Government Securities Market Development in Lower-Income Economies: Discovery of "Utilities"

by

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Abstract

The government securities market (GSM) is vital for modern economic management, and the development community, like the World Bank and IMF, established a comprehensive policy framework for GSM development in the early 2000s. However, the results are disappointing for lower-income economies (LIEs). Nonetheless, no efforts have so far been made to review the conventional policy framework (CPF).

This dissertation reified the implicitly conflated and muddled concept of the CPF into an addressable, analyzable, and localizable concept. In particular, the dissertation pointed out the blind reliance on the primary dealer system, the CPF's core policy, introduced a phase-differentiated "Two-Dimensional Policy Framework for Government Securities Market Development," and theorized the dominant role of utilities in early-phase GSMs and historically differing policy bases for early-phase and advanced GSMs.

Summary

The government securities market (GSM) is a core economic infrastructure for modern economic management. Hence, the international development community (IDC) established a comprehensive policy framework for GSM development in the early 2000s (the conventional policy framework−CPF) and undertook GSM development initiatives for more than two decades. However, the results are disappointing for lower-income economies (LIEs).[1] The secondary markets of most LIEs remain illiquid or considerably low liquid. Nonetheless, no efforts have so far been made to review the CPF.

This dissertation aims to improve upon the CPF for LIEs. To this end, the dissertation poses two questions: why and how has the CPF not worked for GSM development in LIEs, and how the CPF can be improved upon to be more effective for LIEs. I took three steps: reviewing the practicality of a primary dealer system (PD system), the CPF's core policy for LIEs, proposing an alternative framework, and testing the alternative framework for applicability.

For the first step, I estimated the economies of PD systems by decomposing observed bid-ask spreads into order-processing, adverse selection, and inventory-holding costs (the three-way decomposition). The GSM data of 12 LIEs and 22 High-Income Economies were collected from Bloomberg.

For the second step, I introduced a "Two-Dimensional Policy Framework for Government Securities Market Development" (TDPF) alternative to the CPF. During my fieldwork in Mumbai, India, from September to December 2019, I tested the TDPF for its practicality in an early-phase market against the policies that Indian policymakers had implemented in the

[1] This dissertation defines the World-Bank-defined low-income economies (LIEs) and many lower-middle income economies (LMEs) as “lower-income economies” unless otherwise specified. The World Bank defines low-income economies and lower-middle-income economies as those with a GNI per capita of $1,025 or less in 2018 and those with a GNI per capita between $1,026 and $3,995, respectively. (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups) “Emerging economies” in common parlance include not only “lower-income economies” but also higher-income economies that are not included in “advanced economies.”

1990s and the 2000s. Also, I undertook semi-structured interviews and written surveys with Indian primary dealers (PDs) about their PD system's workings and collected the Indian GSM's monthly averages of daily market data from 2005 to 2019 from the local clearing corporation. I regressed observed trade volumes on endogenous market variables with Autoregressive Distributed Lags (ARDL) models and used a stepwise method to estimate endogenous variables' contributions to the trade volume growth.

For theorizing the economic agents' behavior in GSM development, I applied the theories and concepts borrowed from established fields outside GSM development. The theories and their primary authors (in parentheses) include the externalities, public goods, and club goods theory (Ronald H. Coase, Richard Cornes, and Todd Sandler), the transaction cost economics (Ronald H. Coase, James M. Buchanan, and Oliver E. Williamson), the cooperative game theory (Francis Ysidro Edgeworth, Werner Hildebrand, Richard Cornes, and Todd Sandler), the diffusion of innovation theory (Everett M. Rogers), the disruptive innovation theory (Clayton M. Christensen), the product life cycle and buying hierarchy theories (Geoffrey Moore and Clayton M. Christensen), and the loss aversion theory (Daniel Kahneman and Amos Tversky).

The estimated economies of PD systems implied that contrary to the CPF, PD systems were hardly working in most of the LIE environments. India was an exception. The fieldwork in Mumbai found that the Indian GSM policymaker had independently implemented policies that the TDPF mapped for the Nascent and Evolving Phases. The interviewed Indian PDs unanimously attributed the Indian GSM's success to the "ease and transparency" of their integrated trading, clearing, and settlement system with a central counterparty function. The ARDL model run showed the "ease and transparency" (its proxy) and other endogenous variables explained 40 percent of the trade volume growth in the rapid market growth period from 2005 to 2013. The theories borrowed from outside GSM development were developed to explain economic agents' real-world behaviors, in contrast to the efficient-market hypothesis or the perfect market theory. They explain well the observed trading behaviors in the early-phase markets.

These findings suggested that improving on the CPF would require a better understanding of GSMs' evolution and diversity than before. The CPF implicitly conflated GSMs that were in

different development phases. As such, inadvertent mismatches between adopted policies and LIE realities often misled GSM development in LIEs. The phase-differentiated and phase-coherent TDPF would mitigate mismatch risks. Apart from the effects of unmanageable exogenous policy variables, the GSM policymaker's work on endogenous policy variables would be significantly practical for GSM development. The GSM policymaker needs to manage endogenous policies to ride on favorable environments for successful GSM development. Hence, this dissertation argues that endogenous market development through the TDPF would be practical for the GSM policymaker. The policymaker is part of a development phase.

Meanwhile, a GSM's public/impure-public good setting for the market structure warrants the government intervention in GSM development and operation through regulation, subsidies, and direct or indirect provision. Consequently, the government is the primary provider of the utilities and the positive externalities released from a market structure. This public/impure-public good setting explains historically differing policy bases for early-phase and highly advanced GSMs and justifies the government's policy differentiation. Without the government's intervention, a GSM's explicit transaction costs would be prohibitively expensive from the beginning and defeat the GSM's objectives.

This dissertation pointed out the blind reliance on the PD system, introduced phase-differentiation and phase-coherence concepts into the TDPF, a two-dimensional (market development phases versus market components) framework, and discovered and theorized the dominant role of utilities in trade volume growth, especially in early GSM phases or their early stages. The theories borrowed from established fields outside GSM development helped theorize the dynamics of GSM development involving utilities. For example, the public/impure-public good and social optimality theories provided a basis for differentiating market policies between advanced and early-phase markets. Consumption theories for imperfect markets would equip the GSM policymaker with the predictability of trade volume evolution and phase transition.

This dissertation's contributions cover local policymakers, academics, and practitioners, including the development community. The dissertation first reified the conflated and muddled concept of GSMs into an addressable and analyzable concept primarily through the

TDPF. Second, the dissertation opened a new research theme, GSM development in early-phase markets, for academics. Third, this research provided practitioners, including the development community, with a new perspective and a guideline for program formulation.

This research is subject to limitations. Though qualitative evidence is based on a twenty-year field assessment, quantitative evidence is limited to the Bloomberg data and the Indian GSM case. Especially, the TDPF can be upgraded by getting tested with more GSMs. Inter- or multi-disciplinary theory application is new to the GSM development study, and further theoretical consistency tests solidify GSM development's theoretical base. This research has excluded market microstructure. However, IT technologies possibly have significant impacts on GSM development policies.

Many issues remain open for future study on GSM development in LIEs. A study on the PD system's interactions between the primary and secondary markets would upgrade policy comprehensiveness. Insights into interactions between a GSM's exogenous and endogenous factors would add more credibility to endogenous market development strategies. A GSM's utility adoption patterns may differ, depending on utility contents, like reliability, functionality, convenience, and utility facilitators/conduits, like technologies, laws and regulations, accounting rules or operational procedures, or overall institutional capacities.

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Abbreviations

ADB	The Asian Development Bank
AfDB	The African Development Bank Group
ATS	Automated trading system
AUD	Australian Dollar
BA	Bid-ask
BIS	Bank for International Settlements
CAD	Canadian Dollar
CCP	Central counterparty
CPF	Conventional policy framework
CPI	Consumer price index
CPL	Chilean Peso
CSD	Central securities depository
CZK	Czech Koruna
DKK	Danish Krone
DM	Debt management
DVP	Delivery versus payment
EBRD	The European Bank for Reconstruction and Development
EUR	Euro
GBP	Pound Sterling
GDP	Gross domestic product
G-sec	Government securities
GSID	Graduate School of International Development, Nagoya University
GSM	Government securities market
HIE	High-income economies
HKD	Hong Kong Dollar
HUF	Hungarian Forint
IDB	The Inter-American Development Bank
ILS	New Israeli Sheqel
IMF	International Monetary Fund

NR	Indian Rupee
KRW	South Korean Won
LIC	Low-income country
LIE	Lower-income economies (Combined Low-income economies and Lower Middle-income economies)
LME	Lower-middle income economies
MATB	Most actively traded bond issue
MOSB	Bloomberg's Most Active Traded Bonds page
NOK	Norwegian Krone
NZD	New Zealand Dollar
OECD	The Organisation for Economic Co-operation and Development
OMO or OMOs	Open market operations
OTC	Over-the-counter or Over-the-counter market
PD	Primary dealer
PLN	Polish Złoty
RBI	The Reserve Bank of India
REPO	Repurchase agreement
RTGS	Real-time gross settlement system
SAR	Saudi Riyal
SEK	Swedish Krona
SGD	Singapore Dollar
STP	Straight through processing
STRIPS	Separate trading of registered interest and principal of securities
SWIFT	Society for Worldwide Interbank Financial Telecommunication.
TB or T-bill	Treasury bill
TPF	Two-Dimensional Policy Framework for Government Securities Market Development (Section 4.4.1.).
TWD	New Taiwan dollar
USD	U.S. Dollar
WB	The World Bank

Glossary and Definitions

This “glossary and definitions” covers words for securities transactions used in this dissertation but may also apply to other transactions.

Ask (or offer)	An offer to sell a security at a definite price
Auction	A sale of securities for which the seller invites bids
Automated trading system (ATS)	A computer-based system in a financial market that automatically executes security transaction orders according to pre-set rules or algorithms. Usually, it is electronically connected with clearing, settlement, and depository systems to form a straight-through processing (STP) system.
Bank for International Settlements (BIS)	An international financial organization owned by 60-member central banks, representing countries from around the world
Bank-centricity	A state of a financial market where banks are predominant
Beneficial owner	The actual owner of securities registered with a book-entry register. c.f. registered owner
Bid	An offer to buy a security at a definite price
Bid-ask spread	A spread between a pair of bid and ask prices for a security that a dealer earns
Book-entry	A system of evidencing the ownership, including rights and obligations of securities where no physical certificates of the securities are issued or given to the beneficial owner. The system can be electronic or physical (book).
Book-entry register	The record of book entries of securities kept for securities accounts in a CSD

Broker	Person or entity engaged in the business of effecting transactions in securities for the account of others for a fee
Buy-back	A method of consolidating an outstanding issue where the issuer buys back all or part of its outstanding issue
Call auction	A simultaneous auction where buy and sell orders are called for securities, and the securities are sold at the price that matches the supply and demand of securities
Call auction market or call market	A trading method where the market calls buy and sell orders for securities at predetermined auction times, normally once to several times a day, and executed at the price at which executable buy and sell orders match in volume or at the price with the highest executable order volume and the lowest surplus in the order book (market clearing price)
Central bank	A statutory bank that monopolistically manages the currency, foreign exchange, and monetary policy of a country. In many countries, it supervises its country's commercial banking system, serves as the fiscal agent for the central government, and issues loans and government securities on behalf of the central government and, in some cases, local governments. In some countries, it also is a public debt manager or a market regulator for the GSM. Central banks may or may not be independent of the government.
Central counterparty (CCP)	An institution that interposes itself between parties to an executed financial transaction as principals, eliminating counterparty risk for the original parties
Central securities depository	A securities market infrastructure that safe-keeps securities either in physical or dematerialized form so that the ownership of the securities can transfer by book-entry instead of physical

	delivery. It often renders clearing, settlement, and asset services as well.
Clearing or clearance	Making an executed transaction ready for settlement by comparing transaction specifications presented by parties to the transaction
Clearing system	A manual or automated system that carries out clearing
Coalition	In the Edgeworth Box theory, a group of traders acting uniformly with uniform endowments
Commission	Monetary consideration payable to agency intermediaries for their intermediation
Congestion	In the club theory, the state where increasing members in a club intensify rivalry among club members or reduce club members' excludable benefits (utilities) from the club good
Continuous market	A trading method where buyers and sellers continuously display their orders, which are continuously matched and immediately executed during a trading session. Most continuous markets start their trading session by determining the opening price of securities with a call auction.
Conventional policy framework (CPF)	The collection of policy analyses and recommendations that the World Bank and IMF established through a series of their publications, mainly from 2001 to 2007, to advise and assist emerging market economies on developing their domestic government securities markets. OEDC, ADB, AfDB, IDB, and EBRD also cooperated to operationalize and reinforce the framework. Besides these institutions, emerging market governments, international development agencies, development consultants, and academics have generally or selectively applied it to emerging economies through their financial sector

	assessment, technical assistance, grant, lending, and other development programs.
Core	In an Edgeworth Box analysis, a set of equilibriums in which a trader coalition's improving on the allocations of the trading goods does not harm its counterpart's utility (preference-utility in my definition, see "utility" in this Glossary and Definitions.)
Corporate investor	A corporation that invests in securities while primarily engaged in other business activities
Counterparty	The opposite party to a financial transaction
Credit rating	An evaluation of the credit risk of debtor corporations, government sovereigns, or other institutions, predicting their ability to pay back the debt timely, and an implicit forecast of the likelihood of their defaulting, and customarily expressed by numbers, letters, and symbols.
CPF-policies	Policies formulated, advised, and implemented under various CPF programs. Most of them are found in World Bank, and IMF (2001a), World Bank (2007a, 2007b), and the World Bank/IMF's financial sector program documents, such as Financial Sector Assessment Program (FSAP) reports.
Custodian	A financial institution, mostly a bank that holds customers' securities for safe-keeping or convenience. Also, it often administers other services, including clearance and settlement, cash management, foreign exchange, and securities lending.
Custodian bank	Bank engaged in custodial services
Custody	The safekeeping and administration of securities or financial instruments on behalf of others
Dealer	An intermediary who buys and sells financial products, such as securities, for its account

Delivery versus payment	A procedure of securities and funds transfer where transacted securities and funds are delivered simultaneously
Dematerialization	The transformation of a proof of securities ownership from physical form (paper certificate) to electronic record at a central securities depository
Discriminatory (Multiple) price auction	A simultaneous auction where bidders pay the price they bid for each security
Edgeworth Box	A graphical model to analyze barter trades between trader coalitions of two types exchanging limited quantities of goods to find equilibriums and the Pareto-optimal equilibrium in allocating the goods along the two transacting coalitions' utility indifference curves convex to origins diagonally placed at the two corners
Electronic trading	Securities trading of which all or most of trading operations an electronic system performs
Emerging GSM	A GSM that has not been fully developed. It includes an LIE GSM.
Endogenous (exogenous)	Internal (external) to a GSM unless otherwise specified
Endogenous (exogenous) factor	An endogenous (exogenous) economic category that includes a numeric or string variable. By comparison, an endogenous (exogenous) variable is numeric. Endogenous factors include market components, such as accounting rules, legal rules, primary market, secondary market, money market, debt and cash management, clearing and settlement, and derivative and futures market (see Section 4.4.1)

Fail	A failure to settle a securities transaction on the settlement date, usually because of technical or temporary difficulties. Fail is usually distinguished from "default."
Fiscal agent	An entity that acts on behalf of another party performing various financial duties such as assisting in the redemption of bonds or coupons, handling tax issues, replacing lost or damaged securities. A central bank usually acts as the fiscal agent of the government.
Government	The central government of a country, unless otherwise specified
Government securities	Debt securities issued by a government, such as Treasury bills, notes, and bonds, but not central bank securities
GSM policymaker	A policymaker responsible for formulation or implementation of government policies on GSM development and operation
Hedge fund	An alternative investment vehicle that is available only to sophisticated investors with significant assets being less regulated than other funds and aiming at high returns by employing various investment strategies
Immobilization	Depositing of physical certificates of securities in a CSD to facilitate book-entry transfers
Institutional investor	A financial institution that professionally invests in securities or other assets such as investment funds, including mutual funds, pension funds, hedge funds, and insurance companies
Intermediary	An individual or an entity that acts as the middleman between two parties to a financial transaction on a principal basis or an agency basis, such as a bank, a securities broker, and a securities dealer

Intermediation	A trader's act of interposing itself between trading parties as a temporary principal or an agent to match security buy and sell orders on terms agreeable to the trading parties.
Investor	A natural or legal person who invests in or trades securities for non-intermediary purposes.
Investor base	An aggregate of homogeneous or heterogeneous investors in a securities market
Issue calendar	An issuer's securities issuance plan, showing securities specifications, such as issue amount, security type, maturities, and timings. Usually, it is announced at the beginning of a fiscal year to cover the fiscal year, regularly updated to facilitate traders' or investors' readiness for bidding, purchasing, or underwriting.
Liquidity risk	The risk that a counterparty (or participant in a settlement system) will not settle an obligation in full value when due
Market infrastructure	A component of a market structure, which consists of financial market facilities that provide functional services such as trading, clearing, settlement, depository, or information to market participants
Market making	An act of a dealer voluntarily or obligatorily, continuously and simultaneously quoting the sell and buy prices of a security (two-way quote) under prescribed terms, such as trade lot size and settlement, to induce trades
Market microstructure	A set of logistic or algorithmic systems executing financial transactions
Market regulator	A statutory institution that regulates and supervises securities markets, such as equities, corporate debt securities, public debt securities, or derivatives and futures. The institution belongs to the government, the central bank, or is independent. In many

	countries, market jurisdictions are assigned separately to more than one institution.
Market structure	A long-term set of infrastructures, institutions, policies, laws, regulations, rules, and others aligned for financial transactions, or the way they are organized
Market surveillance	Watch or guard kept over the state of and activities in a securities market by the market regulator
Market-making market	A market where dealers do market making for securities
Matching	A process of comparing the trade or settlement details provided by counterparties (part of clearing)
Multiple-price auction	An auction of securities where successful bidders pay the actual price they bid
Mutual fund	A professionally managed investment vehicle that pools funds from unspecific and many investors and invests the funds in stocks, bonds, and other securities
Negotiated market	A market, also known as a dealers' club market, where the buyer and the seller negotiate and agree on the price of a security and other terms either directly or through a broker. Traders act as dealers or brokers.
Netting	The offsetting of mutual positions by participants in a clearing or settlement system to reduce a large number of individual positions to a smaller number of obligations
Nominee	An entity (the registered owner) in whose name securities are recorded on a book-entry register and held for their beneficial owner (the actual owner) under a custodial agreement with the beneficial owner

Novation	Legal replacement of the original counterparty with a central counterparty as principals
Open participation in auctions	Auctions of securities are open to the public as well as to various investment entities. All of them are allowed to bid for their accounts in auctions. c.f. primary dealership
Order-driven	Initiating a transaction by placing an order unilaterally for the anticipated transaction
Order-driven market	A financial market that displays all trade buy and sell orders and sellers and executes matched orders
Order-matching	An intermediary's act of matching security buy and sell orders on terms agreeable to the trading parties
Original sin	The inability of an emerging economy's capital market to raise long-term capital in the local currency regularly
OTC (over-the-counter) market	A network of dealers and their customers in which they trade securities with one another through face-to-face, telephone, email, proprietary electronic trading platforms, or other means with no centralized marketplace. In an OTC market, dealers voluntarily or obligatorily make markets for securities.
Paying agent	An entity that pays interests, principals, dividends of securities to the holders of securities on behalf of an issuer
Payment system	A funds transfer system
Payment system laws	Laws and their rules and regulations that govern a payment system
PD system	Primary dealer system
Phantom Liquidity	The market liquidity that exists when prevailing market conditions are favorable to market makers but otherwise disappears (is withdrawn)

Phase-coherence, phase-coherent	Coherence or coherent across policy sets in a market phase for optimal implementation efficiency (for "phase," see "Phase-differentiation, phase-differentiated")
Phase-differentiation, phase-differentiated	Differentiation of emerging GSMs or differentiated by their development phases for accurate market assessment or realistic policy formulation and implementation. This study differentiates emerging GSMs into four phase-groups: the Nascent, Evolving, Advanced, and Highly-Advanced Phases.
Price (Yield) auction	A securities auction method where offered securities are allocated to bidders on the basis of bid price (yield) competitiveness
Primary dealer (PD)	A dealer that the government or the market regulator designates and obliges to buy or underwrite and distribute newly issued government securities in the primary market or make a market for designated government securities issues to support or maintain their liquidity in the secondary market or do both
Primary dealer system (PD system)	A securities issuing and trading system where the market regulator obliges designated dealers to buy or sell readily through two-way firm quotes in predetermined lots or more in exchange for monetary or non-monetary benefits that the regulator grants them
Primary dealership	The status of being a primary dealer. Also used for a primary dealer system
Primary market	A securities market where new securities are issued
Private pension fund	Pension fund set up for employees of corporations
Proprietary trading	Securities trading as principal
Proprietary trader	A trader who trades securities as principal

Public debt management	A statutory function to plan, coordinate, manage and monitor external and domestic public debts, including loans and debt securities. In some countries, it includes the issuance of public debts. This function belongs to the government or the central bank or is independent.
Qualified Institutional Investors	Institutional investors whom the securities law or relevant regulation qualify for the exemption from certain securities regulations normally on the basis of their financial sophistication, asset size, or income level, including commercial banks, insurance companies, pension funds, public and private funds, finance companies, and leasing companies.
Quote-drive	Initiating a transaction by a dealer quoting an indicative or firm price for the anticipated transaction
Quote-driven market	A financial market where transactions are quote-driven
Reopening	A securities issuance method where an issuer solicits orders for additional tranches of an outstanding issue some months (normally three to six months) after the closing of the issue
Repo	Repurchase agreement
Repurchase agreement	A contract to sell and subsequently repurchase securities at a specified date and price
Retail investor	An investor who is an individual person and usually neither substantial nor professional
Reverse repo	A contract to buy and subsequently resell securities at a specified date and price
Rolling settlement	A securities trade settlement process where executed trades successively settle on business days a pre-defined or agreed number of business days after their trade dates

Screen-based	Electronically matching and executing a transaction often remotely by a video screen rather than in a physically centralized marketplace
Secondary market	A security market where outstanding (seasoned) securities are traded
Securities lending	Loaning securities to an individual or entity against cash or other collateral
Settlement	Irrevocably finalizing financial transactions by exchanging financial products and considerations
Settlement bank	A bank that maintains cash accounts to settle payment obligations associated with transactions
Settlement system	A system that settles transfers of funds, securities, or financial instruments
Straight through processing (STP)	Electronically automated processing of the entire life cycle of securities transactions from beginning to the end to enhance the efficiency of transactions
Supply and demand for immediacy	A buyer and a seller's urgency with which to get its offered transaction executed
Swap or swap agreement	A contract for an exchange of payments agreed upon between two parties at some point(s) in the future
Switching	A method of consolidating an outstanding issue where the issuer switches (exchanges) less liquid outstanding issues with securities of actually or potentially more liquid issue
Systemic risk	The risk that the failure of a participant in a financial system to meet its required obligations will cause other participants to fail in their obligations when due

Tap issuance	A securities issuance (funding) method where an issuer (borrower) continually and individually issues its securities to investors in required amounts on mutually agreed terms
Telephone-voiced	Negotiating, matching, and executing a transaction by dealers communicating on the telephone
Trade value	The value of a security or securities transacted
Trade volume	The number of securities transacted
Trader	A natural or an entity that trades securities for its or its customer's account in a securities market. However, its precise definition may differ from context to context. A trader in a broad sense, as defined above, includes an intermediary (a dealer acting as a temporary principle for intermediation and a broker acting only as an agent for intermediation), a proprietary trader (trading professionally for its account for trading gains), and an investor (investing in or trading securities for non-intermediary purposes, primarily for investment purposes).
Trading platform	A physical or virtual (electronic) system for executing financial transactions
Trading system	A set of rules or algorithms that systematically identifies trading opportunities and executes trades
Two-Dimensional Policy Framework (TDPF)	Two-Dimensional Policy Framework for Government Securities Market Development (see Section 4.4.1.). A phase-differentiated policy framework for GSM development.
Two-way quotes	Simultaneous bid and ask (offer) quotes for market making
Underwriter	A person or an entity engaging in underwriting
Underwriting	A financial commitment to buy unsold securities in a substantial lot that are anticipated to be issued.

