach

In Section 4.1.1 we first set up a regression model to identify the determinants explaining the CIFS transactions. Additionally in Section 4.1.2 we employ a structural change model to test if there exists a significant adverse change in CIFS transactions between the pre- and post-2008 financial crisis periods, and then discuss the possible causes of the structural transition in CIFS's transactions. Finally in Section 4.1.3, we adopt a VAR model to further analyze the interaction relations among the variables of interest.

4.1.1 The Benchmark Model

In this section, the model is set up to explain the determinants of CIFS transactions and test the impacts of market transmitting effects on CIFS. As shown in Chart 6, the four-market flows, FISC-FIS and TCH-CCS settlements account for major shares in relation to CIFS transactions. Therefore, their transaction values are included as independent variables.

Table 6
Data Definition

Data Span	Monthly transaction data from 2003M1 to 2012M12
Variables	Definitions
CIFS	CIFS transaction value, TWD, mn
FISC	FISC-FIS transaction value, TWD, mn
TCH	TCH-CCS transaction value, TWD, mn
MMT	Money Market transaction value, including bills market, RP/RS markets and call loan markets, TWD, mn
FXMT	FX Market net transaction values, USD, times to NT$/US$ monthly exchange rates, mn
BMT	Bond Market transaction values, TWD, mn
SMT	TWSE Stock Market transaction values, TWD, mn

Source: CBC.

The model is set as follows:

$$CIFS = \mathrm{c} + \beta_1 FISC + \beta_2 TCH + \beta_3 MMT + \beta_4 FXMT + \beta_5 BMT + \beta_6 SMT + \varepsilon \quad (1)$$

where CIFS, FISC and TCH denote the monthly transaction values from 2003M1 to 2012M12. MMT, FXMT, BMT and SMT represent the monthly transaction values of Money Market, Foreign Exchange Market, Bond Market and Securities Market respectively (see Table 6 for definitions and Appendix 4 & 5 for data figures). To avoid spurious regression, we conduct the Dickey-Fuller GLS test and Phillips-Perron test to investigate the unit root properties prior to the model testing. The results show that nearly all the variables are stationary and significant at 99% confidence interval.

The resulting benchmark model[14] is

$$\widehat{CIFS} = 8.21{*}10^6 + 1.27FISC - 5.57TCH + 0.95MMT + 0.56FXMT$$
$$\text{(se)}^{15} \quad (2.22{*}10^6)^{***} \quad (0.41)^{***} \quad (1.03)^{***} \quad (0.24)^{***} \quad (0.16)^{***}$$
$$- 0.32BMT - 1.05SMT \qquad \bar{R}^2 = 0.84, \quad Prob(\text{F-stat}) = 0.00 \qquad (2)$$
$$(0.07)^{***} \quad (0.40)^{***}$$

In the benchmark model, it reaffirms that FISC-FIS and TCH-CCS, as systemically important payment systems, are significantly correlated with the CIFS operations. While FISC-FIS contributes to the CIFS transactions in an ascending trend, the TCH-CCS transactions are negatively correlated to CIFS transactions. That is, although the transactions of CIFS and FISC-FIS have been both increasing steadily in recent years, the TCH-CCS's businesses have been downsizing due to the emergence of electronic payments. Furthermore, the market transmission impacts on CIFS transactions are also significant at 1% level between 2003 and 2012. The Money Market and Foreign Exchange Market correlate positively to the CIFS and the market transactions in these two markets have been increasing since 2008, the same as the CIFS transactions. As to the Bond Market and Securities Market, the transactions are inversely correlated with the CIFS transactions.

4.1.2 Pre- and Post-2008 Effects

Following the benchmark model, in order to explore the effects of the 2008 global financial crisis that started at the end of 2007, we include a dummy variable to examine whether there exists a structural transition in the CIFS transactions between the pre- and post-2008 periods. Furthermore, in order to determine the appropriate

[14] For ease of reference, equation (2) is referred to as "the benchmark model".

[15] *** stands for significance at 1% level, **, idem, 5%, *, idem, 10%.

breaking point for the structural change, the Quandt-Andrews breakpoint test is conducted. The test indicates the structural change happened most likely around 2008M10 to 2009M02 (The test statistic is shown in Appendix 6). Therefore, the dummy variable is set to equal 1 from 2008M10 to 2012M12 and 0 otherwise.

The resulting structural change model[16] is

$$\widehat{CIFS} = 1.38*10^6 + 6.91*10^6\text{DUMMY} + 1.05FISC - 2.67TCH$$
$$\text{(se)} \quad (1.57*10^6) \quad (0.47*10^6)*** \quad (0.25)*** \quad (0.72)***$$
$$+0.72MMT + 0.46FXMT \qquad \bar{R}^2 = 0.93, Prob(\text{F-stat}) = 0.00 \qquad (3)$$
$$(0.12)*** \quad (0.10)***$$

Although the 2008 financial crisis struck some domestic financial markets and its transaction amount reduced, the significance of the positive dummy variable coefficient indicates there is a positive structural level change in the CIFS transactions between pre- and post-2008 period. The results are valid since the CIFS transactions in Money Market, FISC-FIS and NTD-leg Foreign Exchange Market have increased significantly on average in the post-2008 period compared to the average transactions in pre-2008 period,[17] and the CBC incorporated the GTSM-EBTS, TWSE-SBECS and CGSS into CIFS in 2007 and 2008. After we include the dummy variable in the structural change model, the MMT and FXMT remain significant at 1% level, yet the BMKT and SMT both become insignificant,[18] suggesting that the transmission effects of 2008 global financial crisis on Taiwan's Securities Market and Bond Market linked to CIFS were negligible.

Two points are worth noting. First, the structural reforms of CIFS (e.g., to provide final settlement services for other systems) may be more significant than the transmitting effects from Bond market and Securities market. The reasons are as follows: compared to the benchmark model, the inclusion of dummy variable trivialized the influences from the two markets in the above structural change model, where the impacts of structural reforms are captured by the dummy variable. Second, the transmitting effects from Money market and Foreign Exchange market into CIFS are more essential than the influences from Bond market and Securities market. This also makes sense because the transactions in Money market and NTD-leg Foreign Exchange market account for significant shares in CIFS transactions (see Chart 6).

---

16 For ease of reference, equation (3) is referred to as the "structural change model".

17 Since CIFS transactions are mainly composed of Money market, FISC-FIS and NTD-leg Foreign Exchange market transactions, the significant positive incremental is partly due to their average transaction increases in the post-2008 period (refer to Chart 5 and Chart 7).