Uniform-price (single-price) auction	An auction of securities where all successful bidders pay the cut-off price
Utility	In the GSM development context, the trader's or the investor's preference, or value that the trader or the investor subjectively obtains from trading relative to alternatives, regarding trading objects, quantities, qualities, timings, modes, counterparts, and other trading behavior attributes. Its preference criteria inevitably involve non-monetary or psychological values, such as reliability, functionality, convenience in consuming trading services. It is usually not objectively measurable. When its measurement matters, this study refers to it as utility value, utility amount, or utility quantity. My analysis terms an economic agent's selection priority "preference-utility" to distinguish it from my definition of "utility" as defined here. See Footnote 62.

1 Introduction

This dissertation researches the government securities market (GSM) development policies for low-income and lower-middle-income economies. Collectively, "lower-income economies" or LIEs account for 36.2 percent of 218 World Bank member economies.[2]

1.1 Background

The GSM is a core economic infrastructure of the modern economy since it supports public finance through the primary market and ensures financial efficiency through its secondary market. The GSM's two markets jointly help distribute or redistribute its financial resources efficiently across the economy. This leverage of the GSM has been discovered in modern economies and applied to economic development; GSM development has been placed at the center of a large family of economic development policies. The GSM is thus widely recognized as a public good (Sundararajan, Dattels, & Blommenstein, 1997; RBI, 2007).

Therefore, the international development community, including the World Bank (WB) and the International Monetary Fund (IMF), has been undertaking GSM development programs for emerging market economies since the turn of the century. The international community and many of its advised client governments have followed the WB and IMF framework jointly established in the early 2000s (the conventional policy framework− CPF). The program involved several publications and undertook many market assessments, workshops, technical assistance programs, and policy advisory missions. The campaign was intense. For example, after producing several policy working papers at each of the two institutions in the late 1990s, they published *Developing Government Bond Markets: A Handbook* (ISBN 0-8213-4955-4), a flagship publication for the program in 2001, and conducted global dissemination workshops in Rio de Janeiro, Tunis, Istanbul, Shanghai, Johannesburg, and Colombo over three years. A

[2] World Bank country classification for 2021 fiscal year. Low-income countries: 29, Lower middle-income economies: 50, Upper middle-income economies: 56, High-income economies: 83. (Source: World Bank Country and Lending Groups. Data. Retrieved May 4, 2021, from https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups)

total of 5,314 copies of the flagship publication were distributed as of the end of April 2021.[3]

However, the results are mixed. LIEs have been polarized between a few successes and many failures. When it comes to the 29 low-income economies, no success has been reported. LIEs look the same even in the thriving local currency bond market of East Asia. Among the nine economies covered in ADB's Asian Bonds Online program, only the Philippines and Vietnam, both lower-middle-income economies, are included as of the end of April 2021. The program does not monitor other lower-middle-income economies in the region, namely, Lao PDR, Cambodia, Myanmar, and Mongolia.[4]

The state of the CPF also confuses market development policies. An example is misconceived bond exchanges. Private "bond exchanges" were set up in some relatively advanced GSMs to replace functioning OTC markets and enhance market transparency. Its market microstructure was continuously order-driven. The unintended consequence was that traders negotiated and matched orders outside the exchanges and either put through their matched orders only for clearing and settlement purposes or circumvented the exchanges to save relatively expensive exchange charges. A market with an established efficient dealer network may ensure transaction transparency with an electronic information dissemination system. This misconceived market microstructure also could risk suppressing the diversification of active trading securities. A continuous order-driven market, which lacks market-making, keeps trading on a few most liquid issues.

1.2 Research Questions

Against this background, I ask the following two questions for this dissertation:

- Why and how has the CPF not worked for GSM development in LIEs?
- How can the CPF for GSM development be improved upon for LIEs?

These questions presume the efficacy of GSMs as financial infrastructure. The presumption

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[3] Sold: 1,709 copies, Free: 656 copies. The World Bank launched World Bank Open Knowledge Repositories (OKR) since 2012, from where anyone can download the file. Their statistics are: Abstract views: 3,967, Filedownloads: 2,949. (Source: The World Bank's Publications and Marketing Department)
[4] AsiaBondsOnline. Asia Development Bank. Retrieved May 4, 2021, from https://asianbondsonline.adb.org/. North Korea is the only low-income economy in the region.

requires, first, the following question to be addressed:

- Why does the ability to develop a GSM matter to an LIE?

The answers lie in a GSM's rich complementarity to the financial system and the chronic fragility unfolding again in the exigencies of the Covid-19 crisis. Economies can run without a functioning GSM, as is the case in many LIEs, but only in a considerably inefficient manner. Meanwhile, LIEs severely ravaged by the Covid-19 crisis need to build back their economies and societies in a manner that betters the pre-Covid-19 period.

A GSM serves as a principal economic infrastructure mainly by undertaking public finance and facilitating economy-wide financial efficiency. The ability and discipline of public finance are highly desirable for economic and social development since long-time gaps between investment expenditures and revenues are inevitable in LIEs. A liquid GSM delivers financial efficiency through its resource (re-)allocation and measurement mechanisms. A GSM facilitates asset exchange between G-sec and cash or between G-secs via cash, while G-sec transaction prices provide objective financial measurement for other assets. The GSM, unlike the banking market, is an open and ongoing source for market information. As the versatility of money penetrates every corner of an economy, the GSM indirectly affects the achievement level and speed of wellbeing programs, such as each of the Sustainable Development Goals, in LIEs. Dysfunctional GSMs have been deterring, if not halting, the betterment of LIE societies.

The Covid-19 crisis exemplifies the disproportional fragility of LIEs to shocks. The accelerated reinforcement of LIE societies, or "building back better," would be indispensable in the heels of the pandemic. The CPF, or the status quo strategy, is unlikely to serve for LIE's betterment. It is unlikely that GSM development alone would eliminate the "original sin," since the problem is a macroeconomic one, but the development would mitigate the problem by minimizing LIEs' unnecessary dependence on foreign currency-denominated long-term debts. Also, a functioning GSM would enhance domestic financial ability, even if it is much less prominent than its counterpart in an advanced economy.

The ineffectiveness of the CPF for LIEs is attributable to a model-reality gap, a common dilemma over development policy formulation. The comprehensive set of policies were drawn

out of well-functioning and easily observable markets, while early-phase markets were hardly organized and functioning.[5] Observed gaps between the model and the reality were regarded as policy deficiencies in emerging GSMs (World Bank, 2007b).

Academics' causality research on GSM development has yet to help LIE governments. Their research has focused mostly on macroeconomic aspects. Their findings are generally consistent with on-the-ground findings (see Section 3: Literature Review). However, they stop short of proposing operational policies for GSM policymakers.

As a result, GSM policymakers in LIEs have been constrained in operational policy tools for market development. They have rarely been advised on formulating, testing, implementing, monitoring, and improving their homegrown market development policies. The research questions above are designed to fulfill these market development policy gaps.

1.3 Research Aim, Strategy, and Objectives

This research aims to improve upon the GSM development policy framework for LIEs. To achieve this goal, I take three steps: reviewing the CPF's applicability to LIEs, proposing an alternative framework, and testing the alternative framework for applicability.

I first show that a primary dealer system (PD system), a core CPF policy, is hardly workable in LIE environments. The PD system has been presented to almost every market as if it were a panacea for activating their secondary markets. This proof establishes that the conventional policy framework must be reconsidered for LIEs.

Second, I introduce a "Two-Dimensional Policy Framework for Government Securities Market Development" (TDPF), an alternative policy framework, to give a realistic perspective on GSM development issues in LIEs. The TDPF divides emerging GSMs into four groups by

[5] The cover page picture of “Developing Government Bond Markets: A Handbook” may symbolize an unconscious bias for highly advanced markets. The picture is the trading floor of the then Solomon Brothers in downtown New York City. The investment bank was one of the most powerful global bond houses.

market development phases (phase-differentiation) and organizes CPF-policies[6] by market components to form a two-dimensional matrix table. It aims to fit market development policies to a market's development phase and local conditions ("phase-fit and locally-fit").

Third, I test the TDPF for its applicability to an LIE with the Indian GSM's development path. India independently formulated and implemented its GSM development policies in the 1990s and the 2000s. The country's economic performance allowed the World Bank to move up its country-category from a low-income economy to a lower-middle income economy in 2007. How the country aligned its nous GSM policies with its favorable macroeconomic factors is of interest.

Furthermore, I explore the role of utilities that a market structure generates in trade volume growth and their dynamics in a market structure's evolution and transition in early-phase markets. Also, I investigate the implications of the ownership arrangements associated with GSMs.

1.4 Academic Contributions

This dissertation's contributions extend to local policymakers, academics, and practitioners, including the international development community. The dissertation first reifies the conflated and muddled concept of GSMs into an addressable and analyzable concept, primarily through the TDPF. This reification brings a GSM closer to local policymakers. Consequently, policy issues associated with GSMs become more addressable for LIE governments than before. Second, the dissertation opens a new research theme, GSM development in early-phase markets, for academics. The knowledge gaps regarding the theme include endogenous causality factors in scarcely resourceful economies, the properties and effects of utilities, and the interactions between exogenous and endogenous factors. Third, this dissertation provides practitioners, including the international development community, with a new perspective and a guideline for program formulation.

1.5 Structure

[6] Policies formulated, advised and implemented under various CPF programs. Most of them are found in World Bank and IMF (2001a), World Bank (2007a, 2007b) and the World Bank/IMF's financial sector program documents, such as Financial Sector Assessment Program (FSAP) reports.

This dissertation is built on the collection of three of my articles (Component Articles): "The Primary Dealer System in Lower-income Economies (Endo, 2020)," "Endogenous Market Development for Government Securities in Lower-income Economies (Endo, 2021a, under review)," and "Utilities and Development Dynamics in Early-Phase Government Securities Markets (Endo, 2021b, working manuscript)." The first is Chapter 3 of this dissertation and has been published in Emerging Markets Review in December 2020.[7] The second is Chapter 4 of this dissertation and is under review for publication by the same journal.[8] The third is Chapter 5 of this dissertation and is a working manuscript that has —at present—not been submitted to an academic journal for publication.

Because of the above structure, some descriptions, tables, or figures are duplicated.

The rest of the dissertation is organized as follows: Chapter 2 reviews the literature. Chapter 3 empirically examines the viability of the PD system in LIE environments. In Chapter 4, I elaborate on a phase-differentiated approach, present the TDPF, test the framework for applicability with the Indian GSM's development path, and conduct an endogenous causality analysis. The role of utilities and positive externalities in GSM development are theorized in Chapter 5. Chapter 6 integrates the discussions of the three-component articles and discusses their implications to GSM development. Chapter 7 concludes this dissertation.

[7] https://doi.org/10.1016/j.ememar.2020.100715

[8] To comply with the GSID's originality guideline, the author minimizes modification to the original articles. Exceptions are (1) the literature review sections moved to Chapter 2 Literature Review of this dissertation, (2) the numbering of tables and figures, and (3) the references moved to the References section of this dissertation.

2 Literature Review

The sections of this chapter are from the literature review sections of my Component Articles.

2.1 The Primary Dealer System in Lower-income Economies

The IMF and World Bank present the policy framework and market development model that policymakers and policy advisors have followed widely. Prior studies dealt with the impediments to GSM development in a general way or pointed out macroeconomic factors exogenous to the market. The impediments that they argued for include high costs of issuance, a weak overall financial sector, and sometimes a financial crisis (Aguilar 2006; Arif 2007; Arvai & Heenan 2008; BIS 2002, 2007; Castellanos 1998; De Brun, Gandelman, Kamil, & Porzecanski 2008; De la Torre & Schmukler 2007; Jiang & McCauley 2004; Leal & Carvalhal-da-Silva 2006; Sophastienphong, Mu & Saporito 2008; Sy 2007; Szilagyi, Batten & Fetherston, 2003).

Some other studies outline how a market has improved and why (Amante, Araujo, & Jeanneau 2007; Silva 2008; Sophastienphong, Mu, & Saporito 2008). Le Grazie and Fernandez (2006) draw lessons from the European markets for Latin American countries. AfDB (2007) and AfDB (2010) offer overviews and data on the structures of government debt markets in its African member countries. Blommestein and Horman (2007) and Berensmann, Dafe, and Volz (2015) also overview African debt markets, along with their debt management practices. However, macro-level cross-sectional studies that searched for determinants of the development of local currency bond markets stop short of looking into lower-income economies (Abbas & Christensen, 2007; Adelegan and Radzewicz-Bak, 2009; Akamatsu & Puongsophol 2017; Claessens, Klingebiel, & Schmukler, 2007; Hanson, 2007; IMF & World Bank, 2016; Kumhof and Tanner, 2005; Panizza, 2008, IMF, World Bank, EBRD, & OECD, 2013; Smaoui et al. 2017; Warnock & Burger, 2006).

In estimating total trading costs, this work capitalizes on the research on the economies of dealers' market-making in the U.S. stock markets for two reasons. First, the bond and stock dealers share trading commonalities in market-making. The price for trading service matters to this study, but the price or value of a security does not. An essential difference in market-

making between stock dealers and PDs lies in that the former is voluntary while the latter is obligatory. Second, no prior research is available on the economies of bond intermediation in lower-income economies. Instead, the extensive literature on the value of the stock dealer's dealing service reveals that the bid-ask spread of a stock quoted by the market maker or dealer represents the stock's per-trade cost of trading with three components: order processing, adverse selection, and inventory costs (Amihud & Mendelson, 1980; Demsetz, 1968; Easley & O'Hara, 1987; Garman, 1976; Glosten & Milgrom, 1985; Grossman & Miller, 1988; Ho & Stoll 1981, Copeland & Galai, 1983; Huang & Stoll, 1997; Madhavan & Smidt, 1993; Stoll, 1978). This approach is also known as the three-way decomposition of the spread (Foucault, Pagano & Röel, 2014, p. 173; Huang & Stoll, 1997).

2.2 Endogenous Market Development for Government Securities in Lower-income Economies

This study complements the prior GSM development literature with new approaches. The prior literature deals with GSMs in what could be considered a conflated manner and examines GSM development causalities from a macroeconomic perspective. In contrast, this study presents a phase-differentiated approach to GSMs and investigates GSM development endogenously. Figuratively, while the prior literature can explain half of GSM development, this study explains the other half. More important, GSM policymakers can take charge of the latter but not the former. In specific, this study contributes to the literature by discussing how to translate macroeconomic or exogenous opportunities into functional GSMs in LIE environments.

Following studies on GSM microstructure, such as Dattels (1995), Sundararajan, Dattels, and Blommenstein (1997), and Schinasi and Smith (1998) in the 1990s, the World Bank and IMF jointly took the lead in formulating the policy framework for GSM development in emerging economies through their monumental publication. World Bank and IMF (2001a) overviewed theories, market structure, market practices and laid out policy measures to advance essential components of GSMs. Subsequently, World Bank (2007a, 2007b) assessed 12 emerging

markets[9] against the "sound practices" of public debt management and GSM development that they established in their previous publication. As for the dynamics of market development, World Bank (2007b) points out the "chicken and egg" problems in market development (pp. pp. 54 and 92) but stops short of elucidating their mechanism and policy solutions. Prior studies tend to spell out how to transplant the features and practices of GSMs in advanced economies into emerging economies.

More recently, a growing body of literature showcased the efforts that emerging economies made for local currency bond market development (Aguilar, 2006; Arif 2007; Arvai and Heenan, 2008; BIS, 2002; Castellanos & Martinez, 2006; De Brun, Gandelman, Kamil, & Porzecanski, 2008; De la Torre and Schmukler, 2007; Jiang & McCauley, 2004; Leal and Carvalhal-da-Silva, 2006; Sophastienphong, Mu, and Saporito, 2008; Sy, 2007; Szilagyi, Batten & Fetherston, 2003). Some other studies outline how markets have improved (Amante, Araujo, & Jeanneau, 2007; Silva, 2008; Sophastienphong et al., 2008). AfDB (2007, 2010) provides data on government debt markets' structures in 53 and 41 African countries. Blommestein and Horman (2007) and Berensmann, Dafe, and Volz (2015) also overview African debt markets along with their debt management practices. IMF and World Bank (2021) compile recent GSM development experiences and technical issues of middle-income economies into a guidance note for technical assistance programs.

An increasing number of macro-level cross-section studies searched for determinants of local currency bond market development. However, neither do those studies systematically distinguish emerging markets by development phases, nor do they explore the dynamics of market development determinants (Abbas & Christensen, 2007; Adelegan & Radzewicz-Bak, 2009; Akamatsu & Puongsophol 2017; Claessens, Klingebiel, & Schmukler, 2007; Hanson, 2007; IMF & World Bank, 2016; IMF, World Bank, EBRD, & OECD, 2013; Kumhof & Tanner, 2005; Panizza, 2008; Smaoui, Grandes & Akindele, 2017; Warnock & Burger, 2006). As a consequence of this research trend, market microstructure approaches have been rare until Endo (2020) questioned the validity of the PD system in lower-income economies.

[9] Bulgaria, Colombia, Costa Rica, Croatia, Indonesia, Kenya, Lebanon, Nicaragua, Pakistan, Sri Lanka, Tunisia, and Zambia (p. ix, World Bank 2007b)

The prior literature rarely sees GSMs as consumer markets where the investor consumes trading services that the trader provides and utilities that the government provides through a market structure. However, it is observed and theorized in consumer markets that the values, such as functionality, reliability, and convenience, often come before prices (Christensen, 1997a, 1997b; Gurowitz, 2012; Horton, n.d.; Moore, 2014). A life cycle also operates for new products, services, or technologies. Roger's (2003) diffusion of innovation theory portrays consumers' technology adoption behaviors with a logistic curve, while Moore's (2014) technology adoption cycle model is comprised of four adoption stages characterized by consumers' unique psychographic profiles.[10]

Indian's GSM development path is well documented. Moitra (1983) portrays the Indian GSM before the Deregulation in 1991 as characterized by captive investors, artificial bond yields, and crowding-out of the private sector. Patil (2001) vividly lays out the detailed design of the Indian GSM that the RBI subsequently built. Reddy (2002) discusses the issues and dilemmas that the Indian debt market faced in its development until the GSM Reform.[11] Mohan (2004) and Mohan (2006) review the steady developmental path of the Indian GSM relative to its corporate debt market and present prospective issues for the next leap. Mohan and Ray (2009) analyze the Indian debt market development by introducing three phases: the first phase (1992-95) in which India created the enabling environment, the second phase (1995-2000) in which the country built the market and institutional infrastructure, and the third phase (2001-) in which the market enhanced liquidity and safety. Mohan and Ray (2017) briefly refer to the bond market but discuss more the financial market settings in which the bond market developed.

The literature on the functional improvement of the Indian GSM is growing. Shankar and Bose (2008) confirm the efficiency of the auction system in the Indian GSM. Nath (2013) shows that the Turnover Ratio and the Amihud Illiquidity Ratio indicate the Indian GSM market liquidity well, but impact cost does not. Rajaram and Ghose (2015) review the evolution and explore PDs' functions in the Indian GSM. Fleming, Sareen, and Saggar (2015)

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[10] "a combination of psychology and demographics that makes its marketing responses different from those of the other groups" (Moore, 2014, p. 15).

[11] See Section 4.1.

and Fleming, Sareen, and Saggar (2016) analyze the current workings of the Indian GSM. They show the highly positive impact of the NDS-OM on the secondary as well as primary markets. Deuskar and Johnson (2016) find that Indian government securities' price dynamics are substantially attributable to the dynamics of the RBI's liquidity provision.

2.3 Utilities and Development Dynamics in Early-Stage Government Securities Markets

This dissertation intends to deepen a systematic understanding of the GSM development mechanism in lower-income economies. The focus is placed on inter- and intra-phase dynamics of the four market development phases proposed in the “Two-Dimensional Policy Framework for GSM Development" (Chapter 4; Endo 2021). Since an academic field for securities market development in LIEs has yet to be established, this dissertation can benefit from better-established neighboring disciplines.

The benchmark for GSM development studies is the conventional policy framework that World Bank and IMF created more than twenty years ago. The study began with GSM microstructure studies, such as Dattels (1995), Sundararajan, Dattels, and Blommenstein (1997), and Schinasi and Smith (1998) in the 1990s. Subsequently, the World Bank and IMF jointly lay a firm foundation for GSM development in emerging economies through their monumental publication. World Bank & IMF (2001a) recapped theories, market structure, market practices and drew out policy sets to foster essential components of GSMs. Subsequently, World Bank (2007a, 2007b) assessed 12 emerging markets against the "sound practices" of public debt management and GSM development formulated in their previous publication. Prior studies tend to assume GSMs in advanced economies as models for the rest of the world and explicate how to transplant their features and practices into emerging economies. Extensive literature of country and regional case studies and macroeconomic causality studies ensued in the same line until Endo (2020, 2021a) proposed to improve upon the CPF.

My first concern is how transaction costs relate to institutional arrangements. Historically, the concept of transaction costs is broader and more fundamental than today. Coase (1960, 1988, 1991) pioneers the study of transaction costs to determine institutional arrangements (the firm or the price mechanism). Williamson's transaction cost economics tightens the determinants of transaction types (the firm or the market) to the three dimensions: uncertainty, frequency,

and asset specificity (Williamson, 1979, 1989, 1995, 2005, 2010). These views support the mainstream securities market theories that evolved around the efficient-market hypothesis. However, the investor's behavior observed in the Indian GSM deviates from the price mechanism and stays in the exchange market. Consumer behavioral theories provide helpful insights into this puzzle. Consumers, individuals or firms, tend to rely on non-monetary and subjective values to make buying decisions in the early stages of market or product development. The values, such as functionality, reliability, and convenience, often come before prices (Christensen, 1997a, 1997b; Gurowitz, 2012; Horton, n.d.; Moore, 2014). Also, Roger's diffusion of innovation theory portrays the stages of product life cycles that reflect consumer behaviors. (Roger, 2003) These insights answer my questions about transaction motivation.

The public good and club good theories elucidate how the interplays among the economic agents (the investor, the trader, and the government) shape the existing market arrangements. Cornes and Sandler (1996) comprehensively provide mathematical rationales behind the theories. Hildenbrand (1974) gives mathematical explanations specifically on the cooperative game theory's core allocation. Williamson's "bilateral dependency" and "ex-ante" governance (credible commitments) are supportive of the invertor-trader bondage in securities markets, including GSMs (Williamson, 1979, 1981, 1989,1995, 2005, & 2010). Faias and Luque (2017) apply club theory to equilibrium search for traders' stock exchange selection in a multiple stock exchange setting.

3 The Primary Dealer System in Lower-income Economies

3.1 Introduction

The primary dealer (PD) system based on the PD's market-making has long been the prime policy for developing government securities markets (GSMs). Policy advisors, including the international development community, have been advising emerging market economies to set up and operate the market-making system. Most of them claim to have put the system in place. Nonetheless, the liquidity of their GSMs remains very low. I examine the prevalence of the PD's market-making and its commercial viability in GSMs of lower-income economies. The fundamental assumption underlying this research is that the PD is a private-sector dealer who seeks profits from trading and that the PD system is commercially viable for the PD independently (The Fundamental Assumption).

Financial development is fundamental to economic development (World Bank & IMF, 2001a). Bond markets have been playing a significant role in financial development (Herring & Chatusripitak, 2000; Turner, 2002; IMF, World Bank, EBRD, & OECD, 2013; IMF & World Bank, 2016; Smaoui, Grandes & Akindele, 2017). The absence of a liquid secondary market keeps government securities' price discovery unreasonably erratic or arbitrary. Their primary market is not adequately integrated with the rest of the economy. Consequently, financial efficiency and economic management are compromised in an economy. These financial market flaws prevent lower-income economies from mobilizing and reallocating their scarce resources efficiently for economic development.

Most lower-income economies have difficulty developing the secondary market of their government securities markets (GSMs). Perceived impediments to their development may be grouped into supply, demand, and intermediation. Supply-side problems include the absence of critical mass or issuance regularity for trading. Underdeveloped debt and cash management and submarket pricing in the primary market often aggravate the supply-side impediments. A low-income level or a low savings level is typical of a demand-side impediment. Finally, intermediation between the supply- and demand-sides encompasses a legal and regulatory

framework, market infrastructure, and market microstructure. Most of them are endogenous to the market. All these supply-side, demand-side problems and the ultimate goal of economic development are dynamically interconnected in a market development process. Given this complex landscape, I focus on market microstructure to address the secondary market efficiency of GSMs in lower-income economies.

In addressing market microstructure, the development community has been regarding the PD system as an essential, if not a panacea, for generating liquidity in GSMs even in an early market development phase **(**Iden & Arnone, 2003; Arnone & Ugolini, 2005; BIS, 2007; World Bank, 2010**).** The PD system requires the primary dealer (PD) to make a market for benchmark issues by continuously offering two-way firm quotations to the market. The backdrop of such a policy position is that when it launched the GSM development initiative for emerging economies, the development institutions implicitly modeled emerging GSMs on the contemporary GSMs in advanced economies where the PD system is playing a pivotal role (World Bank and IMF, 2001a, 2001b, 2014; World Bank, 2007a, 2007b). However, the persistently low liquidity in the secondary market of lower-income GSMs prompts us to investigate the practicality of the PD system in a nascent market.

My investigation has three stages. First, I draw out a brief cross-sectional picture of lower-income GSMs allegedly operating the PD system. The market data of GSMs in lower-income economies are rarely available comprehensively and comparably. The electronic network of market information services recently expanding to some lower-income economies sheds dimmed light on those GSMs. The electronic network is an imperfect but practical way I can collect comparable market data economically. Second, I overview the economic structure of market-making in trading as well as market development graphical and mathematical models. Third, I empirically examine the economy of market-making in GSMs of lower-income economies. I estimate the ratio of the per-trade inventory-holding cost to the per-trade bid-ask spread (IHC Ratio, as will be defined in Section 3.5.3) through a three-way decomposition model of the bid-ask spread to assess the economic viability of market-making. The assessment follows the same process for the high-income economies (HIEs) to compare them with the lower-income economies to discover the properties of the PD system effectively.

The rest of this work is structured as follows.[12] Section 3.2 explains the analytical frameworks for this study, namely, PDs, bid-ask spreads, trading cycle, the three-way decomposition of the bid-ask spread, and the estimation model for the inventory holding cost. Section 3.3 graphically analyzes the PD's trading behavior. In Section 3.4, I examine the order-processing and adverse-selection costs with mathematical models. Section 3.5 outlines the empirical data and methodologies of this research. Section 3.6 presents the results. In Section 3.7, I discuss their implications. Section 3.8 concludes by wrapping up the findings, implications, limitations of this research and suggesting a further research perspective.

3.2 Analytical Frameworks

3.2.1 Primary Dealers (PDs)

The regulator of a GSM, which is usually the central bank, designates several to a few dozens of competent and well-capitalized intermediaries as PDs. The PD system requires the PD to make a market for designated government securities (benchmark issues) in the secondary market for price discovery purposes. The market regulator regulatorily or contractually obliges the PD to quote firmly bid and ask prices with a pre-determined spread or less for at least a pre-determined lot of benchmark issues (two-way firm quotes). The PD's market-making is designed to ensure trade immediacy or minimize trade latency of benchmark bonds not only in stable market conditions but also in volatile ones. Thus, the PD's market-making is consistent and continuous but not sporadic and opportunistic.

Accordingly, the trade frequency in a quote-driven market is dependent significantly on liquidity supply by the market-making dealers. Supposedly, the PD is a liquidity supplier, while the trader is a liquidity demander or seeker. The PD system generally pairs the PD's market-making responsibility with its take-on responsibility or privilege in the primary market. The government, mostly through the central bank, requires or allows the PD to take on substantial portions of new issues in the primary market for customers or themselves. The take-on responsibility may cause the PD market losses. To compensate for the downside risk in the primary market or possible losses on market-making in the secondary market, the

[12] The literature survey of this chapter has moved to Chapter 2.

regulator exclusively or preferentially grants the PD some privileges, such as exclusive access to the management of the monetary authority or participation in the primary market. Because the two-way firm quote obligation inevitably requires cash and securities positions for immediate order execution, the regulator appoints relatively well-capitalized and sophisticated dealers as PDs.

3.2.2 Bid-ask Spread (BA Spread)

The bid-ask spread (BA spread) is the cost of a round-trip transaction payable by traders.[13] In this way, the trader pays the PD for the supply of liquidity or trading service. Instead of investing in government securities, the trader can invest its[14] funds in bank deposits. With other things being equal and ignoring tax effects, the trader would choose an investment with a higher effective yield between government securities and bank deposits. The present work assumes for simplicity that the investments in government securities and deposits have the same credit risk, size, and maturity. The effective yield of investment in government securities is net of the trading cost, namely, the BA spread. The yield on bank deposits is a deposit rate that the bank offers depositors for an amount comparable to a trading lot of government securities. The difference between the government security yield and the bank deposit rate, if positive, forms the break-even spread (BES) (Figure 3-1).

Since trades repeat, the BA spread, price volatility, and liquidity interact with each other, and their effects feedback to themselves in trading cycles. Figure 3-2 depicts the feedback route in dashed lines. Low market liquidity prolongs the PD's inventory holding period for market-making. As a result, the "temporary fluctuations" of supply and demand (Garman, 1976) intensify, and market volatility stays high or surges. Volatility clustering (Alexander, 2001, pp. 31 and 65) or short-term bursts of high volatility (Shumway and Stoffer, 2016, p.254) may

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[13] The spread is a cost to the trader and revenue to the market-making PD. For simplicity, this work does not distinguish the PD's markup from expenses. The literature on listed stocks, except for Stoll (2003), ambiguously refers to the spread as profit though the spread includes substantial expenses.

[14] This paper uses gender-neutral nouns and pronouns (it, its, they, their, etc.) for inclusive language purposes as well as because market agents in this paper are institutions rather than natural persons. In case the pronoun(s) or noun(s) that a pronoun refers to is distinctly a natural person(s), this paper uses a gendered noun(s) or pronoun(s) in a gender-neutral way (e.g. he or she, his/her, etc.)

flare up even in such a low liquidity market. Volatility surges occasionally face PDs. These uncertainties widen the BA spread. This linkage may work as an endogenous route for autocorrelation of low-liquidity government securities that this work carefully removes for unbiased analyses.

3.2.3 Three-way Decomposition of the BA Spread

The stock dealers market in the U.S. and the PD system share commonalities in their market microstructure or trading mechanism but not securities evaluation. My research focus is on market structure. These commonalities allow us to capitalize on the academic achievements about the bid-ask spread in the U.S. quote-driven stock markets. Hasbrouck (2007) and Foucault, Pagano, and Röel (2014) review and summarize these achievements well.

Trading cost models developed to analyze quote-driven U.S. equity markets lend rich insights into trading costs and their implications in GSMs. The quantitative evaluation of the dealership on the U.S. stock markets was a great concern to the public, regulators, and academics since the 1960s. They, unlike many other stock exchanges, are partially or fully quote-driven markets. Specialists on the NYSE and market makers on the NASDAQ form market prices by offering firm selling and buying quotes simultaneously for particular stocks. Most GSMs with the PD system are also quote-driven markets, as described earlier in Section 3.2.1

A bid-ask spread[15] in dealer markets represents the trading cost of orders. Standard models decompose trading costs into three components: order processing, adverse selection, and inventory-holding costs. They are costs and mark-ups that dealers incur, pay, and gain for the delivery of their services. The bid-ask spread for a government bond S can be expressed as the sum of the three components:

[15] Different bid-ask spreads, namely, quoted, effective, and realized bid-ask spreads, are observable in liquid equity markets. By contrast, effective and realized bid-ask spreads are hardly observable in the GSMs of lower-income economies. Therefore, bid-ask spreads in this paper are all quoted bid-ask spreads unless otherwise specified.

$$S = s_{op} + s_{as} + s_{ih} \tag{3.2.1}$$

where s_{op}, s_{as}, and s_{ih}, denote the order processing, adverse selection, and inventory-holding cost components for a bond transaction, respectively.

3.2.4 Trading Cycle

The trader trades government securities and repeats the trading cycle of market-based orders if the BA spread (s_{pd}) remains less than the BES (s_0) on average.[16] The failure in satisfying the condition ($s_0 > s_{pd}$) would stop the trading cycle, defaulting the PD system. Figure 3-1 illustrates the trading cycle (in bold arrows) and events associated with the trading. The container in the Figure represents the mechanism that the PD's BA spread forges with three cost components: order processing, adverse selection, and inventory-holding costs.

3.2.5 Estimation model for the inventory-holding cost

I develop a model for order-processing costs and borrow other models for adverse-selection and inventory-holding costs from Foucault et al. (2014). The risk-averse, rational dealer bears inventory-holding costs to cover the market risk of a securities inventory and finance the holdings. I outline the modeling of the inventory-holding cost here. First, I assume that the dealer compensates the market risk of its security inventory by a bid-ask spread s_{ih} and the security's price takes a random walk. When it expects buying orders, the dealer quotes the ask price at time *t+1*, a_{t+1}, for the securities in its inventory as follows:

$$a_{t+1} = \mu_t + \rho\sigma_\epsilon \tag{3.2.2}$$

where μ_t is the expected price of the security at time *t*, ρ is the dealer's risk-averse

[16]The averaging period varies depending on the sustainability of primary dealerships in each GSM.

coefficient, and σ_ϵ is the expected standard deviation of security prices from time *t* to time *t+1* in the market. This model ignores the size of trades. On the other hand, when it expects selling orders, the dealer would quote the bid price at time *t+1*, b_{t+1}, for the securities that it builds in its inventory as follows:

$$b_{t+1} = \mu_t - \rho\sigma_\epsilon. \tag{3.2.3}$$

From Equations (3.2.2) and (3.2.3), the bid-ask spread s_{ih} that the dealer quotes for trading at time *t+1* can be expressed as follows[17]:

$$\begin{aligned} s_{ih} &= a_{t+1} - b_{t+1} \\ &= (\mu_t + \rho\sigma_\epsilon) - (\mu_t - \rho\sigma_\epsilon) \\ &= 2\rho\sigma_\epsilon. \end{aligned} \tag{3.2.4}$$

Adjusting the model (3.2.4) for liquidity further explicates the effect of price volatility on the inventory-holding cost. If the dealer clears its inventory by every trade (at time *t*), the price volatility affects the inventory-holding cost at the interval from time *t-1* to time *t*. The interval reflects market liquidity. By introducing a liquidity factor, we can statistically estimate the possible impact of price volatility on each trade or the precautionary bid-ask spread for the PD to cover. Let κ be the liquidity factor, and λ be the trade frequency rate. The trade frequency rate λ is the average number of trades[18] per trading day. Assuming that trades take place with even intervals during the Observation Period, as will be defined in Section 3.5.1, the liquidity

[17] Foucault et al. (2014) derive two models for the inventory-holding cost component of the bid-ask spread (S_t) as $S_t = 2\rho_v\sigma_\epsilon^2$ from a linear mean-variance function and as $S_t = 2\rho_{sd}\sigma_\epsilon$ from a linear mean-standard deviation function (pp.105-115).

[18] Neither trade volume (number of securities) nor trade value or amount.

factor is $\kappa = \sqrt{1/\lambda}$. By letting σ_d and σ_e represent the standard deviation of daily last prices and the effective standard deviation (the per-trade standard deviation of bond prices) respectively, $\sigma_e = \kappa\sigma_d = \sqrt{1/\lambda}\sigma_d$. Then, we can model the spread for the inventory-holding cost component s_{ih} in a given liquidity situation as follows:

$$\begin{aligned} s_{ih} &= 2\rho\sigma_e \\ &= 2\rho\kappa\sigma_d \\ &= 2\rho\sqrt{\tfrac{1}{\lambda}}\sigma_d \end{aligned} \qquad (3.2.5)$$

where ρ is the PD's risk-averse coefficient. This analysis assumes the coefficient ρ to be 1.00 for the PD to be risk-neutral. Since market liquidity varies widely, so does the inventory-holding cost component.

The analysis presented here suggests another feedback loop in market development. As was argued earlier in this work, market liquidity is a function of the dealer's bid-ask spread and other factors. In Equation 3.2.5, we can see that the inventory-holding cost component depends on market liquidity. This mutual dependency forms a feedback loop in the market development process. This endogenous linkage also appears responsible for the autocorrelation of trade prices to varying degrees, depending on securities and market environments.

Additionally, the PD in a low-liquid GSM may explicitly bear the funding cost for the inventory. The stock dealer model has no interest expense term probably because a stock dealer can immediately hedge its security position or counter-orders arrive at intervals of seconds or minutes. The hedging fee indeed includes the interest cost that the hedging instrument provider incurs in producing the hedging instrument. By contrast, it is common that the PD in the low-liquid GSM of a lower-income economy has no hedging instrument available, and counter-orders arrive at horizons of days, weeks, or months. Meanwhile, interest accrues on the government bond. Therefore, the funding cost is the net of accrued interest, which I denote c_f. If the trade frequency rate $\lambda > 1$, we can extend the inventory-holding cost component as follows:

$$s_{ih} = 2\rho\sqrt{\frac{1}{\lambda}}\sigma_d + c_f$$

$$= 2\rho\sqrt{\frac{1}{\lambda}}\sigma_d + \frac{h}{365.25}(r_L - y) \quad (3.2.6)$$

where h is the days of the holding period, r_L is the annual lending rate, and y is the government bond's annual yield. A bank PD may internally fund the holding at a lower rate than the lending rate, closer to its deposit rate, and it may argue that it has a positive carry rather than a negative one. However, diverting funds from the lending operations to the PD operations incurs the bank PD an opportunity loss. Despite this meticulousness, the direct funding cost would be insignificant relative to the liquidity effect since the liquidity effect is material in GSMs of lower-income economies[19].

3.3 Graphical Analysis

This section graphically analyzes the PD's ability to enhance market liquidity. The analysis shows that the PD's ability to enhance market liquidity is modest unless the demand and supply schedules shift favorably; that the favorable shift of the schedules is expected to need advancements in the economic structure; and that the ability improves when the PD's market-making obligation is removed.

3.3.1 Supply-demand schedules

This graphical analysis utilizes hypothetical supply-demand schedules developed for this analysis.[20] These schedules assume that the bid and ask values p_b and p_a of the BA spread are quadratic functions of trade frequency rate λ per unit time[21]. The two quote values are

[19] For example, when the carry spread (the lending rate minus the security yield) and the daily standard deviation both stand at 3.00 percent and the PD holds the security for a month (30 days), the net funding cost amounts to approximately 0.25 percent while the effective standard deviation is as much as 4.69 times the daily standard deviation, that is, 14.07 percent.

[20] I adopt the model from Garman (1976) and Hasbrouck (2007; p.107) and modifies it for this analysis.