18 The test results of the complete model are presented in Appendix 7.

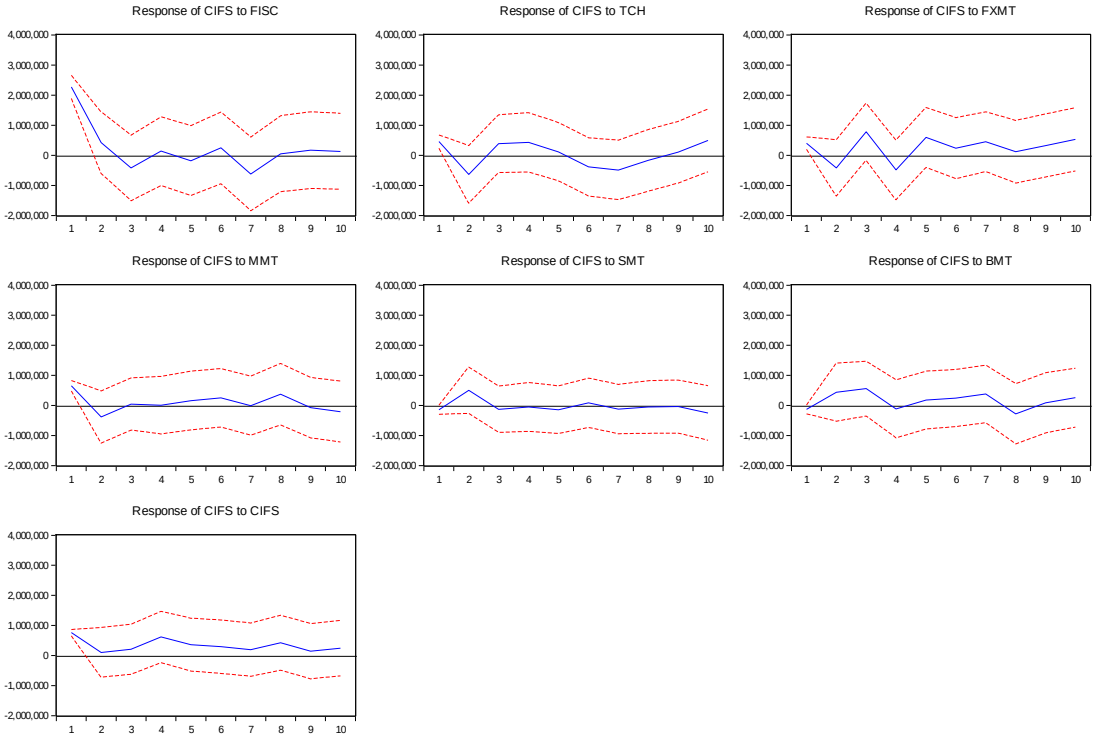
4.1.3 Vector Autoregressive (VAR) [19] Model Approach

In consideration of the dynamic relations in time series, we then conduct a Vector Autoregressive (VAR) model to further explore the interconnection relationships among the concerned variables in Section 4.1.1. The monthly data were used in the VAR model with the following ordering: FISC, TCH, FXMT, MMT, SMT, BMT and CIFS. Based on Akaike Information Criterion (AIC) test, the optimal period of lag order is selected as twelve. The resulted analysis of the impulse response and variance decomposition is, then, shown below.

In the first place, the resulting analysis of impulse response was displayed in Chart 9. It is obvious that the response results are stably varied around zero after the first period within the standard error bands. Furthermore, it showed that the responses of CIFS to FISC were positive and with the largest effect at the first period, dying off and stably fluctuated around zero over time. Additionally, the response of the CIFS to MMT was also comparatively large at the first period. For other variables, the responses of CIFS were slightly varied around zero. In other words, this demonstrates that the effects of other variables' shocks on CIFS were limited based on the historical data series.

Chart 9

The Impulse Response Analysis



[19] Please see Bernanke & Blinder (1992).

Secondly, the empirical study demonstrates the percentage of variance decomposition of the forecast error of variables to CIFS. It helps to understand the degree of the change a variable could be explained by itself or other endogenous variables and judge the strength of each variable's exogeneity. The results are shown in Table 7. The empirical result indicated that in terms of the variance of CIFS transactions, FISC transactions had considerably high explanatory power (44.66%~78.53%). For both FXMT and CIFS, the longer the period, the higher the explanatory power to its variance. The explanatory power could reach at most 16.12% and 11.40% for FXMT and CIFS, respectively.

In sum, from the above analysis, FISC, FXMT, and MMT are influential factors in explaining the variation of CIFS transactions, which is consistent with the previous analysis in Section 4.1.

Table 7

The Results of Variance Decomposition

Variance Decomposition of CIFS							
Period	FISC	TCH	FXMT	MMT	SMT	BMT	CIFS
1	78.53	3.14	2.47	6.49	0.31	0.27	8.79
2	67.24	7.71	4.29	7.24	3.45	2.66	7.41
3	59.66	8.20	10.31	6.24	3.14	5.64	6.82
4	54.93	9.35	11.78	5.72	2.91	5.30	10.00
5	52.13	8.94	14.38	5.64	2.95	5.30	10.66
6	50.45	9.90	14.25	5.95	2.89	5.59	10.96
7	49.39	11.03	14.71	5.45	2.77	6.31	10.35
8	47.65	10.87	14.29	6.37	2.69	6.72	11.40
9	47.21	10.80	14.91	6.33	2.67	6.69	11.39
10	44.66	11.96	16.12	6.28	2.98	6.81	11.19
Cholesky Ordering: FISC TCH FXMT MMT SMT BMT CIFS							

4.2 Bivariate Analysis

To examine the relationship between transaction value of RTGS and financial market, a covariance analysis over CIFS/GDP with financial related development indicators (mentioned in Section e3.3) is conducted and discussed in the following sections. The results are shown in Table 8, which suggest that the financial development indicators have a more robust relationship with the CIFS than the stock market development indicators.

Table 8
Covariance Analysis (2003M01:2012M12)

Correlation (t-Statistic)	CIFS/GDP	Financial Development Indicators			Stock Market Development Indicators		
		Liqliab	Commbank	Bankcred	MktCap	ValTrade	Turnover
CIFS/GDP	1.00 -----						
Liqliab	0.77 (12.99)***	1.00 -----					
Commbank	0.38 (4.43)***	0.47 (5.75)***	1.00 -----				
Bankcred	0.74 (12.07)***	0.90 (22.65)***	0.25 (2.84)***	1.00 -----			
MktCap	0.50 (6.32)***	0.38 (4.52)***	0.14 (1.51)	0.52 (6.69)***	1.00 -----		
ValTrade	0.03 (0.34)	-0.08 (-0.89)	-0.06 (-0.73)	-0.08 (-0.87)	0.40 (4.71)***	1.00 -----	
Turnover	-0.26 (-2.94)***	-0.29 (-3.30)***	-0.10 (-1.07)	-0.39 (-4.57)***	-0.15 (-1.65)	0.83 (16.37)***	1.00 -----

Note: *means significance at 10% level. **, idem, 5%. ***, idem, 1%.
Source: CBC; FSC.

4.2.1 Correlation between CIFS/GDP and Financial Development Indicators

Table 8 indicates that CIFS/GDP is positively correlated with all of the 3 financial development indicators within 1% level of significance. The coefficients between CIFS/GDP and *Liqliab*, *Commbank* and *Bankcred* are 0.77, 0.38, and 0.74, respectively. Moreover, these 3 indicators are positively correlated with each other within 1% level of significance. The statistics to some extent provide suggestion that positive relationships exist between the CIFS transaction value and domestic financial intensity, the level of banks' credit allocated to the private sector and the ratio of banks assets to the combined assets of commercial banks and the central bank (in the order of correlation level).

4.2.2 Correlation between CIFS/GDP and Stock Market Development Indicators

Though the correlation between CIFS/GDP and financial development indicators are significant, yet similar results seem not applicable to the stock market development indicators. Within the stock market development indicators, 2 indicators are within 1% level of significance. Only *MktCap* is positively correlated (0.5). The other one, *Turnover*, is negatively correlated (-0.26). Besides, the results of covariance analysis are mixed in the cross correlation within these 3 stock market development

indicators.

4.3 Discussion on FMI Oversight and Supervisory Framework

To be in line with the development of global trends when developed countries have established single financial supervisory authorities to consolidate the supervision of financial institutions and markets, the FSC was established on 1st July 2004 as the competent authority responsible for development, supervision, regulation, and examination of financial markets and financial service enterprises in Taiwan.

In general, the FSC is regarded as the main supervisory authority for financial markets and financial institutions while the CBC is the competent authority in charge of the oversight of payment systems pursuant to Article 2 of the Organic Act Governing the Establishment of the Financial Supervisory Commission, as mentioned in Section 2.3.

The CBC coordinates with the FSC on the oversight and supervision of FMIs to minimize duplication, particularly for payment systems. The CBC and the FSC exchange views and both establish information-sharing arrangements so as to achieve public policy objectives. In this regard, the CBC holds "Promotion for the Sound Operation of Payment Systems" meetings regularly with the FSC, the TDCC, the FISC and the TCH.

In addition, "to help cross-strait cooperation, the FSC signed three MOUs, involving banking, insurance, and securities and futures services, with the China Banking Regulatory Commission, the China Insurance Regulatory Commission and the China Securities Regulatory Commission, respectively, on 16 November 2009. The content of these MOUs covered supervisory cooperation including information exchanges, confidentiality, financial examinations, and cross-strait contacts. The terms were effective as of 16 January 2010"(CBC, 2010, p. 80). These MOUs are expected to contribute to the collaboration of cross-strait supervision. Moreover, the coordination may support Taiwan's supervisory authorities to obtain a more complete picture of the relevant activities of Taiwan's financial institutions in China.

5. Conclusion

The BIS-CPSS reports "The Interdependencies of Payment and Settlement Systems" (2008) and "Principles for Financial Market Infrastructures" (2012) serve as the important sources and research motives of this paper. Derived from these reports, this paper tries to examine the interdependencies between FMIs and the CIFS, and how they were influenced through the interdependencies when some shock events occurred, such as the 2008 global financial crisis. Above all, this paper locates the CIFS in the center of discussion since the CIFS is the most systemically important FMIs in Taiwan, and any disruption or impacts on the CIFS could result in systemic risk to financial markets.

Some important statistics of CIFS in Section 3 are worth noting. Firstly, the CIFS transaction value is on an upward trend during 2003-2012, probably due to the inclusion of the payments from TDCC, TWSE, GTSM and CGSS. The second, when we disaggregate CIFS transaction value in 2012 by system (Chart 4) and by market (Chart 6), the level of interdependencies (if both financial markets and systems are put into consideration) seems easy to tell. Overall, Money Market shares the most (25%), with FISC-FIS (23%) the next, and the third, Foreign Exchange Market (21%). These statistics to some extent explain the interdependencies between the CIFS and other systems (and financial markets).

The benchmark model is employed using monthly data ranging from 2003M1 to 2012M12 to identify the factors influencing the CIFS transaction value. The empirical results are consistent with previous statistics. The major influential factors are FISC-FIS, Money Market and Foreign Exchange Market transactions. We further include a dummy variable in the regression model to capture the effects of structural change in CIFS transactions. The significance of the positive dummy variable coefficient indicates a positive structural level change in the CIFS transactions between pre- and post-2008 periods. The reasons may be the increasing transactions in Money Market, FISC-FIS and Foreign Exchange Market as well as the recent CIFS reforms to provide final settlement services to other systems. Accordingly, since the positive incremental in CIFS transactions is statistically significant, the transmitting effects of the 2008 financial crisis on CIFS transactions seem to be negligible. On the other hand, the VAR analysis reaffirms that FISC-FIS, Foreign Exchange Market and Money Market transactions are important factors in explaining the variation of CIFS transactions. Furthermore, a covariance analysis between the CIFS transaction value and financial indicators is conducted and the results show that the CIFS is positively correlated with financial development indicators within 1% level of significance,

while the relationship between the CIFS and stock market development indicators are vague.

Regarding the oversight of the CBC, to ensure smooth and efficient operation of significant payment systems, the CBC has requested the FISC and the TCH to conduct self-assessment against the "Core Principles for Systemically Important Payment Systems" published by BIS-CPSS in 2001 and reviewed their assessment results. Since both the statistics and the regression results suggest that the FISC became the most critical FMI in terms of the system-based interdependencies of the CIFS, the safety and efficiency of the FISC should be proportionately emphasized. Though the CBC oversees the FISC, the FSC remains the regulatory authority. Thus, cooperation for the supervision of systemic FMIs between the CBC and the FSC, such as regular meetings and information sharing, becomes essential. In this regard, we suggest that both authorities coordinate more closely on specific issues such as requesting systemic FMIs to conduct self-assessments against the "Principles for Financial Market Infrastructures" and share the review results so as to enhance sound operation of these FMIs and efficiency of supervision.

Finally, as the hub of domestic FMIs, some data of the CIFS are still presented in raw data form which needs to be processed, disaggregated and calculated before analysis. Therefore, we suggest that the CIFS build up a data base which can be more user-friendly to facilitate further research and analysis.