[21] Order arrival rate per unit time in Garman (1976) and Hasbrouck (2007).

expressed as follows:

$$f_a(\lambda) = p_a = \alpha_a\lambda^2 + \beta_a\lambda + \gamma_a \tag{3.3.1}$$

$$f_b(\lambda) = p_b = \alpha_b\lambda^2 + \beta_b\lambda + \gamma_b \tag{3.3.2}$$

where $\{\alpha_a, \beta_a, \gamma_a\}$ and $\{\alpha_b, \beta_b, \gamma_b\}$ are coefficients and constants of the two quadratic functions, respectively. Letting the BA spread be denoted as s_{pd}, the spread is:

$$\begin{aligned} s_{pd} &= f_a(\lambda) - f_b(\lambda) \\ &= p_a - p_b \\ &= (\alpha_a - \alpha_b)\lambda^2 + (\beta_a - \beta_b)\lambda + (\gamma_a - \gamma_b) \end{aligned} \tag{3.3.3}$$

The ask (supply) and the bid (demand) schedules are downward- and upward-sloping, respectively. Assign coefficients and constants *{0.1, -1.0, 102}* and *{0.5, 0.2, 98}* for $\{\alpha_a, \beta_a, \gamma_a\}$ and $\{\alpha_b, \beta_b, \gamma_b\}$ in Equation (3.3.1) to obtain downward- and upward-sloping functions (3.3.2) and (3.3.3) of p_b and p_a , respectively, as shown in Figure 3-3.

$$f_a(\lambda) = p_a = 0.1\lambda^2 - \lambda + 102 \tag{3.3.4}$$

$$f_b(\lambda) = p_b = 0.5\lambda^2 + 0.2\lambda + 98 \tag{3.3.5}$$

Then, from Equations (3.3.3), (3.3.4), and (3.3.5), the BA spread that we can use for the graphical analysis is expressed as follows:

$$s_{pd} = -0.4\lambda^2 - 1.2\lambda + 4 \tag{3.3.6}$$

Let π_{pd} represent the PD's revenue at s_{pd}. The PD's revenue at s_{pd} is:

$$\begin{aligned} \pi_{pd} &= \lambda \cdot s_{pd} \\ &= \lambda(-0.4\lambda^2 - 1.2\lambda + 4\ ) \\ &= -0.4\,\lambda^3 - 1.2\lambda^2 + 4\lambda \end{aligned} \tag{3.3.7}$$

3.3.2 The PD's possible behaviors

The PD's possible behaviors expressed by Equations (3.3.6) and (3.3.7) are graphically analyzed, as shown in Figure 3-3 and Figure 3-4. The Figures illustrate hypothetical supply and demand schedules of government securities trading.

The x-axis, primary y-axis on the left, and secondary y-axis on the risght have trade frequency rates per unit time λ, price quotes of government securities in terms of percentage of face value p, and the PD's revenue amounts from a round-transaction of a unit security π along with them, respectively.

On the primary y-axis on the left side (the price axis), p^* indicates the equilibrium price between supply and demand. On the secondary y-axis on the right side (the revenue axis), π_{max} denotes the PD's maximum possible amount of revenues from a round transaction of unit security. On the x-axis (the trade frequency rate axis), λ_0, λ^*, λ_{pd}, $\lambda(\pi_{max})$ represent the trade frequency rates at the break-even spread (BES) s_0, the equilibrium price p^*, the PD's BA spread s_{pd}, and the PD's maximum possible amount of revenues from a round transaction

of a unit security π_{max}, respectively.

The two schedules cross at the equilibrium trade frequency rate and the price at coordinate (λ^*, p^*) (Figure 3-Figure 3-4). Constant function $\lambda = \lambda_0$ represents the trade frequency rate at the BES s_0 (Figure 3-3 and Figure 3-4) while constant function $\lambda = \lambda_{pd}$ indicates the trade frequency rate at the PD's BA spread s_{pd} (Figure 3-3).

Since the PD works only if $s_0 > s_{pd}$, the BA spread line always stays to the right of the BES line ($\lambda_0 < \lambda_{pd}$). The BES may be called the "Banking Wall." The PD's revenue (π) matches the rectangular area ABCD. The dashed parabolic line shows its function between s_0 at λ_0 and zero at λ^*. The revenue π reaches the maxim π_{max} at the trade frequency rate $\lambda(\pi_{max})$ or the spread s_{max} as shown with the rectangular area A'B'C'D'.

3.3.3 The PD's ability to enhance market liquidity

Even if $s_0 > s_{pd}$, the given demand- and supply schedules would constrain the PD's ability to enhance market liquidity. Since the BA spread ranges from the BES to zero ($s_0 > s_{pd} > 0$), the market liquidity runs from λ_0 *to* λ^*. However, the PD is not pecuniarily motivated to increase the market liquidity beyond the trade frequency rate λ_{max} by further narrowing the BA spread (reducing s_{pd}) as its revenue (presumably its profit as well) peaks off at the trade frequency rate λ_{max}. Subsidiaries likely move the PD's revenue maximization point to the right. The market liquidity in terms of trade frequency rate per unit time stands at $\lambda_0 = 0.791$, $\lambda(\pi_{max}) = 1.082$, and $\lambda^* = 2.000$. The PD's highest motivation point for market-making and its self-sacrificing (zero revenue) effort for market-making heighten the market liquidity by 1.367 times and 2.528 times, respectively.

The removal of the PD's market-making obligation, the consolidation of public debt onto the GSM, or the structural reform could unleash intrinsic market liquidity. First, the removal of the PD's market-making obligation would help generate additional transactions. The removal releases the PD of bearing the market risk of an inventory. It would allow the PD to narrow the BA spread substantially and move the constant function $p = \lambda_d$ to the right, close to λ^*. Thus, the partial PD system or the PD system without the market-making obligation is the market microstructure practical for most lower-income GSMs.

Second, the consolidation of existing public debt, such as the government's existing external debt and public enterprises' debt into government securities, could also enhance market liquidity. The consolidation would shift up the ask (supply) schedule (increase the constant variable γ_a) and shift down the bid (demand) schedule (decrease the constant variable γ_b), widening the space between the schedules to allow λ_d and λ^* to move to the right when $s_0 > s_d$.

Third, heightening the sensitivity of trading demand to the BA spread ($d\lambda/ds$) by reducing the slopes of the schedules would open up space to the right between the schedules. The reduced slopes would allow λ_d and λ^* to move to the right significantly. However, a reduction of the slopes would require a long-term structural change to the economy. The economy would have to build up a broad base of sophisticated and competitive institutional investors and intermediaries to achieve and keep its high sensitivity.

3.4 Model-based Analysis

My model-based analysis suggests that the per-trade order-processing cost is considerably sensitive to trade frequency rate (market liquidity), the length of market development history, and the extensiveness of social capital available to market development and operations. The per-trade inventory-holding cost would, if two-way firm quote market-making were committed, be also sensitive to the trade frequency rate, the market volatility, and the risk-averseness of traders. I ignore the adverse selection costs since the observed lower-income GSMs have not developed to have the significant presence of informed traders.

3.4.1 Order-processing cost

The order-processing cost is path-dependent, independent of adverse-selection and inventory-holding costs, at least in the short range of period (*e.g.,* a few years). It covers the dealer's explicit expenses and fees for operations, administration, and mark-ups. These expenses, unlike the market-risk part of the inventory-holding cost, are recognizable for financial accounting purposes. They include those incurred for originating, marketing, executing, processing, and settling orders. I ignore PDs' mark-up for the sake of simplicity in this work, like past studies.

The share of the order-processing cost in lower-income GSMs appears substantial in the trading cost as it is so in the active advanced equity markets. Huang and Stoll (1997) reveal that the order processing component accounted for 61.2 percent of spreads across 19 major stocks listed on the New York Stock Exchange in 1992[22]. They also show that small-size trades tend to have larger shares of the order-processing cost than large-size trades.

The nascence of GSMs and their weak social capital environments in lower-income economies raise the per-trade order-processing cost relative to advanced markets. A historically accumulated capital stock and an economy-wide social-capital network support a well-functioning market. However, most lower-income economies are considerably smaller in these assets. The order-processing cost for a government bond transaction in a lower-income market, as denoted as s_{op}, can be modeled as follows:

$$s_{op} = \frac{1}{\lambda}\left(F^d\left(\hat{C} - C^a\right) - \hat{E} + \hat{G}\right), \qquad (3.4.1)$$

where λ is the trade frequency rate (hence $1/\lambda$ is the per-transaction conversion factor), $\hat{C}$ is the capital stock that the market needs to have in place to run the market well, C^a is the capital stock that the market has accumulated and completely depreciated but can use productively, F^d is a capitalized cost allocation function such a depreciation function, $\hat{E}$ is the benefits that the market gains from the rest of the economy through positive externalities, and $\hat{G}$ is the period cost of the market, such as general and administrative expenses.

I further model subcomponents $\hat{C}$, C^a, and $\hat{E}$. First, I set the well-functioning GSM in a medium-sized economy as the reference market. Then, let the market sizes of the reference market and the target market be M^* and $\hat{M}$, and let us denote the market size ratio as m =

[22] This estimate results from a three-way decomposition method. A two-way decomposition (adverse selection and inventory holding components vs. order processing component) estimated the order processing component at 88.7% on average.

$\widehat{M}/M^*$[23]. Using m, we can express the subcomponents as follows:

$$\hat{C} = mC^*, \tag{3.4.2}$$

where C* is the capital stock in the reference market,

$$C^a = \mathrm{m} \sum_{t=0}^{n} f^d(t) C_{t-n}, \tag{3.4.3}$$

where it is assumed that the reference market started developing n years before year t, C_{t-n} is the capital stock accumulation for the reference market in the reference economy in year t-n, and, $f^d(t)$ is the capitalized cost allocation function such as a depreciation function in the reference market at year t, and,

$$\hat{E} = mE^* \prod_{t=0}^{n} (1 + e_{t-n}), \tag{3.4.4}$$

where E^* is the original base of external benefits that the reference market received in year t-n (the first year of its market development), and it is assumed that the externality benefits has grown at the rate of e_{t-n} since year t-n. This aggregate externality benefit $\hat{E}$ is closely related

[23] $m = \widehat{M}/M^*$ implies that the capital stock size is linear to the market size. Given economies of scale and scope, this likely makes the capital stock size less sensitive to the market size, heightening the desirable level of capital stock for a lower-income GSM.

to social capital. A high level of social capital reduces transaction costs (Knack, (1999; Blair and & Carroll, 2008; Andrews, 2011).

$$s_{op} = \underbrace{\frac{1}{\lambda}}_{\text{(a)}}\Bigg[\underbrace{F^d(\varphi}_{\text{(h)}}\Bigg(\underbrace{mC^*}_{\text{(b)}} - \underbrace{m\sum_{t=0}^{n} f^d(t)C_{t-n}}_{\text{(c)}}\Bigg)\underbrace{) - mE^*\prod_{t=0}^{n}(1+e_{t-n})}_{\text{(d)}} + \underbrace{G}_{\text{(e)}}\Bigg] \quad (3.4.5)$$

(a) Conversion factor to per-transaction at the trade frequency rate λ in year *0*

(b) Desirable level of capital stock at year *0* adjusted at the market size ratio *m*

(c) Fully allocated but productive capital stock accumulated over *n* years up to year *0* adjusted at the market size ratio *m*.

(d) Benefits from positive externalities from the rest of the economy (social capital) expanded from their original base E^*at rate e_{t-n} up to year *0* over *n* years adjusted at the market size ratio *m*

(e) Period cost in year *0* (G&A, etc.)

(f) Required level of capital stock in year *0*

(g) Affordable level of capital stock in year *0* adjusted at the market quality factor φ

(h) Capital stock allocated in year *0*

The introduction of the market quality factor φ ($0 < \varphi < 1$), as termed here, brings the model of the operating cost component close to reality. The market quality factor φ indicates the quality level of the market against the reference market. Lower-income markets can ill afford to equip themself with capital stock at a level comparable to the reference market. It compromises its market quality at φ. The factor is the variable dependent on all other variables in the model equation or the *adaptor* to hold the market variable. Substituting (3.4.2), (3.4.3) and (3.4.4) to (3.4.1) give the order-processing cost s_{op} for the model equation (3.4.5) above.

The model equation (3.4.5) shows how market liquidity and development paths affect the development and operations of a lower-income GSM. An unproportionally high conversion factor (the inverse of a trade frequency rate λ) in the term (a) powerfully leverages the order-processing cost comprised of capital stock, externality, and operations costs in a lower-income GSM.

Nevertheless, the rest of the Equation also reflects the coincidental (synchronic) and historical (diachronic) constraints that face the nascent market. The smaller *n* is (the shorter the

development history is), the more unfavorable to the market the cost becomes. The term (c) is historically accumulated capital stock. Its absence or dearth pushes up the cost (diachronic constraint). The term (d) is closely related to social capital supporting the market (a synchronic constraint). The income level is likely to be a factor in the growth rate e_{t-n}. The term (b) sets a desirable level of capital stock to run the market efficiently, prudently, and resiliently, commensurate with the well-functioning reference market. The terms (a), (c), and (d) cause the PD to keep its BA spread wide to accommodate the term (b). However, the "Banking Wall," namely, the BES (the break-even spread) discussed earlier in Section 3.2.2, limits, and market forces relatively restrict the PD's ability to hike the cost to stay commercially viable. The corollary is that the government, the regulator, the PD, and other market stakeholders have to lower the level (b) to an affordable level (g) by lowering the quality factor φ significantly from 1.0.

3.4.2 Adverse-selection cost

Adverse-selection costs[24] are theoretically conceived losses that less informed or uninformed traders incur when they trade with better-informed counterparts. Bagehot (1971) introduced the concept of adverse-selection cost. Market-making dealers, who make a market by quoting firmly in two ways, are usually less informed than better-informed traders who confidently hit dealers' firm quotes. Market-making dealers preemptively incorporate these potential losses into their bid-ask spreads.

The presence of informed traders in the quote-driven equity markets is known to give rise to adverse-selection costs (Stoll, 1978; Ho & Stoll, 1981; Copeland & Galai, 1983; Glosten & Milgrom, 1985; Easley & O'Hara, 1987; Glosten & Harris, 1988; Stoll, 1989; Easley, O'Hara & Paperman,1996; Huang & Stoll, 1997; Dufour & Engle, 2000; Stoll, 2003). The adverse-selection cost component is estimated to have a small share in the spread, relative to the other cost components. Huang and Stoll (1997) estimate the component at 9.6 percent of the spread on average from the same NYSE dataset[25]. An order-driven market shows that same trend. Brockman and Chung (1999) estimate a median adverse selection component on the Hong

[24] Also known as asymmetric information costs or information costs.

[25] The result of the same estimation as the order processing component.

Kong Stock Exchange at 33 percent. Assuming that the terminal value *v* of a stock has a binary distribution between the high and low values v^H and v^L, Foucault et al. (2014) give a model for the adverse-selection cost component s_{as} at time *t* as follows (p.91):

$$s_{as} = \pi\theta_{t-1}(1- \theta_{t-1})\left(\frac{1}{\pi\theta_{t-1}+(1-\pi)\frac{1}{2}} + \frac{1}{\pi(1-\theta_{t-1})+(1-\pi)\frac{1}{2}}\right)(v^H - v^L) \qquad (3.4.6)$$

where π is the share of informed traders in the market at time *t*, θ_{t-1} and 1- θ_{t-1} are the probabilities that the dealer views at time *t* the terminal value *v* takes v^H and v^L, respectively, when the next order is executed. Appendix A shows the derivation of (3.4.6). Figure 3-5 and Figure 3-6 depict s_{as} values when π and θ incrementally change from 0 percent to 100 percent.

The model (3.4.6) suggests that the adverse-selection cost is negligible in the early development phases of GSMs ($\pi \cong 0$). Figure 3-7 and Figure 3-8 graphically show that the adverse selection cost is zero in a market where informed investors account for less than 30 percent in the model. Nascent GSMs, particularly in lower-income economies, do not have any significant presence of informed traders. State-chosen PDs in lower-income economies, unlike specialists on the New York Stock Exchange or market makers on the NASDAQ, tend to be locally powerful, better placed, and close to the authorities. Institutional investors are inadequately developed in lower-income economies. If $\pi = 0$, there will be no adverse-selection cost according to the model.

The market development likely escalates the effect of the adverse-selection cost component over time. This effect is one of the reasons for granting some privileges to PDs to compensate for the cost in advanced economies. When institutional investors develop and get sophisticated and foreign investors are permitted to participate in the domestic market, trade frequency, and size increase. The impact of these developments is evident in advanced equity markets. Dufour and Engle (2000) suggest an increased presence of informed traders when markets become most active. Gregoriou (2008) reports the asymmetry of the price impact of

block trades and the bid-ask spread on the London Stock Exchange, and Dey and Radhakrishna (2015) document the widening of spread as institutional trading increases in the NYSE's TORQ data[26]. NYSE specialists and NASDAQ dealers are allowed to adjust not only mid-quotes but also bid-ask spreads to the market to minimize their losses to informed traders and maximize gains for uninformed traders as the market volatility changes. Their spreads are interactive with the market.

The PD may innovate its mid-quotes, but its bid-ask spreads are regulated, pre-determined, and mostly inflexible, at least in the short term. Let v_R^a and v_R^b be the representative PD's bid and ask, then $v_R^a - v_R^b < v^H - v^L$. Otherwise, the spread bid-ask $v_R^a - v_R^b \geq v^H - v^L$ provides informed traders with little incentive to trade with the PD. Since $v_R^a - v_R^b < v^H - v^L$, the representative PD will possibly be left with losses to informed traders when the market presence of informed traders becomes significant. Figure 3-9 and Figure 3-10 illustrate a possible loss distribution. Even worse, the PD may not be able to make up for the losses with gains from uninformed investors since the regulated spread is $v_R^a - v_R^b < v^H - v^L$.

3.5 Empirical Analysis

3.5.1 Data

For this study, I collect empirical data mainly from the MOSB[27] pages of the Bloomberg Professional Service. The electronically collected market data include the identifications of local currency government bond issues in lower-income markets and the time series of their quotes and prices. World Bank Data Help Desk provides the country categories and classification. IMF Data supplies time series of interest rates. Where necessary, the data is supplemented by the websites of central banks, market regulators, and finance ministries.

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[26] Data of trades on the NYSE from November 1990 to January 1991with uniquely detailed information on trade properties. TORQ stands for Trades, Orders, Reports and Quotes. (Hasbrouck, Sofianos & Sobsebee, 1993)

[27] Bloomberg's Most Active Traded Bonds page (Mnemonic: MOSB) displays the most active traded bonds in the electronically observable fixed income markets together with their trade data. In case MOSB data is sufficient, I may refer to Bloomberg's All Quotes pages (Mnemonic: ALLQ), which provide current market data for a selected fixed income security.

Only a limited number of lower-income economies electronically provide assessable time series data. Most low-income economies (LIEs)[28] have no active secondary markets though they may have primary markets and some secondary market trading in Treasury bills. Even among lower-middle income economies (LMEs), the secondary markets are rarely active. Time series data of most LME GSMs are not available in a comparable manner. A scrutiny of the data availability ends up with twelve quantitatively comparable LMEs: Egypt, Ghana, India, Indonesia, Kenya, Morocco, Nigeria, Pakistan, the Philippines, Sri Lanka,[29] Ukraine, and Vietnam (Table 3-1). Of these LMEs, however, the imperfect quality unfits Morocco, Nigeria, Pakistan, and Ukraine for aggregations in the table.

I gather two groups of datasets from Bloomberg. The first group is snapshot datasets of government bond issues outstanding in each observed market as at the end of November 2019. The datasets include the specifications of the bonds and their trades that took place in the three months from September 1 to Nosvember 30, 2019. [30] [31] These variables allow us to single out the most actively traded bond issue (MATB) in each observed GSM (Table 3-2). MATBs are assumed to be benchmark issues or their equivalents for which PDs make a market. My selection is limited to local currency-denominated fixed-rate government securities with a maturity of more than a year when issued. Ghana and Egypt have more active markets of the U.S. dollar- or Euro-denominated government bonds in Europe. The second group is daily time series of the variables of the MATBs over a year ending at the end of November 2019 or a shorter period if the shortage is reasonable (*e.g.*, the bonds were issued in and after December 2018) and long enough for statistical processing (*e.g.,* three months) (an Observation Period).

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[28] For the definitions of low-income economies (LIEs) and lower-middle income economies (LMEs), see Footnote 1.

[29] World Bank categorized Sri Lanka as an LME when this work collected the market data in May 2019, and has recategorized the country as an "upper-middle income economy" since July 2019.

[30] September 1, 2019 and November 30 were both in the weekend. The trading days in this study started on September 1, 2019 and ended on November 30, 2019. For descriptive simplicity, I mention the three months that was the basis for the MATB selection as being from September 1, 2019 to November 30, 2019.

[31] The database of historical prices is now available from the mid-May 2019. I choose the three months that are likely to be free from the impact of the summer or winter holiday seasons.

I also obtain the same datasets of the high-income GSMs from the MOSB database to reveal the PD's behavior in lower-income GSMs clearly in comparison with that in high-income GSMs. The economies include Australia, Austria, Canada, Chile, Czech, Denmark, Germany, Hong Kong, Hungary, Israel, Italy, New Zealand, Norway, Poland, Portugal, Saudi Arabia, Singapore, South Korea, Spain, Sweden, Taiwan, and the United Kingdom. Nonetheless, some caution must be mentioned. First, high-income economies tend to have liquid GSMs, but their high-income level does not necessarily warrant a liquid GSM. Second, the majority of the HIEs, unlike the LIEs, trade their domestic currency fixed-rate government securities in the Euro (German) or other foreign markets besides their domestic markets. They are often more liquid in the foreign markets than in the domestic markets (Table 3-3). Third, quite a few European MATBs are negatively yielding at the moment. I select the positively yielding MATBs regardless of the domestic or foreign markets for this study. However, I should note that their foreign market environments may affect the trading properties that I study here. I remove Denmark and Hong Kong from the comparison. The former's actively traded government bonds are negatively yielding, and the latter's quoted MATBs have no historical data or have been matured.

3.5.2 Methodologies

I examined the fundamental assumption underlying the practicality of the PD system for GSM development in lower-income economies (The Fundamental Assumption). The assumption is the commercial viability of the PD system for independent, private-sector PDs in lower-income economies.

To test the assumption, I investigated the prevalence and commercial viability of the PD system in lower-income GSMs through two hypotheses. First, I quantified the dispersion of the BA spreads of MATBs over the Observation Periods that are supposed to be relatively narrow under the PD system. The visual patterns of observed BA spreads must also be consistent with the prevalence of the relatively stable BA spreads if the market regulator or a market association sets them for the enforcement of the PD's two-way firm bid-ask quotation (the Regulated BA Spreads). I drew line plots, and histograms for observed BA spread time series of the twelve lower-income GSMs and compare them with those in the high-income GSMs (Figure 3-13 and Figure 3-14).

The second hypothesis is that the per-trade inventory-holding cost must be small enough relative to the hypothetical per-trade Regulated BA Spread to accommodate the order-processing cost in the spread for each MATB issue. To test this hypothesis, I needed to estimate pairs of per-trade values. I first assumed that the $2\rho\sigma_{\epsilon}$ in Equation (3.4.4) approximates the order-processing cost component of the trading cost. I estimated the standard deviation from the standard error of the MATB's historical price time series. I also assumed the averaged daily BA spread over the Observation Period to be the hypothetical Regulated BA Spread for each MATB issue. The averaged daily BA spread should lie in the ballpark of the true Regulated BA Spread. The volatility of the observed BA spreads affects the accuracy of the averaged daily BA spread as an estimate of the true Regulated BA Spread. The average is an equally-weighted average by trades as I ignored trade sizes.

The unbiasedness of estimators matters to my analyses. The standard errors or standard deviations are subject to two kinds of bias, that is, the autocorrelation and heteroskedasticity of bond parameters. I regressed the observed variables (BA spreads or logarithmic returns) of the MATBs on their observation numbers to obtain their standard errors. The regression yields the standard error of the time series data points as the standard error of the constant. Since they are financial market time series, however, some of them are likely to violate the assumptions of ordinary regression analysis. To determine the specification of regression, I ran the Shapiro-Wilk test for normality, Durbin's alternative test, and Breusch-Godfrey LM test for first-order autocorrelation, correlogram test for multiple-order autocorrelation up to Lag 10, and run Newey-West regression for lags 0, 1, and 5 to obtain robust standard errors of the autocorrelated time series. Before estimating the per-trade inventory-holding cost, I translated the robust standard errors into the standard deviations by multiplying them with the square root of the number of observations. Substituting the calculated values in Equation (3.4.5) gives us the per-trade inventory-holding costs of the observed MATBs. I ignored the funding cost of an inventory, as shown in Equation (3.4.6).

Heterogeneity is an issue in the collected market data. This work compared BA spreads and bond returns to estimate the PD's behaviors toward MATBs across economies, but those variables were substantially heterogeneous in years to maturity, coupon rates, coupon payment frequencies. Bond duration systemically incorporates these heterogeneous factors that affect BA spreads and returns. I divided my estimated BA spreads and returns by

modified duration to reduce the effect of heterogeneity on the estimators. I call them "duration-neutral" parameters (Table 3-4and Figure 3-12).

Finally, I simulated IHC Ratios (as will be defined in the next subsection) for varying initial shares of fixed cost in the trading cost and multiplying the current trade volume on the IHC calculation model. The PD in a lower-income GSM starts market operations with a low trade volume and moderate capital. It may be useful to know how the PD's initial position and market development may affect the economies of the market-making.

3.5.3 The Inventory-Holing Cost Ratio (IHC Ratio)

From the per-trade inventory-holding cost and the per-trade Regulated BA Spreads, I calculated the ratio of the former to the latter to assess the commercial viability of the market-making under the PD system. I term the ratio the Inventory-Holing Cost Ratio (IHC Ratio).

If independent and profit-seeking PDs are compliant with the market-making obligation, the trading cost (the sum of the order-processing, adverse selection, and inventory holding costs) should be equal or less the Regulated BA Spread on average. The market regulator sets the Regulated BA Spread as the ceiling of two-way quotes for particular securities and requires the PD to abide by it. The Regulated BA Spread setter may adjust when the spread determinants have changed so much that the market-making may become structurally overpriced or underpriced. Thus, the spread is not supposed to change frequently, randomly, or sporadically. The IHC Ratio should be less than 100 percent of the per-trade Regulated BA Spread and be small enough to give room for the order-processing costs. I ignored the adverse selection costs in lower-income GSMs and the impact of trade sizes for simplicity.

3.6 Results

The level of GSM development with the PD system widely varied among lower-income economies. Table 3-2 summarizes trading in the LME GSMs from September 1 to November 30, 2019. No LIE GSMs were electronically observable though some markets like the Ugandan and the Tanzanian GSMs are known to be relatively well organized among LIE GSMs. Among the LMEs, the Indian market is liquid, followed by the Indonesian and Vietnamese markets. The Nigerian and Sri Lankan markets were barely liquid. Others have a

few trades or less every trading day.

The uneven market compositions and trading patterns suggest widely varying degrees of market development among the lower-income GSMs. All these lower-income economies claim to have the PD system in operation. Table 3-2 reveals that these PD systems' market-making was not functional. The statistics in the table evidence the significant low liquidity of the GSMs in Egypt, Ghana, Kenya, Morocco, Pakistan, and Ukraine. Their yields are questionable as interest rate benchmarks to the rest of their economies. Liquidity in the Indian, Pakistan, Ukraine, and Vietnam concentrates too much on the MATBs to build robust benchmark yield curves. The maturities of the fixed-coupon MATBs in the Ghanaian, Moroccan, Pakistani, Ukrainian markets are less than two years. Some of these markets trade T-bills or zero-coupon bonds more actively than fixed-rate coupon government bonds.

The results of the tests of the variables for normality and autocorrelation strongly suggest that most of the time series violate the assumption of ordinary regression analysis (Table 3-5). Table 3-6 and Table 3-7 summarize the results of the Shapiro-Wilk test for normality, Durbin's alternative test, and Breusch-Godfrey LM test for first-order autocorrelation and correlogram test for multiple-order autocorrelation up to Lag 10. The BA spreads of most MATBs were not normally distributed. Their exceptions include Vietnam among the LMEs and Chile and South Korea among the HIEs. The log-returns of all the LME MATBs other than the Indian one were autocorrelated. Of the 22 HIE MATBs, fifteen are also autocorrelated. The possible heteroskedasticity and autocorrelation required me to run Newey-West regression to estimate robust standard errors for most of the observed MATBs.

The relatively large standard errors of the LME MATBs were hardly consistent with the practice of market-making with two-way firm quotes. A comparison between the duration-biased and duration-neutral graphs highlights the impact of bond duration (Figure 3-11 and Figure 3-12). In the duration-neutral graph, the BA spreads of LME MATBs remain unstable with high standard errors relative to HIE MA TBs, but Ghana and Sri Lanka stand out while Australia and Saudi Arabia considerably recede.

The graphical patterns shown in Figure 3-13 indicate that Sri Lanka had some traits of two-way firm quotes. Kenya, Pakistan, and Vietnam also showed some stable ranges of BA spreads, but their spreads appeared too wide to provide the market with liquidity

continuously. Their BA spread ranges were approximately one percent for Kenya, two percent for Pakistan, and 1.6 percent for Vietnam (Figure 3-13). Frequent transactions of those MATBs were too expensive to retain yield gains. Wide BA spreads cannot supply liquidity to traders. Disperse distribution of BA spreads rules other LMEs out of the possibility of the market-making. Among the HIEs, Canada, Chile, Denmark, Israel, New Zealand, Portugal, Singapore, South Korea, Spain, and the UK stably contained BA spreads in narrow ranges, typical of the market-making through two-way firm quotes (Figure 3-14).

The graphical analysis failed to capture the PD's intermediation pattern in a low range of BA spreads. India's case looked like performing market-making. However, its IHC Ratio was too high to be consistent with two-way firm quote market-making. The IHC Ratios of Egypt, Ghana, India, and Kenya were 293 percent, 76 percent, 138 percent, and 152 percent, respectively (Table 3-8). At the same time, low IHC Ratios do not necessarily serve as evidence for market-making practice when market liquidity is too low. The ratios currently stand at 17 percent, 53 percent, and 24 percent for Indonesia, Sri Lanka, and Vietnam, respectively. Low liquidity tends to keep the ratios low, and the ratios may jump up as market liquidity multiplies. Table 3-9 provides the results of simulations on the IHC Ratio model for Indonesia and Vietnam with the initial fixed cost share from 20 percent up to 100 percent, and the trade-increase multiples from one to twenty times. In a likely scenario where the initial share of the fixed cost at 100 percent or the PD does not count the inventory-holding cost at all, the IHC Ratios would quickly soar. The derivative calculation in Appendix B also suggests that a surge in liquidity most likely heightens the ratio.

The estimation of IHC Ratios reveals the complex nature of MATB market-making. The graphs in Figure 3-15 and Figure 3-16 and the quadrant-matrix mode in Figure 3-17, in addition to Table 3-8, may be helpful to see PDs' behaviors relatively. First, MATBs of New Zealand, the UK, Spain, Portugal, Poland, and Canada were trading unexpectedly deep inside the commercially inviable area. Their duration-neutral average BA spreads were narrow (Quadrant 1). From this result, it is not surprising if aggressively uneconomic market-making is prevalent in middle-income economies between LMEs and HIEs as well. Second, the market-makings of the Egyptian, Kenyan, Indian, and Ghanaian MATBs would be commercially inviable if it is practiced (Quadrant 4 except for India in Quadrant 1). Their IHC Ratios are so large that their PDs would not have enough headroom for the order-

processing cost. Third, aggressive PDs with super-high IHC Ratios for HIE MATBs and PDs with high IHC Ratios for LME MATBs except for India significantly differed in the degrees of their possible losses and the dispersity of their BA spreads. The former's losses were significant, and their spreads were tight, while the latter's were modest and wide. Wide BA spreads were inconsistent with continuosus and firm market-making. Fourth, Egypt, Saudi Arabia, Chile, and Kenya positioned themselves in Quadrant 3. Their position may reflect the government's support of the low-liquid GSMs.

3.7 Discussion

The usefulness of the PD system is one of the essential issues for building a better policy framework for market development in lower-income economies. This work investigates how PDs in lower-income GSMs have been practicing market-making and if market-making is commercially viable for the PDs.

This work has expounded the economic structure of the PD's market-making, empirically demonstrated the non-prevalence and commercial inviability of the PD's market-making in a lower-income GSM, dismissed the universality of the assumptions for the PD system, and opened an avenue to designing and positioning the market-making more meaningfully in the entire market development policy framework. I have also identified super-aggressive market-making for MATBs in high-income GSMs. This finding helps to redefine the role of market-making in a broad framework of the PD system.

The methodologies employed for this work are unique in remotely researching a dozen of lower-income GSMs. The analyses center on the time series of BA spreads of MATBs to assess the PD's market-making behaviors. The data collection relies on Bloomberg's MOSB and related pages to compile datasets of a dozen of lower-income GSMs comparably along with those of twenty-two high-income economies. Some key commonalities in market microstructure between the PD system and the dealers' market of U.S. stocks allow this research to capitalize on the theory that has been developed to investigate trading costs and a slew of academic papers. The theory or the three-way decomposition of the bid-ask spread is compatible with this research regardless of the differences in security type. Finally, the division of standard errors of MATBs by their modified durations reduces the heterogeneity latent in the standard errors and makes it possible to compare the MATBs cross-sectionally

(Table 3-4 and Figure 3-12).

There is no evidence found for the prevalence of PDs' continuous and firm market-making in lower-income GSMs. Instead, my finding of widely dispersed BA spreads proves PDs' opportunistic behaviors in intermediating trades, which appear economically rational to manage market risk in imperfectly but practically developed GSMs. The estimations of IHC Ratios for LME MATBs fail to justify PDs' inventory-holding for continuous and firm market-making. Opportunistic market-making reduces the PD's trading cost, possibly allows the PD to narrow BA spreads, and entices traders into trading in lower-income GSMs. India's market-making is a good example. This realistic approach to generating liquidity would require the policymaker and the market regulator to lower the investment community's expectation about the PD's liquidity provision and adjust its regulatory and supervisory framework accordingly.

Understanding the benefits of voluntary market-making as an economically rational policy would facilitate the PD's order-matching in a low-liquidity environment. The pragmatic PD, regulator, or policymaker is probably stranded between the reality of voluntary market-making and the official policy of obligatory market-making. The stranded PD may currently be sharing the benefit of prudently-opportunistic market-making with its customers only halfway. Tanzania exemplifies a solution for the impractical market-making under the PD system in low-income environments. The country used to have a PD system in place (Bank of Tanzania, 2001). However, the country walked away from the PD system and adopted a broker-dealer system in 2015 (Bank of Tanzania, 2015).

The finding of unexpectedly and purposefully aggressive market-making for some HIE MATBs suggests multiple modes of market-making, depending on a GSM's overall policy objectives. The Fundamental Assumptions discussed in Section 3.1 and Section 3.5.2 no longer holds. The governments with aggressive but unprofitable MATB market-making arguably position active market-making as solid support to other GSM objectives, such as low-cost issuance of government securities and the resilient benchmark yield curve. Their governments must be subsidizing or cross-subsidizing PDs, as illustrated in Figure 3-1 and discussed in Section 3.3.3. If so, the government's overall objective of GSM development determines the characteristics of the PD's market-making. The Four-quadrant Matrix in

Figure 3-17 may help assess the relevance of the PD's market-making in a local context.

A market microstructure approach like this work gives insights into the workings of a GSM and practically contributes to GSM designing in lower-income economies. In contrast, a macroeconomic approach provides solutions in the long term, as extensively argued in the literature cited in Section 2.2.

3.8 Conclusion

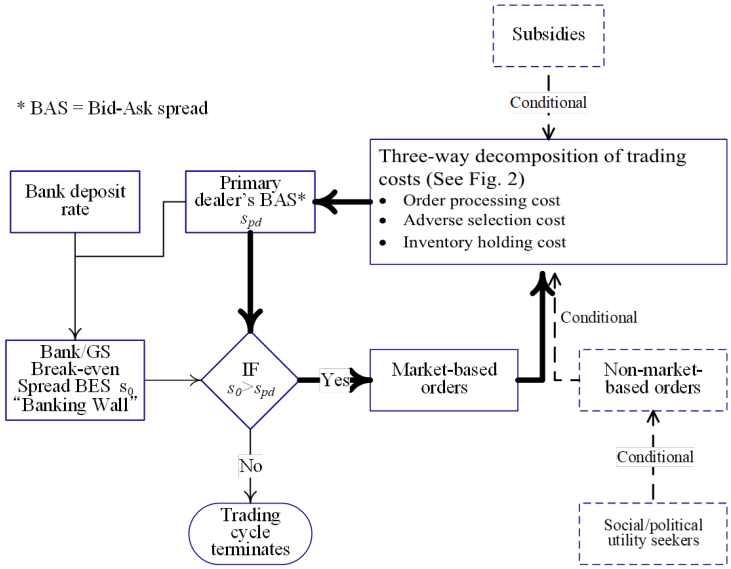
There is no evidence found for the prevalence of PDs' continuous and firm market-making in lower-income GSMs. Instead, my finding of widely dispersed BA spreads proves PDs' opportunistic behaviors in intermediating trades. Consequently, admitting the reality and permitting prudently-opportunistic market-making may lead to positioning the market-making more meaningfully in the entire market development policy framework. The finding of unexpectedly aggressive and purposefully loss-making market-making nullifies the fundamental assumptions of this research that the PD seeks profits from market-making and that its market-making should be commercially viable. The government's overall objective of GSM development determines the positioning of the PD's market-making.

The novel application of the three-way decomposition of the BA spread to fixed-income research in lower-income economies may need further verification or improvement. The data section for research on lower-income GSMs may also be an issue.

Future research should address commercial viability from a broader perspective combining the primary and secondary markets. Purposefully loss-making market-making gives rise to an issue about optimal and fair allocation of costs among different branches of a GSM. Excessively aggressive market-making may unreasonably distort the secondary market as artificially induced demand pushes up bond prices and pushes down yields. Lower-income economies may also waste their resources in the primary market just for the secondary market appearance.

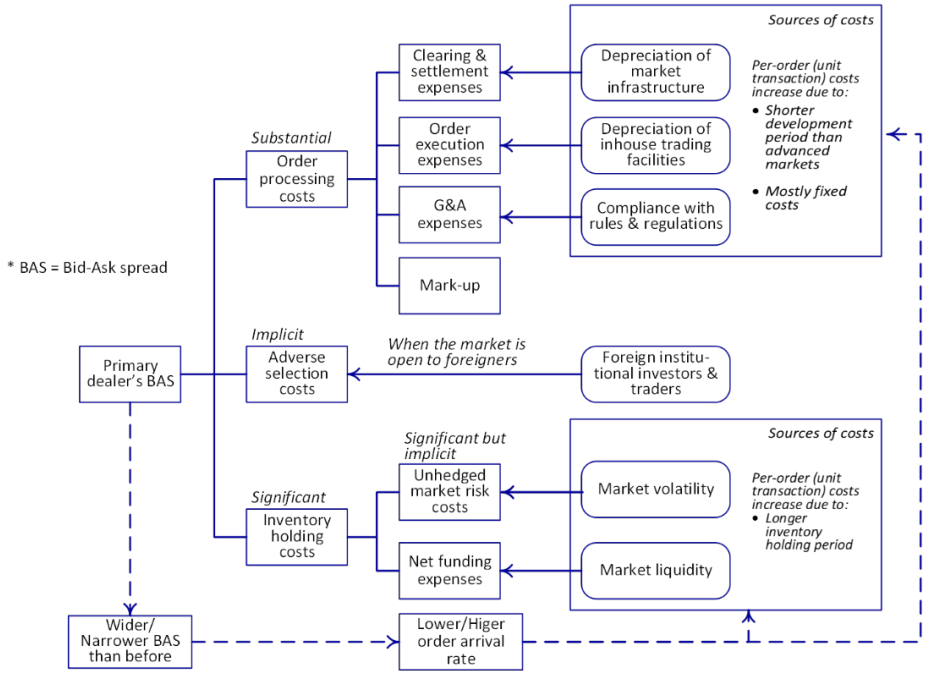
Figures

Figure 3-1: Trading Cycle



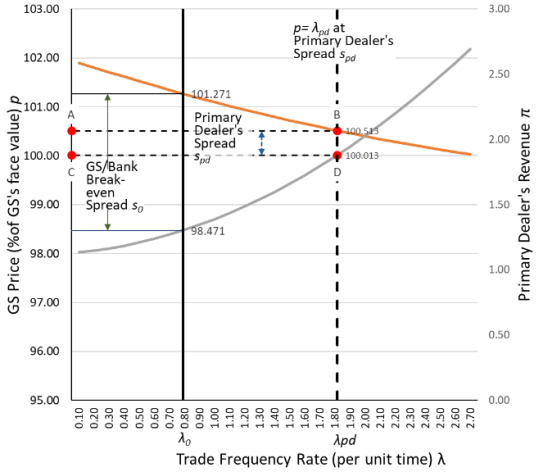
Source: The Author

Figure 3-2: Three Components of the BA spread



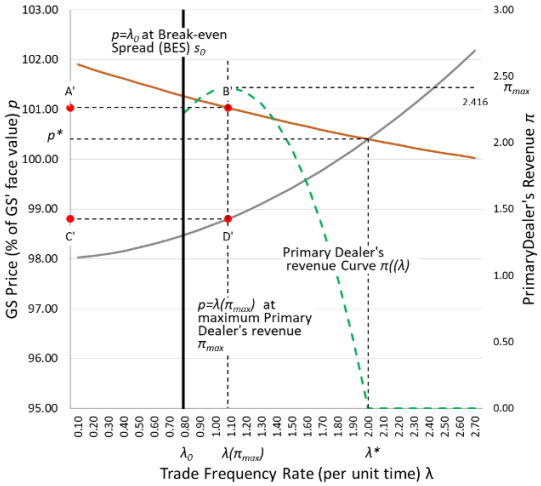
Source: The Author

Figure 3-3: Supply and Demand Function and Primary Dealer's Spread



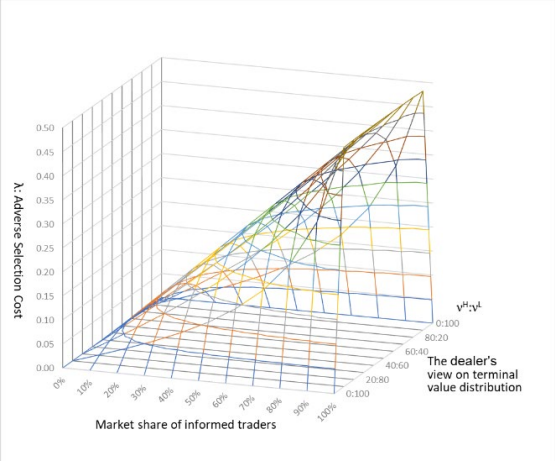
Source: The Author

Figure 3-4: Primary Dealer's Break-even Spread and Revenue Maximization



Source: The Author

Figure 3-5: Adverse-selection cost along with Shares of Informed Traders and Confidence Levels of Terminal Value (1)