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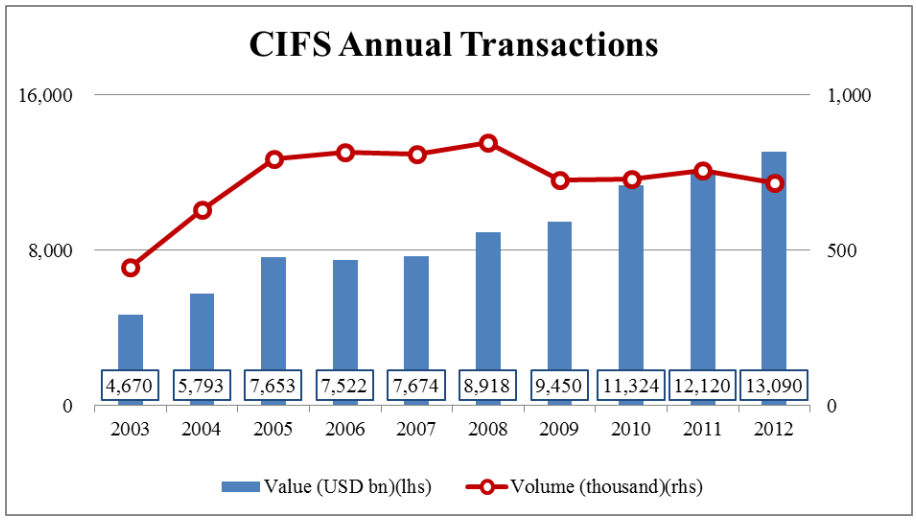
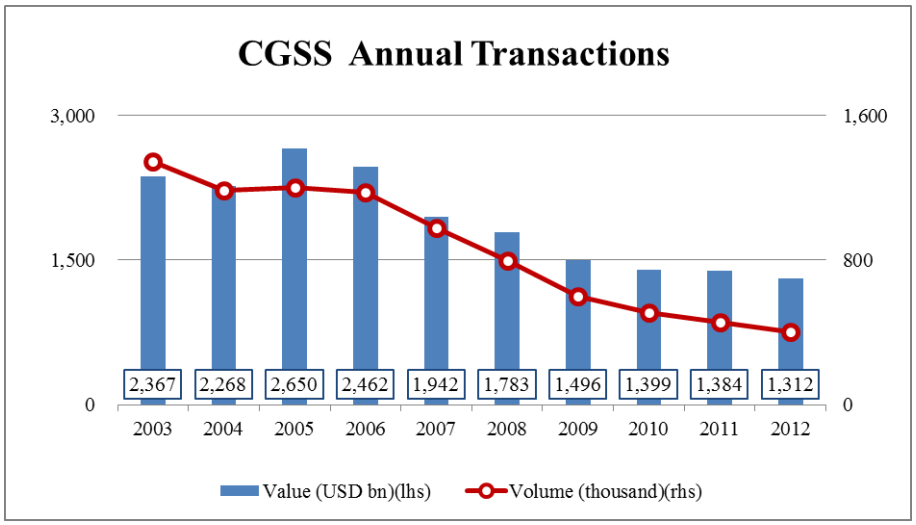
Appendix 1. Stylized Statistics of Taiwan's Economy in 2012

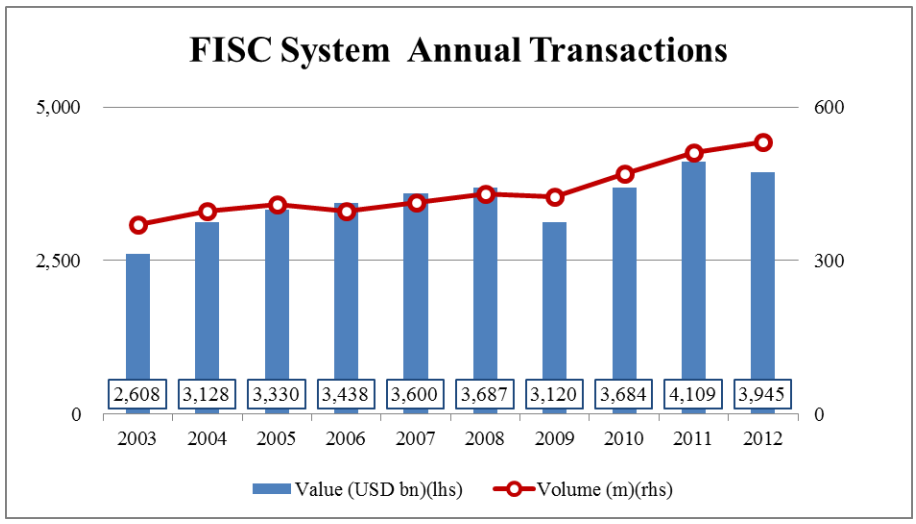
Stylized statistics of participating SEACEN members Economy									
SN	Economy GDP (mill. $)	Pop (mil.)	Area (sq. km)	GT	KA	EI	FD	PST	PS
Taiwan	474,269	23	36,000	A	C	1.40	1.76	37.26	27.61

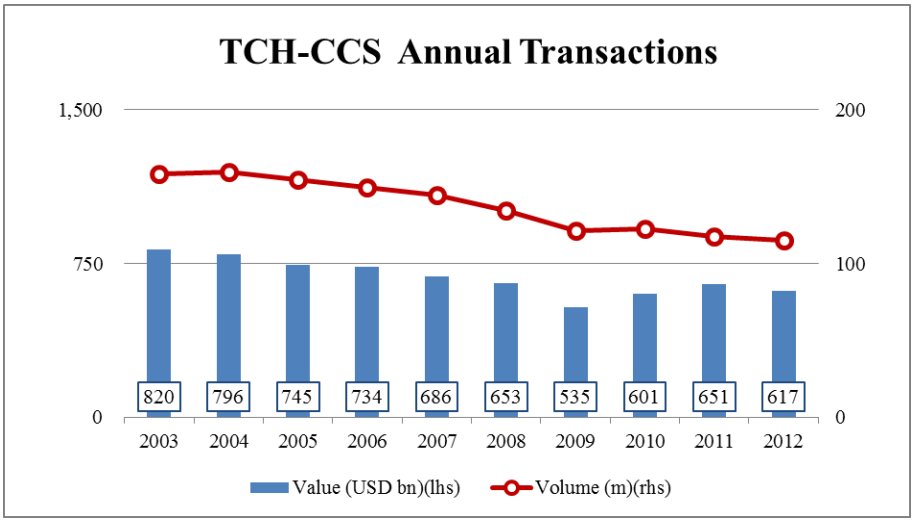
Note: 1. "Economy (in US $ dollars)" in 2012; 2. "Population (in millions)" in 2012; 3. "Area (square kilometers)"; 4. "GT" is Geographical type A. Island, B. Landlocked C. Neither A or B; 5. "KA" is Capital Account A. Not liberalized B. Partially liberalized C. Fully liberalized; 6. External Integration ("EI") indicator is (X of goods and services + M of goods and services)/GDP; in 2012; 7. Financial Development ("FD") indicator is the ratio of total credit of commercial banks and other deposit-taking banks to the private sector by nominal GDP in 2012; 8. Payment System Total ("PST") Transaction Indicator is total transactions (including CIFS, FISC-FIS and TCH-CCS) by GDP in 2012; 9. The CIFS transaction by GDP in 2012

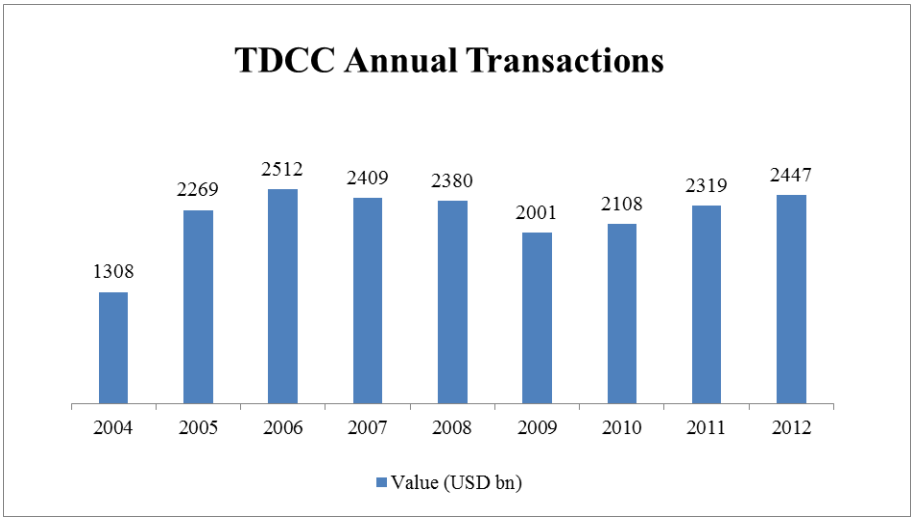
Appendix 2. Annual Transactions of Systemically Important Settlement and Clearing Systems