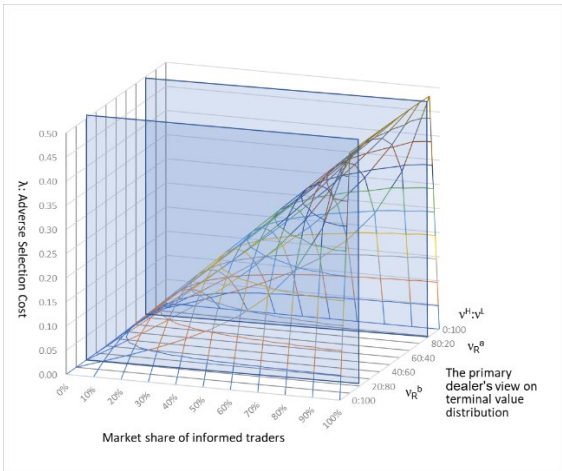


Source: The Author

Figure 3-6: Adverse-selection cost along with Shares of Informed Traders and Confidence Levels of Terminal Value (2)

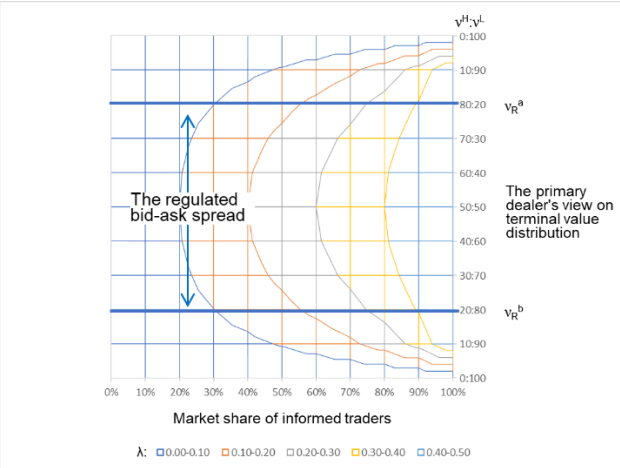
Source: The Author

Figure 3-7: Adverse-selection cost with Regulated Bid-ask Spread Limit (1)



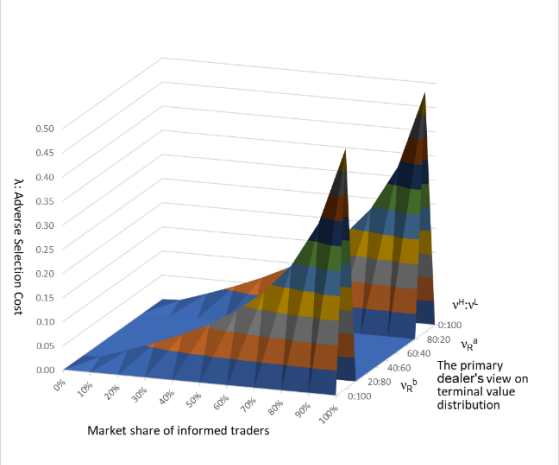
Source: The Author

Figure 3-8:Adverse-selection cost with Regulated Bid-ask Spread Limit (2)



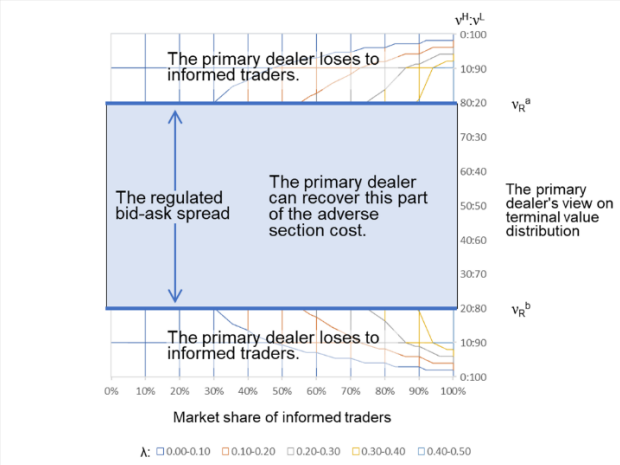
Source: The Author

Figure 3-9: Adverse Selection Losses (1)



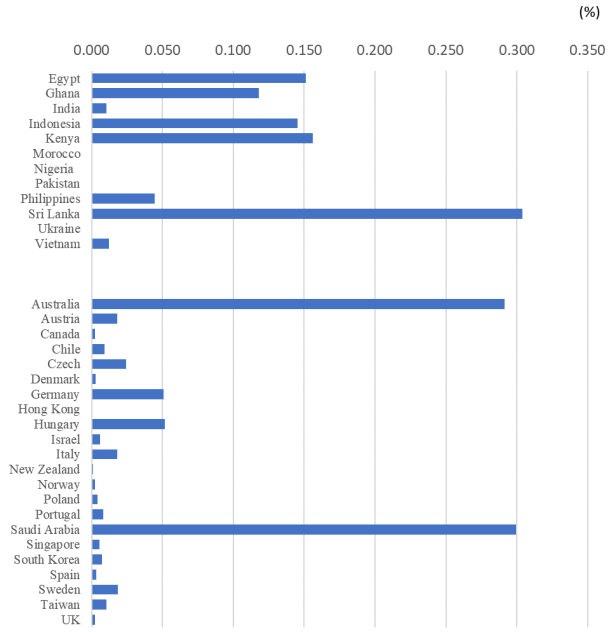
Source: The Author

Figure 3-10: Adverse Selection Losses (2)



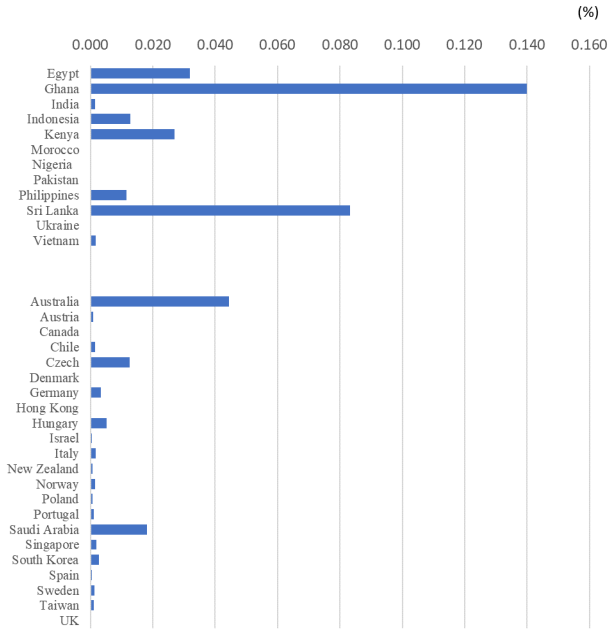
Source: The Author

Figure 3-11: Duration-biased Standard Errors of MATB BA Spreads



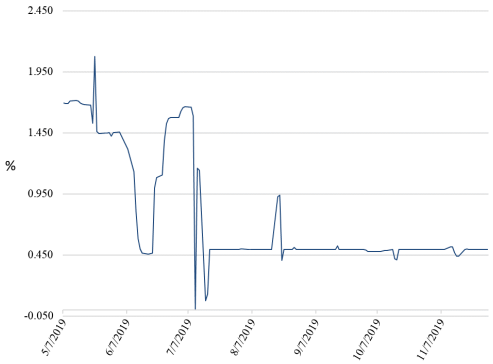
Source: The Author's calculation and drawing from Bloomberg data

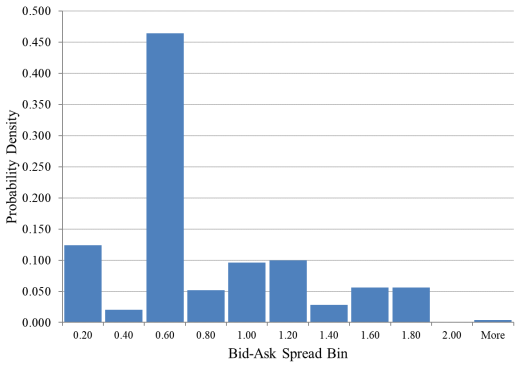
Figure 3-12:Duration-neutral Standard Errors of MATB BA Spreads



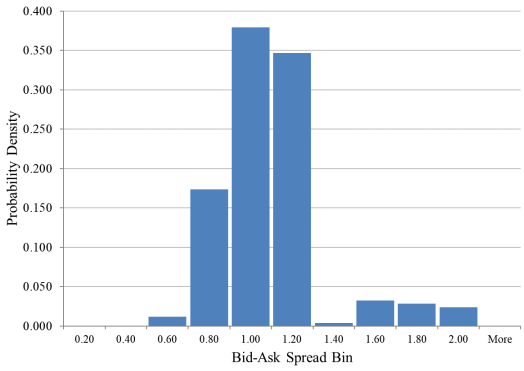
Source: The Author's calculation and drawing from Bloomberg data

Figure 3-13: Bid-Ask Spreads of Most Actively Trades Government Bonds or Their Substitutes

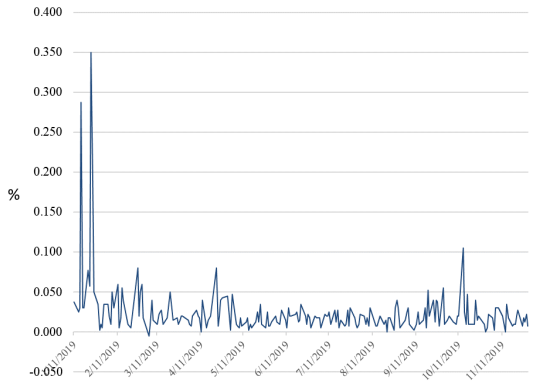


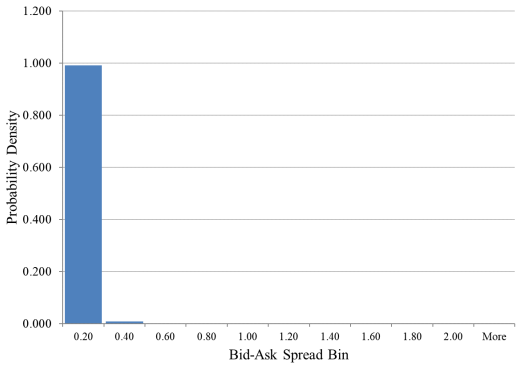


(1) - Egypt: EGYGB 16.1 05/07/29

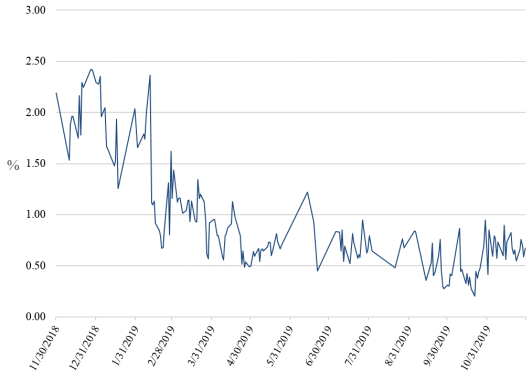


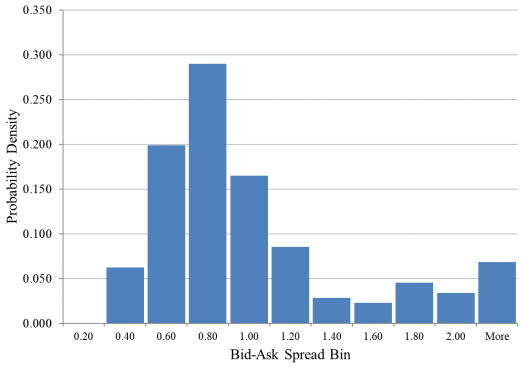
(2) Ghana: GHGB 18.25 09/21/20



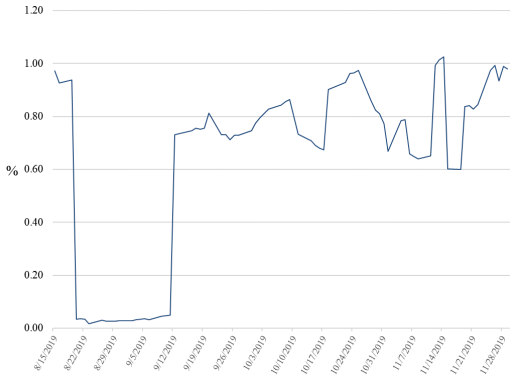


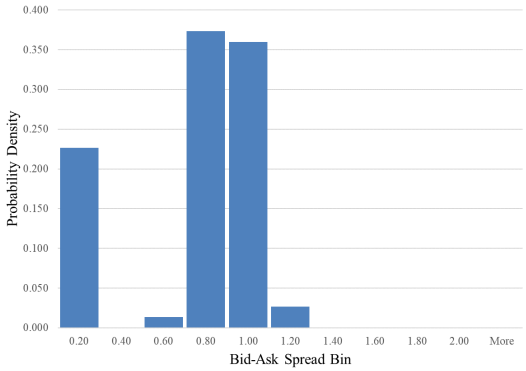
(3) India: IGB 7.26 01/14/29



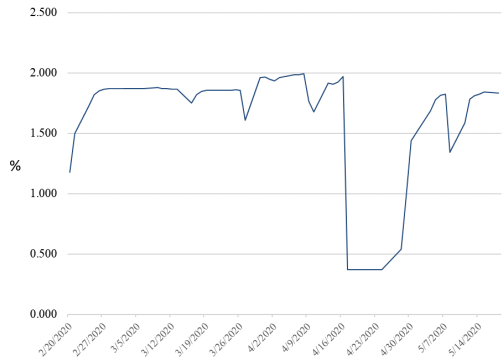


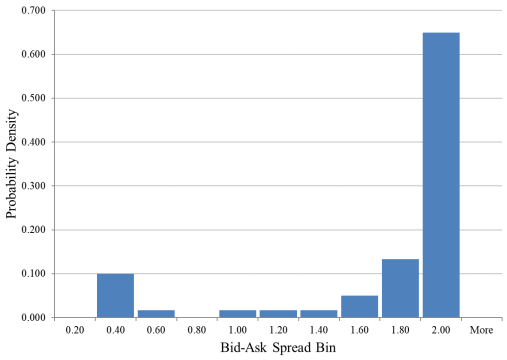
(4) Indonesia: INDOGB 7.375 05/15/48



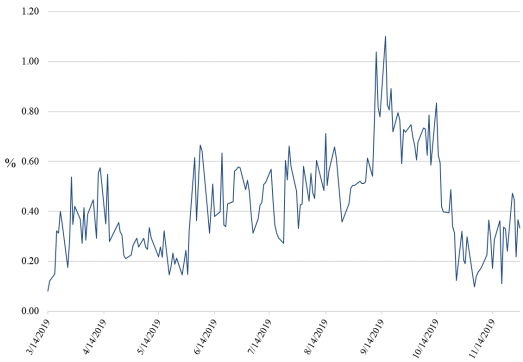


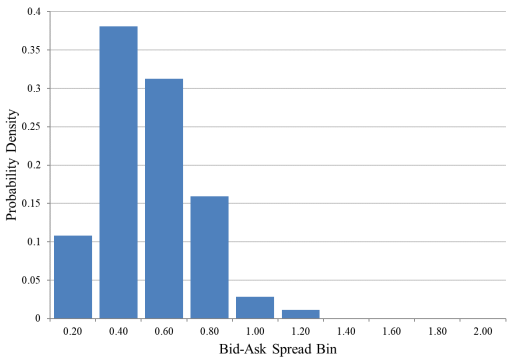
(5) Kenya: KENGB 11.517 08/06/29



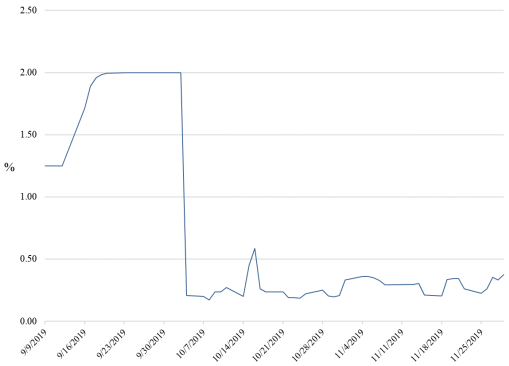


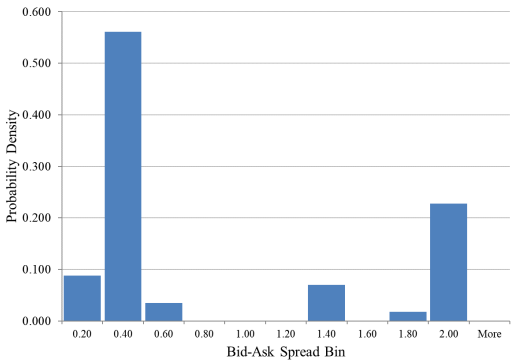
(6) Pakistan: PAKGB 7.25 07/12/21



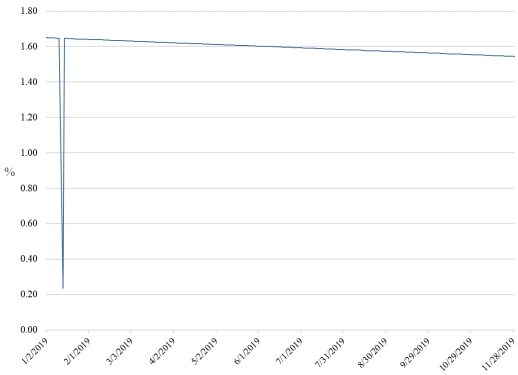


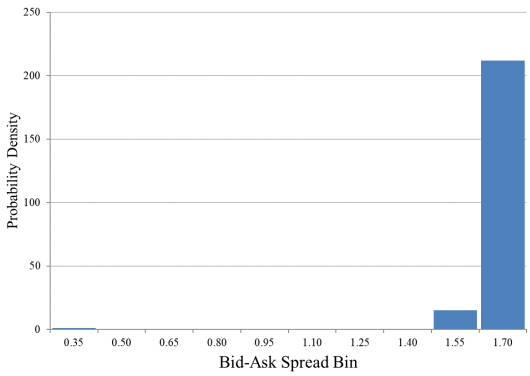
(7) The Philippines: RPGB 6.25 03/12/24





(8) Sri Lanka: Sri Lanka: SRILGB 9.85 09/15/24

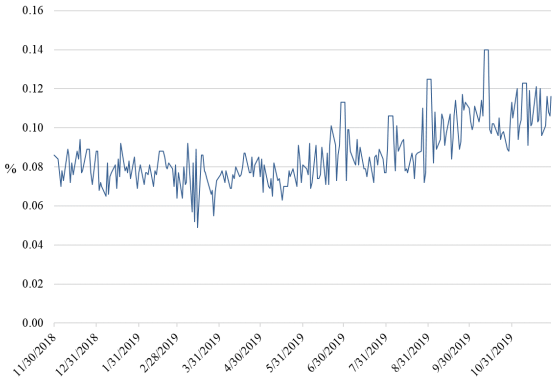


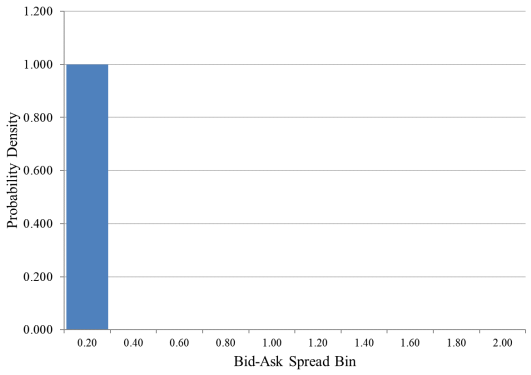


(9) Vietnam: VIETGB 5.1 01/03/29

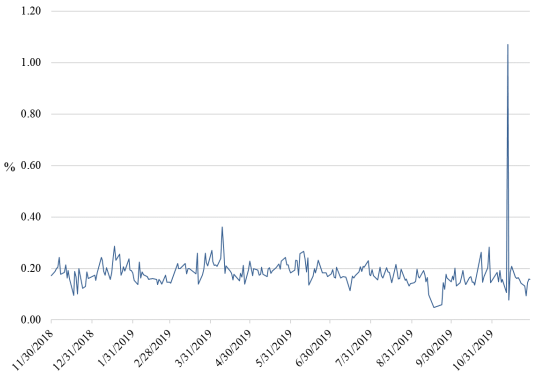
The data range for a year or shorter up to the end of November 2019
Source: The Author's calculation and drawing from Bloomberg data

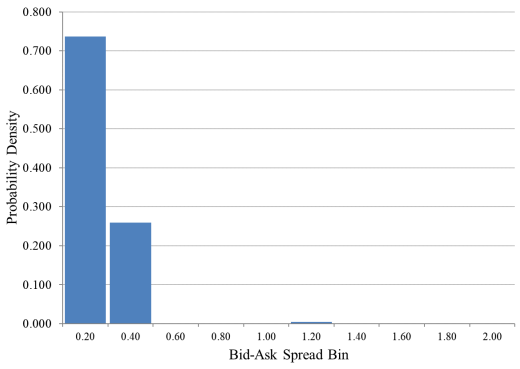
Figure 3-14: Logarithmic Daily Returns of Most Actively Trades Government Bonds or Their Substitutes



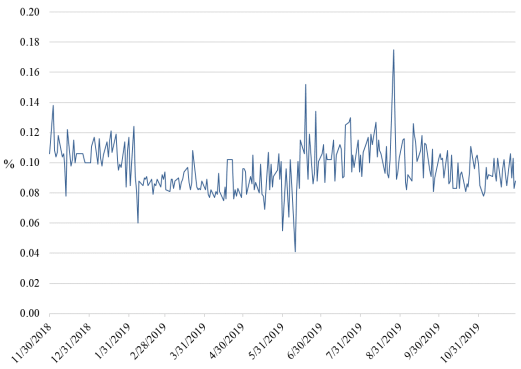


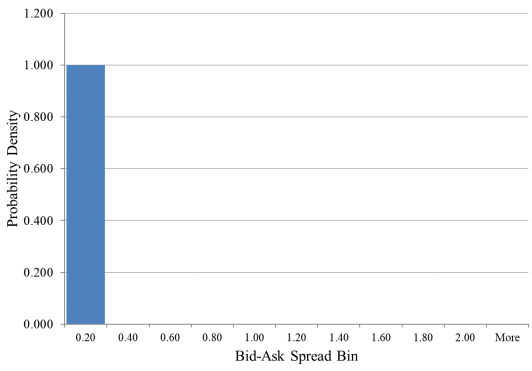
(1) Canada: CAN 2.75 12/01/48



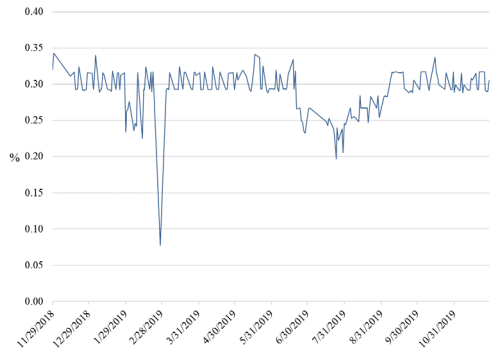


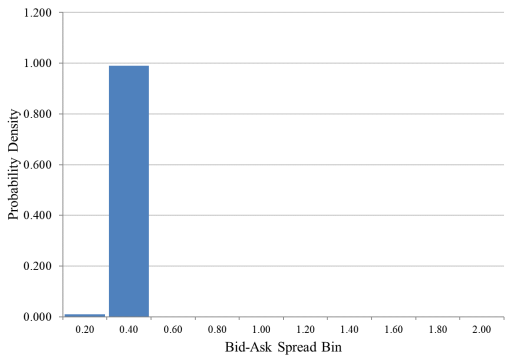
(2) Chile: BTPCL 4.5 03/01/26



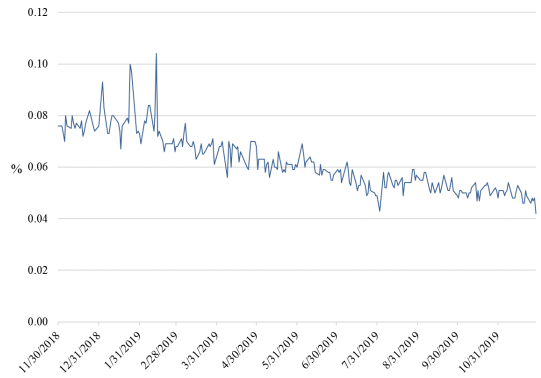


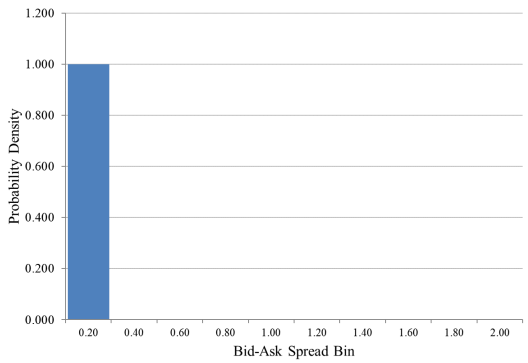
(3) Denmark: DGB 3 11/15/21



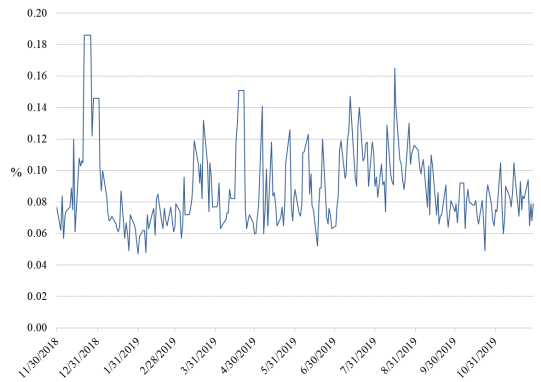


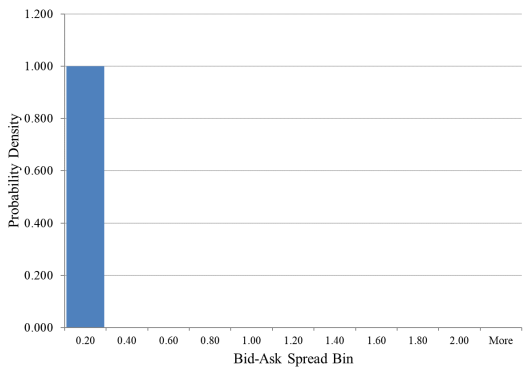
(4) Israel: ILGOV 5.5 01/31/42



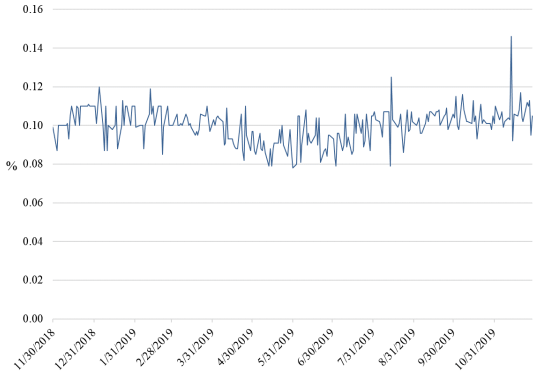


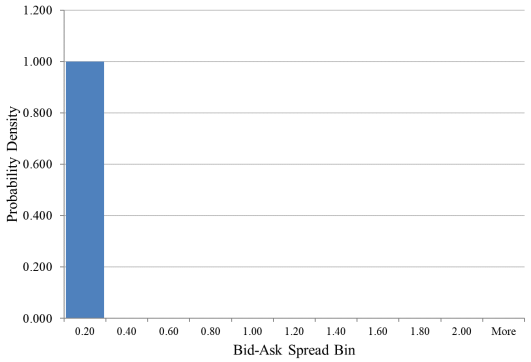
(5) New Zealand: NZGB 6 05/15/21



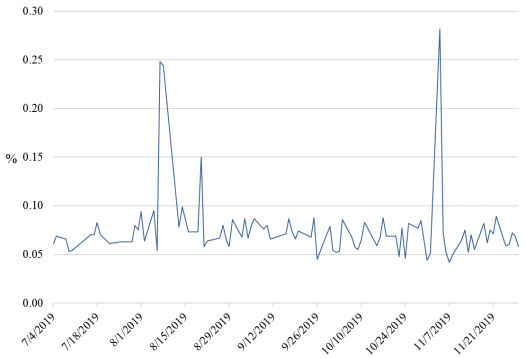


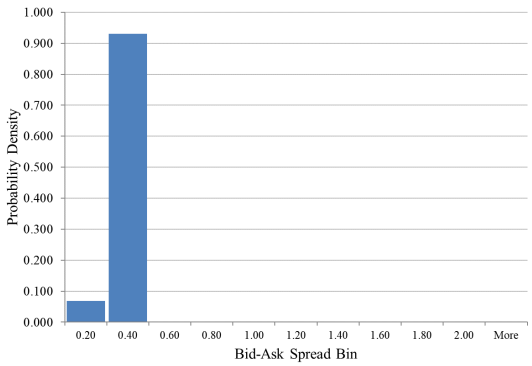
(6) Portugal: PGB 2.125 10/17/28



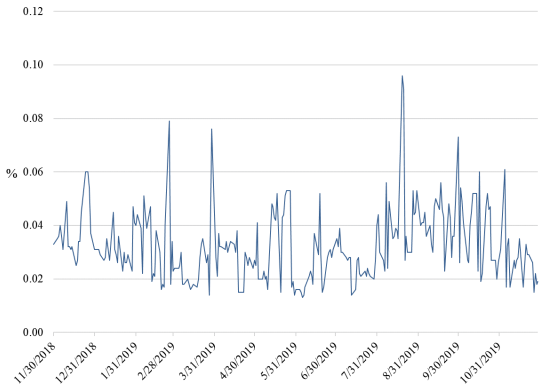


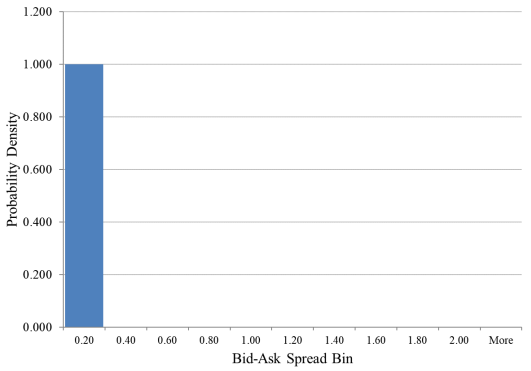
(7) Singapore: SIGB 3 ⅛ 09/01/22





(8) South Korea: KTB 1.875 06/10/29

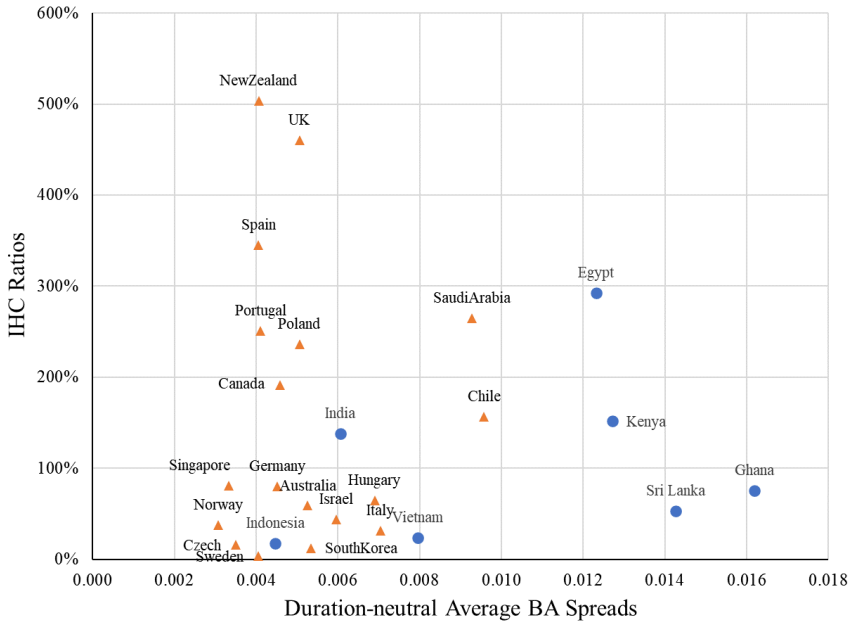




(9) UK: UKT 0.5 07/22/22

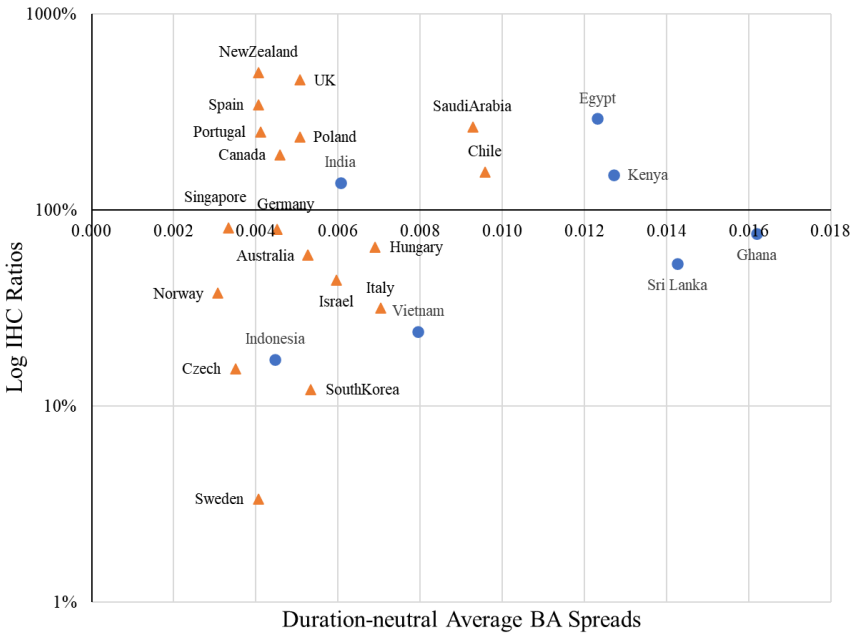
Source: The Author's calculation and drawing from Bloomberg data

Figure 3-15: Duration-neutral Average BA Spreads to IHC Ratios



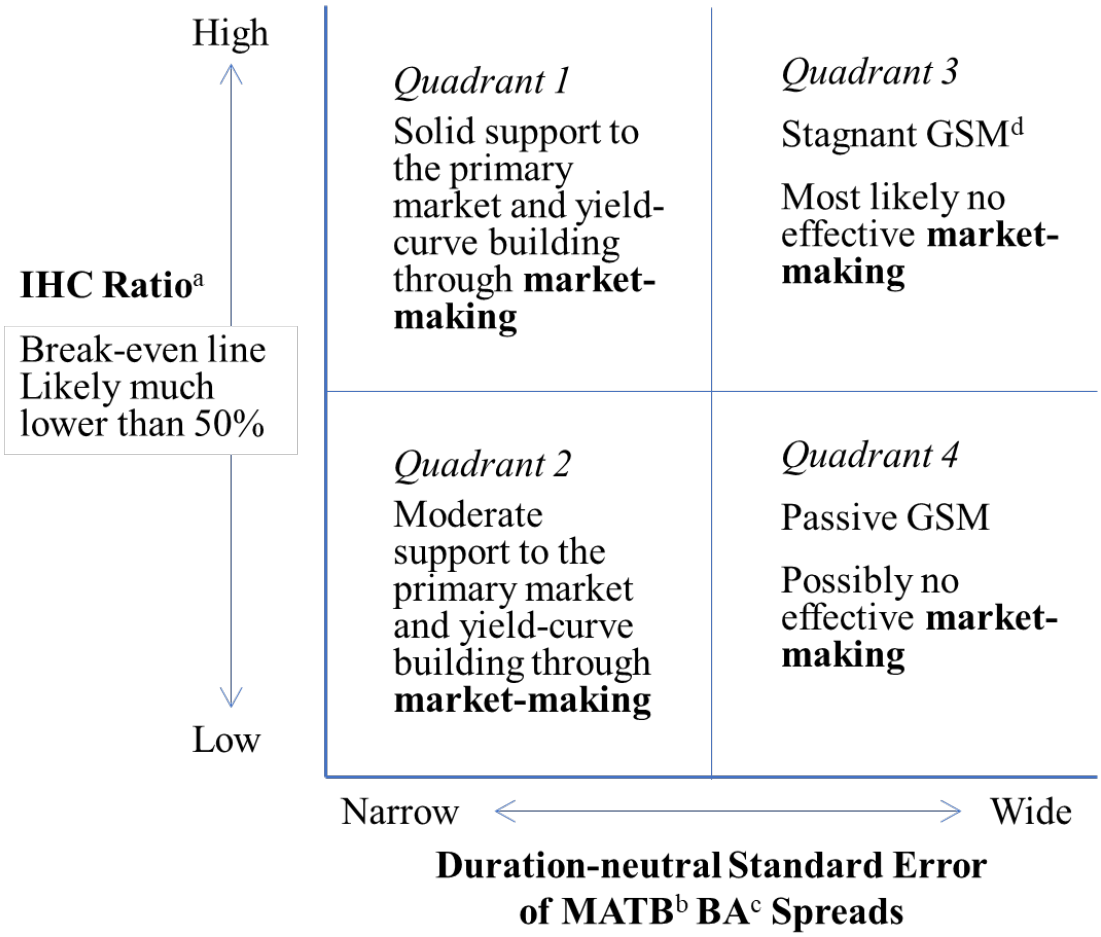
Source: The Author's calculation and drawing from Bloomberg data

Figure 3-16: Duration-neutral Average BA Spreads to Log IHC Ratios



Source: The Author's calculation and drawing from Bloomberg data

Figure 3-17: Quadrant-Matrix of Standard Errors and IHC Ratios of BA Spreads for Differentiating Market-Making



a – Inventory-holding Cost Ratio, b – Most actively traded bond, c- Bid-ask, and d- government securities market
Source: The Author

Tables

Table 3-1: World Bank Classifications of Low-Income Economies (LIEs) and Lower-Middle Income Economies (LMEs)

LIEs (31)	LMEs (47)	
Afghanistan	Angola	Sri Lanka*
Benin	Bangladesh	World Bank categorized Sri Lanka as an LME when this work collected the market data in May 2019 and has recategorized the country as an "upper-middle-income economy" (UME) since July 2019.
Burkina Faso	Bhutan	
Burundi	Bolivia	
Central African Republic	Cabo Verde	
Chad	Cambodia	
Congo, Dem. Rep	Cameroon	
Eritrea	Comoros	
Ethiopia	Congo, Rep.	
Gambia, The	Côte d'Ivoire	
Guinea	Djibouti	
Guinea-Bissau	Egypt*	
Haiti	El Salvador	
Korea, Dem. People's Rep.	Eswatini	
Liberia	Ghana*	* The eleven observed and analyzed in this work.
Madagascar	Honduras	
Malawi	India*	
Mali	Indonesia*	
Mozambique	Kenya*	
Nepal	Kiribati	
Niger	Kyrgyz Republic	
Rwanda	Laos	
Sierra Leone	Lesotho	
Somalia	Mauritania	
South Sudan	Micronesia	
Syrian Arab Republic	Moldova	
Tajikistan	Mongolia	
Tanzania	Morocco*	
Togo	Myanmar	
Uganda	Nicaragua*	
Yemen, Rep.	Nigeria*	
	Pakistan *	
	Papua New Guinea	
	Philippines*	
	São Tomé and Principe	
	Senegal	

	Solomon Islands
	Sudan
	Timor-Leste
	Tunisia
	Ukraine*
	Uzbekistan
	Vanuatu
	Vietnam*
	West Bank and Gaza
	Zambia
	Zimbabwe

Source: World Bank. Retrieved on February 22, 2020, from https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

Table 3-2: The Most Actively Traded Bonds (MATBs) in Lower-Income Economies as of November 30, 2019, or for the period from September 1 to November 30, 2019

	Government Securities Market			**Most-Actively Traded Bond Issue (or substitute)**				
	Number of Govt Bond Issues (a)	Number of Trades (b)	Number of Primary Dealers (c)	Ticker Symbols (d)	Years to Maturity (e)	Number of Trades (f)	Trade share (g) = f/b	Ave. Number of Daily Trades (h) = f/22
Egypt	48	856	16	EGYGB 16.1 05/07/29	9.67	124	14.5%	1.9
Ghana	27	289	13	GHGB 18.25 09/21/20	1.05	33	11.4%	0.5
India	264	171,324	21	IGB 7.26 01/14/29	9.36	81,224	47.4%	1,249.6
Indonesia	42	39,709	10	INDOGB 7.375 05/15/48	28.69	4,528	11.4%	69.7
Kenya	46	6,195	N.A.	KENGB 11.517 08/06/29	9.92	194	3.1%	3.0
Morocco	40	358	9*	MORGB 2.6 03/15/21	1.51	57	15.9%	0.9
Nigeria	18	5,454	13	NIGB 14.8 04/26/49	29.64	1,292	23.7%	19.9
Pakistan	13	366	11	PAKGB 7.25 07/12/21	1.38	223	60.9%	3.4
Philippines	69	15,130	10	RPGB 6.25 03/12/24	4.52	1,494	9.9%	23.0
Sri Lanka	35	2,679	15	SRILGB 9.85 09/15/24	5.01	573	21.4%	8.8
Ukraine	1	9	10	UKRGB 14.64 06/10/20	0.77	7	77.8%	0.1
Vietnam	112	11,464	14	VIETGB 5.1 01/03/29	9.33	3,331	29.1%	51.2

Notes: All the data are as of the end of November 2019, or for the period from September 1 to November 30, 2019, as the case may be. * According to the Clearing Corporation of India Limited, the Government of India had 83 regular issues or odd issues as of the end of November 2019 (Table 3 *CCIL*, 2019a). ** Not confirmed.
Source: The Author's calculation from the data of Bloomberg MOSB and Websites of governments and central banks.