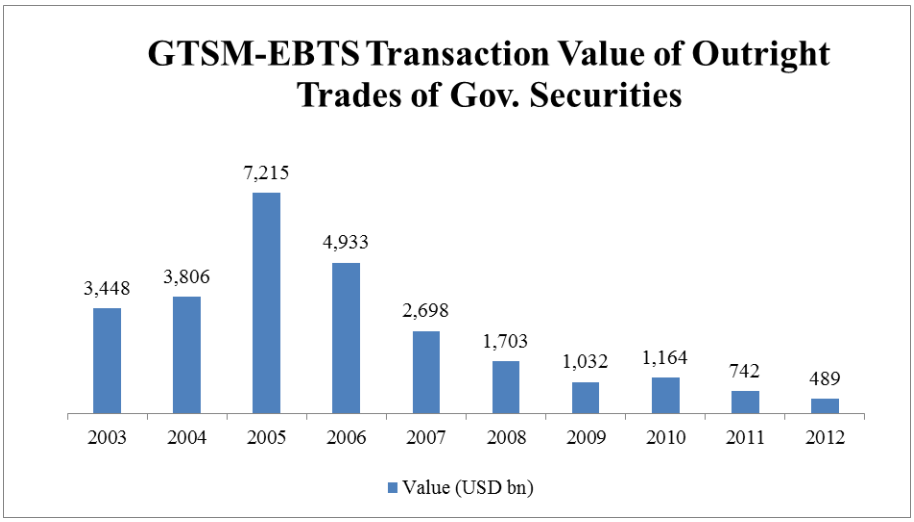


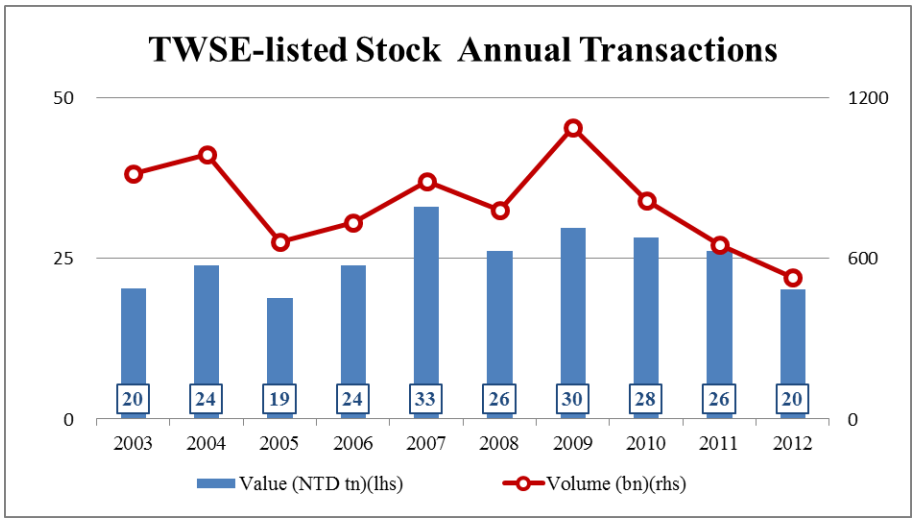


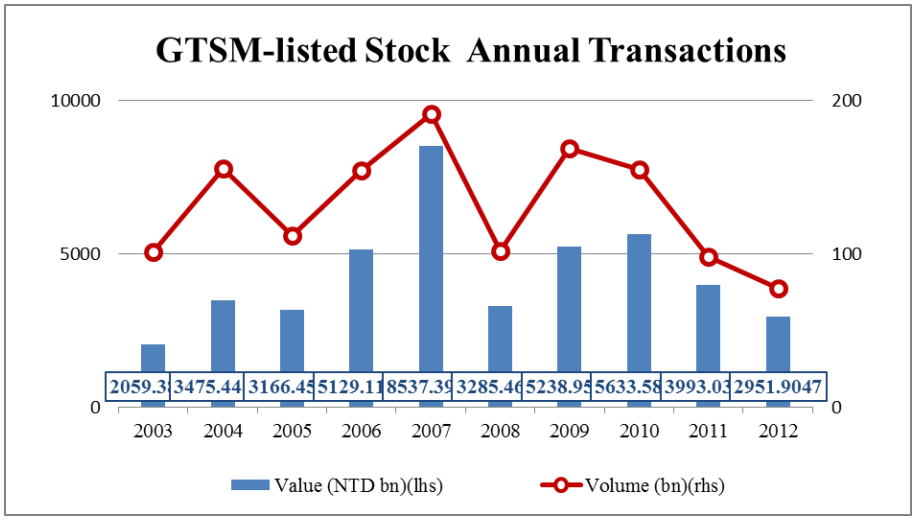



TCH-CCS Annual Transactions
1,500
750
0
200
100
0
820
796
745
734
686
653
535
601
651
617
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Value (USD bn)(lhs)
Volume (m)(rhs)


TDCC Annual Transactions
1308
2269
2512
2409
2380
2001
2108
2319
2447
2004
2005
2006
2007
2008
2009
2010
2011
2012
Value (USD bn)


GTSM-EBTS Transaction Value of Outright Trades of Gov. Securities
3,448
3,806
7,215
4,933
2,698
1,703
1,032
1,164
742
489
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Value (USD bn)


TWSE-listed Stock Annual Transactions
50
25
0
1200
600
0
20
24
19
24
33
26
30
28
26
20
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Value (NTD tn)(lhs)
Volume (bn)(rhs)


GTSM-listed Stock Annual Transactions
10000
5000
0
200
100
0
2059.3
3475.44
3166.45
5129.11
8537.39
3285.46
5238.95
5633.58
3993.03
2951.9047
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Value (NTD bn)(lhs)
Volume (bn)(rhs)

Appendix 3. The Relevant Data Set

SEACEN Research Project: "Analytical Framework in Assessing Systemic Financial Market Infrastructur

Draft Data Form

PS name	CIFS									
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Transaction value (USD bn)	4,670	5,793	7,653	7,522	7,674	8,918	9,450	11,324	12,120	13,090

Annual Market Transaction Value in USD bn

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Money Market*	3,885	4,243	5,275	5,481	4,982	4,403	3,819	4,991	5,445	5,484
FOREX Market	1,838	2,580	3,009	3,911	4,634	4,846	4,111	5,115	6,013	5,893
Bond Market	3,673	3,700	6,891	5,225	2,852	1,905	1,190	1,344	913	622
Securities Market*	592	716	584	736	1,007	835	900	894	891	684

Note:

*Include RP/RS, Call loan market, and both buying and selling trades in Bill Market
**Include only listed stocks

SEACEN Research Project: "Analytical Framework in Assessing Systemic Financial Market Infrastructure

Draft Data Form

Name of Payment System (PS): The Central Bank's Interbank Funds Transfer System (CIFS)

	AVG	**STD**	**2003M01**	**2003M02**	**2003M03**	**2003M04**
No. of PS transactions	60,605	10,972	39,418	28,556	36,528	38,095
Value of PS transactions (USD, Million)	735,716	229,054	481,894	306,534	335,383	349,943

Transaction Values (USD, million)

High Frequency Market Price Value of transactions in USD (highest time series, from 2003 or latest available)

	AVG	**STD**	**2003M01**	**2003M02**	**2003M03**	**2003M04**
Money Market*	400,059	68,685	330,694	238,824	318,624	341,694
FOREX Market	349,589	119,564	132,773	100,305	134,831	141,446
Bond Market	235,947	183,016	257,454	200,626	283,698	414,051
Securities Market**	65,315	22,541	60,744	27,701	27,490	33,888

*Include RP/RS, Call loan market, and both buying and selling trades in Bill Market
**Include only listed stocks

2003M05	2003M06	2003M07	2003M08	2003M09	2003M10	2003M11	2003M12	2004M01	2004M02
37,100	35,368	39,086	36,410	38,342	42,419	35,604	39,598	33,115	38,188
362,507	366,387	402,952	384,337	411,195	468,271	382,094	421,651	396,494	384,711

2003M05	2003M06	2003M07	2003M08	2003M09	2003M10	2003M11	2003M12	2004M01	2004M02
352,957	326,922	342,602	317,261	311,207	340,061	315,770	348,822	257,965	309,377
146,491	143,875	169,654	154,333	196,427	208,785	146,294	162,485	189,592	210,140
486,349	436,952	349,753	238,906	174,411	308,028	231,335	291,044	194,447	184,778
28,397	58,289	85,441	60,722	50,762	67,083	49,233	41,912	54,223	95,617

2004M03	2004M04	2004M05	2004M06	2004M07	2004M08	2004M09	2004M10	2004M11	2004M12
45,268	46,820	50,200	54,228	58,131	57,696	58,679	57,144	64,072	66,389
472,726	467,530	454,367	467,500	487,560	470,301	515,545	473,681	546,738	664,218

2004M03	2004M04	2004M05	2004M06	2004M07	2004M08	2004M09	2004M10	2004M11	2004M12
377,840	359,829	332,483	354,089	383,996	364,094	363,896	334,246	367,854	437,416
232,837	226,268	224,692	212,597	203,491	177,288	195,360	208,148	243,446	256,097
369,503	353,718	250,972	247,640	378,321	291,545	261,170	347,360	411,311	409,066
111,625	95,497	55,298	43,311	34,378	36,377	51,026	48,427	46,615	43,135

2005M01	2005M02	2005M03	2005M04	2005M05	2005M06	2005M07	2005M08	2005M09	2005M10
66,511	46,420	73,493	63,950	62,176	65,543	68,830	70,588	72,699	64,765
672,592	491,046	712,322	648,108	600,875	662,931	691,802	648,139	627,278	627,255

2005M01	2005M02	2005M03	2005M04	2005M05	2005M06	2005M07	2005M08	2005M09	2005M10
424,744	283,130	451,551	405,882	446,800	463,886	457,263	479,191	466,769	438,219
234,346	177,001	272,641	228,777	225,553	256,794	258,726	271,786	264,209	249,288
499,972	263,245	450,243	510,564	672,416	511,738	743,806	831,056	623,848	795,411
36,166	35,511	53,829	37,820	41,823	58,085	59,061	53,771	41,574	42,265

2005M11	2005M12	2006M01	2006M02	2006M03	2006M04	2006M05	2006M06	2006M07	2006M08
66,697	72,516	69,512	58,496	75,934	66,853	72,902	72,380	68,067	70,687
597,487	674,711	704,049	534,275	677,759	661,153	648,722	645,816	664,734	629,570

2005M11	2005M12	2006M01	2006M02	2006M03	2006M04	2006M05	2006M06	2006M07	2006M08
451,878	505,277	474,322	405,241	522,315	479,909	501,289	483,175	463,291	468,232
254,635	314,911	283,364	249,400	327,375	288,450	337,901	344,001	321,316	343,792
584,363	403,937	589,613	506,967	623,965	421,797	275,593	368,259	414,334	473,793
51,280	72,835	67,385	48,672	63,598	72,230	87,249	60,897	45,074	51,894

2006M09	2006M10	2006M11	2006M12	2007M01	2007M02	2007M03	2007M04	2007M05	2007M06
64,759	62,588	68,069	66,761	70,723	46,662	70,311	61,080	68,136	65,152
567,900	627,552	575,253	586,551	672,998	437,933	612,038	564,758	588,629	625,838

2006M09	2006M10	2006M11	2006M12	2007M01	2007M02	2007M03	2007M04	2007M05	2007M06
416,047	410,455	418,602	438,490	477,984	271,903	449,779	425,881	457,611	439,283
346,294	328,583	381,850	358,513	408,619	278,223	439,539	332,873	387,376	358,925
432,245	372,460	430,521	315,336	441,692	146,772	461,348	283,823	320,602	172,027
47,458	49,621	70,893	70,817	80,269	33,218	78,030	63,852	63,295	90,152

2007M07	2007M08	2007M09	2007M10	2007M11	2007M12	2008M01	2008M02	2008M03	2008M04
68,488	75,745	62,442	74,844	74,468	69,915	75,927	57,921	75,870	72,827
686,538	746,316	599,970	727,949	715,007	699,954	769,266	600,955	807,362	778,702

2007M07	2007M08	2007M09	2007M10	2007M11	2007M12	2008M01	2008M02	2008M03	2008M04
445,774	444,636	363,377	400,845	400,148	405,194	408,419	293,770	408,767	414,884
393,440	438,051	341,801	440,552	472,953	341,935	463,801	343,320	486,555	425,740
192,549	196,455	149,646	181,685	150,602	154,335	238,312	153,635	304,474	262,058
150,980	107,471	74,967	107,210	89,843	67,643	94,460	57,612	104,423	108,587

2008M05	2008M06	2008M07	2008M08	2008M09	2008M10	2008M11	2008M12	2009M01	2009M02
73,900	70,779	69,478	71,251	75,079	75,595	61,972	66,773	51,872	59,074
761,885	762,679	766,610	753,018	756,610	846,092	609,437	716,473	552,979	691,475

2008M05	2008M06	2008M07	2008M08	2008M09	2008M10	2008M11	2008M12	2009M01	2009M02
398,199	374,180	379,233	351,168	364,610	370,597	289,998	348,858	237,932	269,645
414,378	400,656	408,843	382,468	472,092	494,008	270,813	283,707	235,322	272,351
153,252	136,620	87,626	125,496	128,010	99,534	94,359	121,290	84,335	104,847
96,397	66,628	72,453	62,639	58,572	38,143	33,634	41,717	25,383	38,193

2009M03	2009M04	2009M05	2009M06	2009M07	2009M08	2009M09	2009M10	2009M11	2009M12
65,144	61,896	55,702	66,548	64,586	59,312	60,701	61,519	58,710	61,470
752,015	655,438	674,060	898,250	861,054	812,350	839,941	929,521	863,052	940,559

2009M03	2009M04	2009M05	2009M06	2009M07	2009M08	2009M09	2009M10	2009M11	2009M12
287,969	282,865	267,904	347,899	330,139	329,860	349,393	384,797	349,322	380,797
324,743	326,238	316,750	367,033	350,487	334,174	390,761	419,592	394,887	378,955
132,409	94,846	100,935	108,924	122,077	92,502	107,391	107,909	65,137	68,427
67,257	92,959	105,127	86,764	92,112	63,750	81,024	85,958	70,632	91,293

2010M01	2010M02	2010M03	2010M04	2010M05	2010M06	2010M07	2010M08	2010M09	2010M10
56,991	46,025	63,319	59,463	63,105	62,513	61,856	62,063	60,762	62,291
868,040	722,789	920,984	889,803	1,007,018	897,214	967,370	1,043,108	954,896	965,236

2010M01	2010M02	2010M03	2010M04	2010M05	2010M06	2010M07	2010M08	2010M09	2010M10
348,935	283,070	411,747	388,963	449,825	380,532	423,541	473,488	426,583	431,946
405,861	317,607	443,291	436,487	473,112	402,100	429,643	443,348	443,641	442,518
139,485	54,494	115,213	142,269	154,032	124,148	143,695	130,776	91,325	100,111
93,516	40,715	72,949	81,515	62,103	51,820	69,495	85,305	82,768	77,100

2010M11	2010M12	2011M01	2011M02	2011M03	2011M04	2011M05	2011M06	2011M07
64,148	65,516	65,145	49,496	69,956	60,923	64,863	63,343	61,027
1,021,188	1,077,685	1,149,806	832,030	1,070,134	981,568	984,074	1,021,009	1,067,199

2010M11	2010M12	2011M01	2011M02	2011M03	2011M04	2011M05	2011M06	2011M07
481,284	490,745	503,480	360,340	505,508	449,217	465,614	451,930	476,360
440,651	436,837	483,478	360,831	517,172	459,101	512,419	542,482	514,015
90,131	58,679	92,376	69,465	96,877	60,211	80,030	88,083	80,793
75,694	100,586	88,519	64,933	89,154	73,427	75,407	71,608	84,370

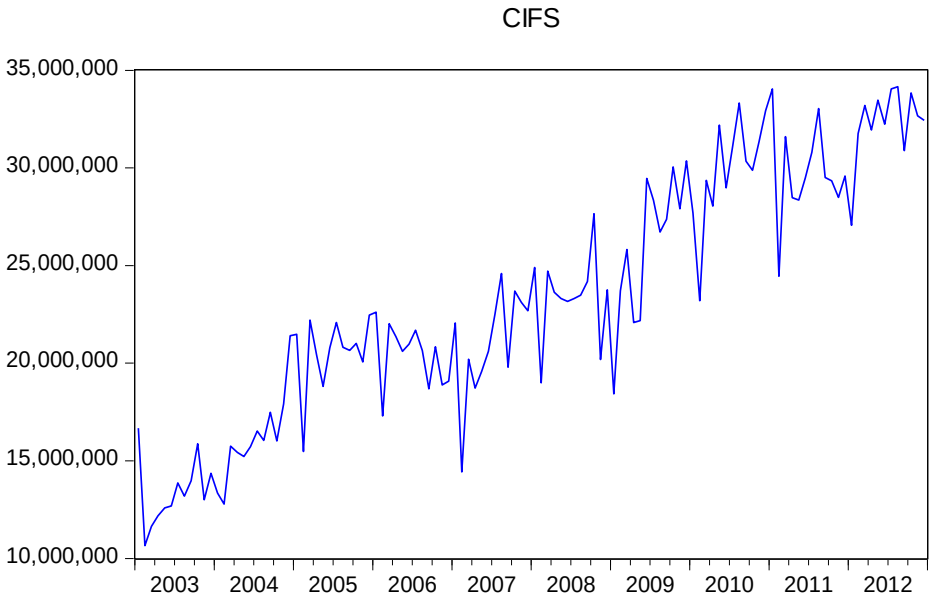
2011M08	2011M09	2011M10	2011M11	2011M12	2012M01	2012M02	2012M03	2012M04
68,212	66,382	60,476	65,082	62,765	51,751	60,635	64,678	56,772
1,139,306	992,059	968,876	942,064	977,151	900,176	1,074,421	1,123,766	1,082,552

2011M08	2011M09	2011M10	2011M11	2011M12	2012M01	2012M02	2012M03	2012M04
503,870	430,788	415,108	430,607	451,949	347,485	433,154	495,218	474,843
633,594	561,292	519,912	495,389	413,670	406,005	492,890	531,590	472,443
89,105	99,753	61,875	49,139	45,608	41,894	62,135	66,373	59,834
100,863	71,805	60,058	62,817	47,924	45,006	94,034	77,709	51,404

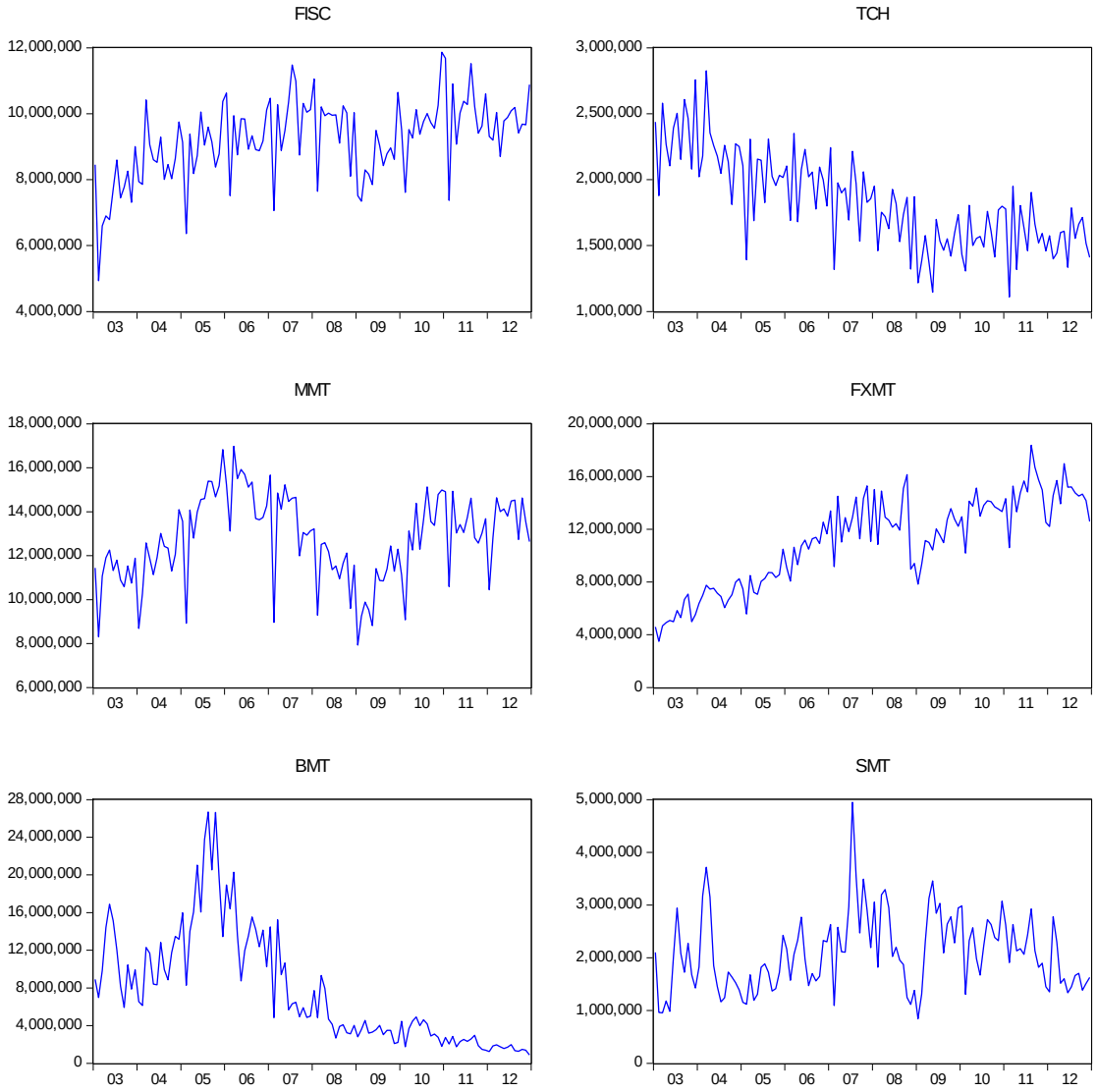
2012M05	2012M06	2012M07	2012M08	2012M09	2012M10	2012M11	2012M12	2013M1
65,143	61,890	63,145	62,142	58,635	60,443	58,030	54,039	61,714
1,133,662	1,076,523	1,134,529	1,139,149	1,043,242	1,153,469	1,119,599	1,114,070	1,237,836

2012M05	2012M06	2012M07	2012M08	2012M09	2012M10	2012M11	2012M12	2013M1
478,445	460,764	482,856	484,340	430,262	498,549	463,722	433,941	414,208
575,068	507,508	506,590	492,608	490,576	499,796	485,900	432,199	645,676
52,850	56,681	66,292	44,633	42,775	50,758	47,541	30,383	66,999
54,366	44,656	48,422	55,577	57,605	47,243	51,830	55,858	58,830

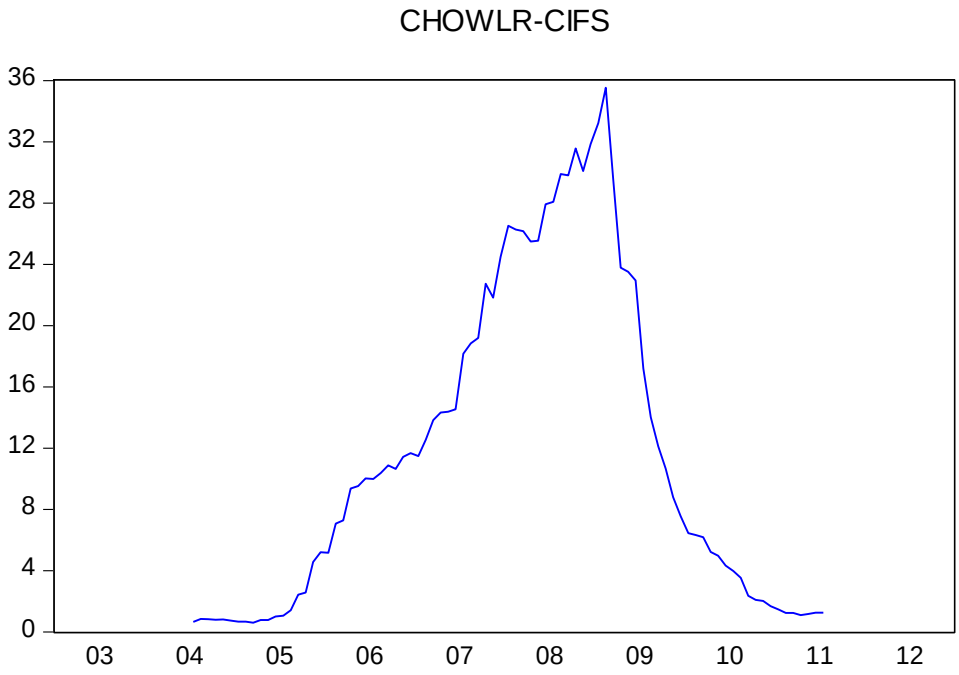
Appendix 4. Dependent Variable: CIFS Transaction Value (2003M1:2012M12)



Appendix 5. Independent Variables of the Benchmark Model (2003M1:2012M12)



Appendix 6. The Resulting Test Statistics of the Quandt-Andrews Test



Appendix 7. The Test Results of the Complete Model

Dependent Variable: CIFS

Method: Least Squares

Date: 07/07/12 Time: 22:09

Sample: 2003M01 2012M12

Included observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1399204.	1567931.	0.892389	0.3741
DUMMY	6394046.	526430.5	12.14604	0.0000
FISC	1.173819	0.273064	4.298689	0.0000
TCH	-2.611297	0.721074	-3.621400	0.0004
MMT	0.743731	0.156538	4.751118	0.0000
FXMT	0.450723	0.107236	4.203112	0.0001
BMT	-0.047972	0.051150	-0.937865	0.3503
SMT	-0.461745	0.265330	-1.740266	0.0846

R-squared	0.933359	Mean dependent var	23286372
Adjusted R-squared	0.929194	S.D. dependent var	6328289.
S.E. of regression	1683921.	Akaike info criterion	31.57549
Sum squared resid	3.18E+14	Schwarz criterion	31.76132
Log likelihood	-1886.529	Hannan-Quinn criter.	31.65096
F-statistic	224.0924	Durbin-Watson stat	0.719710
Prob(F-statistic)	0.000000		

Appendix 8. List of Abbreviations

CBC	Central Bank of the Republic of China (Taiwan)
CCP	Central Counterparty
CIFS	CBC Interbank Funds Transfer System
CGSS	Central Government Securities Settlement System
CSD	Central Securities Depository
FISC	Financial Information Service Corporation
FISC-FIS	Financial Information System of Financial Information Service Corporation
FMI	Financial Market Infrastructure
FSC	Financial Supervisory Commission
GTSM	GreTai Securities Market
GTSM-EBTS	Electronic Bond Trading System of the GreTai Securities Market
PS	Payment System
SSS	Security Settlement System
TCH	Taiwan Clearing House
TCH-CCS	The Check Clearing System of the Taiwan Clearing House
TDCC	Taiwan Depository and Clearing Corporation
TDCC-BCS	Bills Clearing System of Taiwan Depository and Clearing Corporation
TR	Trade Repository
TWSE	Taiwan Stock Exchange
TWSE-SBECS	Securities Book Entry Clearing System of Taiwan Stock Exchange