Table 3-3:Government Securities Markets in High-Income Economies as of November 30, 2019, or for the period from September 1 to November 30, 2019

	Govt Securities Market			Most-Actively Traded Bond Issue (or substitute)						
	Selected for Comparison (*)	Nmbr of Govt Bnd Issues	Nmbr of Trades	Ticker Symbols	Years to Maturity	Market	Currency	Nmbr of Trades	Trade share	Ave. Nmbr of Daily Trades
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(f)	(g) = f/d	(h) = f/65
Australia	*	165	1724	ACGBET 4.75 04/21/27	7.63	Domestic	Domestic (AUD)	203	11.8%	3.1
Austria		23	446	RAGB 0 ½ 02/20/29	9.46	Domestic	Domestic (EUR)	153	34.3%	2.4
	*	177	33,336	RAGB 0 ¾ 02/20/28	8.46	Euro	Domestic (EUR)	794	2.4%	12.2
Canada	*	46	179,283	CAN 2.75 12/01/48	29.24	Domestic	Domestic (CAD)	23,827	13.3%	366.6
Chile	*	30	12,441	BTPCL 4.5 03/01/26	6.49	Domestic	Domestic (CPL)	2,196	17.7%	33.8
Czech		15	156	CZGB 2 10/13/33	14.19	Domestic	Domestic (CZK)	38	24.4%	0.6
	*	97	14,192	CZGB 3.85 09/29/21	2.07	Euro	Domestic (CZK)	933	6.6%	14.4
Denmark		4	20	DGB 4 ½ 11/15/39	20.28	Domestic	Domestic (DKK)	14	70.0%	0.2
	*	163	12,215	DGB 3 11/15/21	2.20	Euro	Domestic (DKK)	718	5.9%	11.0
Germany	*	69	22,724	GGB 4.2 01/30/42	22.41	Domestic	Domestic (EUR)	1,561	6.9%	24.0
Hong		4	32	HKGB 2.31 06/21/21[a]	1.80	Domestic	Domestic (HKD)	15	46.9%	0.2
Kong		110	22,157	HKGB 4.85 06/27/17[b]	-2.19	Taiwan	Domestic (HKD)	14,220	64.2%	218.8
Hungary		20	665	HGB 7 06/24/22 22/A	2.80	Domestic	Domestic (HUF)	67	10.1%	1.0
	*	69	17,032	HGB 3 ¼ 10/22/31 31/A	12.13	Euro	Domestic (HUF)	909	5.3%	14.0
Israel	*	9	140,045	ILGOV 5.5 01/31/42	22.41	Domestic	Domestic (ILS)	25,905	18.5%	398.5
Italy		11	10,513	ITALY 5 ⅜ 06/15/33	13.78	Domestic	USD	6,263	59.6%	96.4
	*	50	3,585	ITALY 5.2 07/31/34	14.90	Euro	Domestic (EUR)	1,535	42.8%	23.6
New		2	11	NZGB 6 05/15/21	1.69	Domestic	Domestic (NZD)	7	63.6%	0.1
Zealand	*	40	11,225	NZGB 6 05/15/21	1.69	Euro	Domestic (NZD)	915	8.2%	14.1
Norway		14	1,065	NGB 3 ¾ 05/25/21	1.72	Domestic	Domestic (NOK)	181	17.0%	2.8
	*	33	13,127	NGB 3 ¾ 05/25/21	1.72	Euro	Domestic (NOK)	1,096	8.3%	16.9
Poland		57	4,481	POLGB 2 ¾ 10/25/29	10.14	Domestic	Domestic (PLN)	355	7.9%	5.5
	*	49	20,954	POLGB 2 ½ 07/25/27	7.89	Euro	Domestic (PLN)	914	4.4%	14.1
Portugal		28	2,511	PGB 1.95 06/15/29	9.78	Domestic	Domestic (EUR)	439	17.5%	6.8
	*	37	33,073	PGB 2.125 10/17/28	9.12	Euro	Domestic (EUR)	1,627	4.9%	25.0
Saudi	*	39	48	KSASUK 4.64 04/24/49	29.64	Domestic	Domestic (SAR)	11	22.9%	0.2
Arabia		51	18,615	KSA 4 ½ 10/26/46	27.14	Euro	USD	772	4.1%	11.9
Singapore		25	1,864	SIGB 2.875 07/01/29	9.82	Domestic	Domestic (SGD)	154	8.3%	2.4
	*	48	22,403	SIGB 3 ⅛ 09/01/22	2.99	Euro	Domestic (SGD)	1,046	4.7%	16.1
South Korea	*	197	420,884	KTB 1.625 06/10/22	2.77	Domestic	Domestic (KRW)	61,299	14.6%	943.1
Spain		88	4,864	SPGB 0.6 10/31/29	10.16	Domestic	Domestic (EUR)	749	15.4%	11.5
	*	317	102,086	SPGB 1.4 07/30/28	8.90	Euro	Domestic (EUR)	1,682	1.6%	25.9
Sweden		13	24,709	SGB 2 ¼ 06/01/32 #1056	12.74	Domestic	Domestic (SEK)	1,369	5.5%	21.1
		37	12,403	SGB 3 ½ 06/01/22 #1054	2.74	Euro	Domestic (SEK)	717	5.8%	11.0
	*	3	343,805	SGB 2 ¼ 06/01/32	19.57	UK	Domestic (SEK)	127,611	37.1%	1963.2
Taiwan		25	7,010	TGB 0.625 06/26/29[c]	9.81	Domestic	Domestic (TWD)	1,110	15.8%	17.1
UK	*	42	5,767	UKT 1 ¼ 07/22/27[d]	7.88	Domestic	Domestic (GBP)	441	7.6%	6.8
		130	62,066	UKT 8 06/07/21[e]	1.76	Euro	Domestic (GBP)	916	1.5%	14.1

Notes: a. No historical prices available; b. Matured; c. No historical prices available; d. The second MOSB, the first MOSB negative yield; e. The first to seventh MOSBs negative yields and unusual quotes

Source: The Author's calculation from Bloomberg MOSB data

Table 3-4:BA Spread Deviations Adjusted for Modified Durations

	Most Actively Traded Issues or substitutes	**SD Daily returns (%)**	Coupon	Maturity Date	Trade Date (assumed)	Settlement Date (T+2)	Adjustment for Duration: Maturity	Mid Price 09/03/19	Yield	Cpn Payment	Day Count	M. Duration (yrs)	**SD/M.Dur (%)**
LMEs													
Egypt	EGYGB 16.1 05/07/29	0.058510	16.100	5/7/2029	9/2/2019	9/4/2019	9.67	106.466	14.809	2	1	4.749	0.01232
Ghana	GHGB 18.25 09/21/20	0.013650	18.250	9/21/2020	9/2/2019	9/4/2019	1.05	99.107	19.180	2	1	0.843	0.01620
India	IGB 7.26 01/14/29	0.040840	7.260	1/14/2029	9/3/2019	9/5/2019	9.36	105.113	6.519	2	4	6.734	0.00607
Indonesia	INDOGB 7.375 05/15/48	0.050980	7.375	5/15/2048	9/4/2019	9/6/2019	28.69	93.152	7.593	2	1	11.410	0.00447
Kenya	KENGB 11.517 08/06/29	0.073370	11.517	8/6/2029	9/2/2019	9/4/2019	9.92	100.016	11.550	2	1	5.770	0.01272
Morocco	MORGB 2.6 03/15/21		2.600	3/15/2021	9/6/2019	9/10/2019	1.51	100.137	2.707	1	1	1.446	0.00000
Nigeria	NIGB 14.8 04/26/49		14.800	4/26/2049	9/2/2019	9/4/2019	29.64	101.550	10.000	2	3	8.785	0.00000
Pakistan	PAKGB 7.25 07/12/21		7.250	7/12/2021	2/20/2020	2/24/2020	1.38	95.529	12.110	2	1	1.252	0.00000
Philippines	RPGB 6.25 03/12/24	0.052140	6.250	3/12/2024	9/2/2019	9/4/2019	4.52	108.736	5.600	4	4	3.874	0.01346
Sri Lanka	SRILGB 9.85 09/15/24	0.052140	9.850	9/15/2024	9/9/2019	9/11/2019	5.01	99.787	10.980	2	1	3.655	0.01427
Ukraine	UKRGB 14.64 06/10/20		14.640	6/10/2020	9/2/2019	9/4/2019	0.77		--	2	3		
Vietnam4	VIETGB 5.1 01/03/29	0.078130	5.100	1/3/2029	9/3/2019	9/5/2019	9.33	107.598	3.400	1	1	7.298	0.01071
												LMEs Av	**0.00795**
HIEs													
Australia	ACGBET 4.75 04/21/27	0.034520	4.750	4/21/2027	9/2/2019	9/4/2019	7.63	130.837	0.607	2	1	6.550	0.00527
Austria	RAGB 1 ½ 02/20/47	0.028190	1.500	2/20/2047	9/2/2019	9/4/2019	27.46	135.844	0.164	1	1	23.337	0.00121
Canada	CAN 2.75 12/01/48	0.097810	2.750	12/1/2048	9/2/2019	9/4/2019	29.24	131.569	1.426	2	1	21.309	0.00459
Chile	BTPCL 4.5 03/01/26	0.054430	4.500	3/1/2026	9/2/2019	9/4/2019	6.49	112.013	2.485	2	3	5.681	0.00958
Czech	CZGB 3.85 09/29/21	0.006810	3.850	9/29/2021	9/2/2019	9/4/2019	2.07	105.815	1.002	1	4	1.945	0.00350
Denmark	DGB 3 11/15/21	0.004460	3.000	11/15/2021	9/2/2019	9/4/2019	2.20	108.801	-0.956	1	1	#NUM!	
Germany	GGB 4.2 01/30/42	0.068850	4.200	1/30/2042	9/2/2019	9/4/2019	22.41	128.909	2.506	1	1	15.228	0.00452
Hong Kong	HKGB 4.85 06/27/17		4.850	6/27/2017						2	3		
Hungary	HGB 3 ¼ 10/22/31 31/A	0.068350	3.250	10/22/2031	9/2/2019	9/4/2019	12.13	113.031	2.032	1	1	9.899	0.00690
Israel2	ILGOV 5.5 01/31/42	0.089670	5.500	1/31/2042	9/2/2019	9/4/2019	22.41	169.729	1.732	1	3	15.026	0.00597
Italy-EUR	ITALY 5.2 07/31/34	0.079450	5.200	7/31/2034	9/2/2019	9/4/2019	14.90	145.877	1.702	1	1	11.288	0.00704
New Zealand	NZGB 6 05/15/21	0.006540	6.050	5/15/2021	9/2/2019	9/4/2019	1.69	108.785	0.822	2	1	1.607	0.00407
Norway	NGB 3 ¾ 05/25/21	0.005130	3.750	5/25/2021	9/2/2019	9/4/2019	1.72	104.474	1.120	1	3	1.667	0.00308
Poland	POLGB 2 ½ 07/25/27	0.036120	2.500	7/25/2027	9/2/2019	9/4/2019	7.89	105.177	1.793	1	1	7.129	0.00507
Portugal	PGB 2.125 10/17/28	0.034200	2.125	10/17/2028	9/2/2019	9/4/2019	9.12	118.759	0.061	1	1	8.321	0.00411
Saudi Arabia	KSASUK 4.64 04/24/49	0.154010	4.640	4/24/2049	9/2/2019	9/4/2019	29.64	112.550	3.920	2	0	16.592	0.00928
Singapore	SIGB 3 ⅛ 09/01/22	0.009570	2.875	9/1/2022	9/2/2019	9/4/2019	2.99	104.370	1.379	2	1	2.870	0.00333
South Korea	KTB 1.625 06/10/22	0.014370	1.625	6/10/2022	9/2/2019	9/4/2019	2.77	101.476	1.082	2	1	2.691	0.00534
Spain	SPGB 1.4 07/30/28	0.034290	1.400	7/30/2028	9/2/2019	9/4/2019	8.90	112.272	0.020	1	1	8.452	0.00406
Sweden	SGB 3 ½ 03/30/39 #1053	0.046080	3.500	3/30/2039	9/2/2019	9/4/2019	19.57	166.676	0.069	1	4	15.625	0.00295
Taiwan	TGB 0.625 06/26/29	0.016230	0.625	6/26/2029	9/2/2019	9/4/2019	9.81	99.849	0.641	1	1	9.473	0.00171
UK	UKT 1 ¼ 07/22/27	0.036900	2.070	7/22/2027	9/2/2019	9/4/2019	7.88	107.560	1.067	2	1	7.282	0.00507
												HIEs Av	**0.00483**

Source: The Author's calculation from Bloomberg MOSB data

Table 3-5: Results of Shapiro-Wilk W Tests for Normality

	BA Spreads					Log Returns				
	Obs	W	V	z	Prob>z	Obs	W	V	z	Prob>z
LMEs										
Egypt	142	0.707	32.575	7.875	0.000	141	0.488	56.487	9.116	0.000
Ghana	248	0.807	34.841	8.258	0.000	247	0.534	83.690	10.294	0.000
India	213	0.442	88.009	10.335	0.000	212	0.985	2.381	2.002	0.023
Indonesia	176	0.847	20.453	6.899	0.000	175	0.715	37.807	8.301	0.000
Kenya	75	0.773	14.802	5.883	0.000	74	0.509	31.605	7.533	0.000
Pakistan	60	0.642	19.463	6.398	0.000	59	0.545	24.423	6.881	0.000
The Philippines	155	0.977	2.715	2.268	0.012	154	0.912	10.444	5.326	0.000
Sri Lanka	57	0.723	14.457	5.741	0.000	56	0.703	15.292	5.855	0.000
Vietnam	228	0.248	125.869	11.199	0.000	227	0.570	71.728	9.894	0.000
HIEs										
Australia	251	0.649	63.859	9.673	0.000	250	0.552	81.232	10.231	0.000
Austria	261	0.986	2.683	2.301	0.011	260	0.987	2.421	2.061	0.020
Canada	261	0.953	8.889	5.094	0.000	260	0.991	1.707	1.247	*0.106
Chile	239	0.486	89.673	10.438	0.000	238	0.609	67.853	9.788	0.000
Czech	258	0.833	31.152	8.013	0.000	257	0.907	17.289	6.640	0.000
Denmark	261	0.956	8.224	4.913	0.000	260	0.938	11.624	5.718	0.000
Germany	260	0.879	22.673	7.276	0.000	259	0.923	14.336	6.206	0.000
Hungary	260	0.932	12.722	5.929	0.000	259	0.991	1.764	1.322	*0.093
Israel	203	0.832	25.441	7.452	0.000	202	0.810	28.610	7.720	0.000
Italy	255	0.937	11.671	5.722	0.000	254	0.974	4.869	3.686	0.000
New Zealand	249	0.946	9.765	5.301	0.000	248	0.906	16.851	6.569	0.000
Norway	261	0.907	17.431	6.664	0.000	260	0.899	18.937	6.856	0.000
Poland	256	0.883	21.699	7.168	0.000	255	0.969	5.725	4.064	0.000
Portugal	261	0.893	20.112	6.998	0.000	260	0.996	0.805	-0.506	*0.694
Saudi Arabia	154	0.870	15.469	6.218	0.000	153	0.383	72.983	9.736	0.000
Singapore	261	0.879	22.743	7.284	0.000	260	0.988	2.299	1.941	0.026
South Korea	97	0.520	38.613	8.092	0.000	96	0.962	3.039	2.460	0.007
Spain	261	0.909	17.119	6.622	0.000	260	0.989	2.002	1.618	*0.053
Sweden	260	0.979	3.874	3.157	0.001	259	0.971	5.449	3.952	0.000
Taiwan	123	0.744	25.150	7.235	0.000	122	0.981	1.862	1.394	*0.082
United Kingdom	261	0.913	16.361	6.516	0.000	260	0.990	1.913	1.513	*0.065

Note: (1) The above tests are on MATBs listed in Table 2 and Table 3. (2) * indicates the acceptance of the null hypothesis that variables are normally distributed.
Source: The Author's calculation from Bloomberg MOSB data.

Table 3-6: Results of Autocorrelation Tests and Robust Standard Errors for BA Spreads

	Tests for Autocorrelation					Standard Errors				
							Newey-West Reg.			Robust
	Durbin-Watson d-statistic	Durbin's alternative test	Breusch-Godfrey LM test	Correlogram 0.05 > p	Auto- or Nonauto-correlated	Ordinary Reg. (%)	Lag (0) (%)	Lag(1) (%)	Lag(5) (%)	Standard Errors (%)
LMEs										
Egypt	0.428	0.000	0.000	Lags1-10	AC	0.0573	0.0719	0.0965	0.1513	0.1513
Ghana	0.064	0.000	0.000	Lags1-10	AC	0.0317	0.0516	0.0718	0.1179	0.1179
India	1.479	0.000	0.000	Lags1-10	AC	0.0047	0.0081	0.0091	0.0105	0.0105
Indonesia	0.535	0.000	0.000	Lags1-10	AC	0.0521	0.0689	0.0907	0.1452	0.1452
Kenya	0.344	0.000	0.000	Lags1-10	AC	0.0611	0.0884	0.1160	0.1561	0.1561
Morocco					AC					
Nigeria					AC					
Pakistan					AC					
Philippines	0.629	0.000	0.000	Lags1-10	AC	0.0260	0.0242	0.0305	0.0445	0.0445
Sri Lanka	0.261	0.000	0.000	Lags1-10	AC	0.1368	0.1513	0.2053	0.3042	0.3042
Ukraine					AC					
Vietnam	2.037	0.780	0.778	Nil.	NAC	0.0124	0.0233	0.0230	0.0218	0.0124
HIEs										
Australia	0.038	0.000	0.000	Lags1-10	AC	0.1622	0.1214	0.1707	0.2913	0.2913
Austria	0.939	0.000	0.000	Lags1-10	AC	0.0088	0.0098	0.0126	0.0183	0.0183
Canada	1.309	0.000	0.001	Lags1-10	AC	0.0014	0.0013	0.0016	0.0024	0.0024
Chile	2.0204	0.871	0.870	Nil.	NAC	0.0090	0.0081	0.0082	0.0096	0.0090
Czech	0.810	0.000	0.000	Lags1-10	AC	0.0151	0.0128	0.0162	0.0246	0.0246
Denmark	1.288	0.000	0.000	Lags1-10	AC	0.0019	0.0017	0.0021	0.0030	0.0030
Germany	0.805	0.000	0.000	Lags1-10	AC	0.0229	0.0269	0.0351	0.0508	0.0508
Hong Kong										
Hungary	0.965	0.000	0.000	Lags1-10	AC	0.0215	0.0254	0.0328	0.0515	0.0515
Israel	1.035	0.000	0.000	Lags1-10	AC	0.0043	0.0043	0.0047	0.0059	0.0059
Italy	1.312	0.000	0.000	Lags1-10	AC	0.0152	0.0108	0.0129	0.0182	0.0182
New Zealand	1.312	0.000	0.000	Lags1-10	AC	0.0006	0.0008	0.0009	0.0011	0.0011
Norway	1.727	0.031	0.032	Lags1-4 & 6-10	AC	0.0020	0.0022	0.0024	0.0026	0.0026
Poland	0.143	0.000	0.000	Lags1-10	AC	0.0026	0.0018	0.0025	0.0042	0.0042
Portugal	0.699	0.000	0.000	Lags1-10	AC	0.0032	0.0040	0.0052	0.0082	0.0082
Saudi Arabia	0.259	0.000	0.000	Lags1-10	AC	0.1513	0.1326	0.1837	0.2996	0.2996
Singapore	0.709	0.000	0.000	Lags1-10	AC	0.0037	0.0036	0.0041	0.0056	0.0056
South Korea	1.641	0.078	0.078	Lag 1	NAC	0.0074	0.0075	0.0087	0.0102	0.0074
Spain	1.389	0.000	0.000	Lags1-10	AC	0.0023	0.0018	0.0023	0.0031	0.0031
Sweden	1.295	0.000	0.000	Lags1-10	AC	0.0131	0.0127	0.0144	0.0187	0.0187
Taiwan	0.960	0.000	0.000	Lags1-10	AC	0.0097	0.0058	0.0073	0.0106	0.0106
UK	1.188	0.000	0.000	Lags1-10	AC	0.0016	0.0015	0.0018	0.0023	0.0023

Note: Morocco, Kenya, Pakistan, and Hong Kong have no data available for this analysis.

Source: The Author's calculation from Bloomberg MOSB data

Table 3-7: Results of Autocorrelation Tests and Robust Standard Errors for Returns

	Tests for Autocorrelation					Standard Errors				
							Newey-West Reg.			**Robust**
	Durbin-Watson d-statistic	Durbin's alternative test	Breusch-Godfrey LM test	Correlogram 0.05 > p	Auto- or Nonauto-correlated	Ordinary Reg. (%)	Lag (0) (%)	Lag(1) (%)	Lag(5) (%)	**Standard Errors (%)**
LMEs										
Egypt	2.630	0.000	0.000	Lags 1-9	AC	0.1029	0.1289	0.0959	0.0585	0.1289
Ghana	2.402	0.001	0.002	Lags 1-5	AC	0.0271	0.0169	0.0156	0.0137	0.0169
India	2.204	0.127	0.127	Nil	NAC	0.0408	0.0322	0.0308	0.0272	0.0408
Indonesia	1.667	0.033	0.034	Lags 1, 3, 4 & 5	AC	0.0701	0.0479	0.0504	0.0510	0.0510
Kenya	1.582	0.000	0.000	Lags 1-10	AC	0.1116	0.0968	0.0734	0.0734	0.0968
Morocco										
Nigeria										
Pakistan										
Philippines	1.269	0.009	0.010	Lags 1-6	AC	0.0352	0.0406	0.0461	0.0521	0.0521
Sri Lanka	1.342	0.011	0.014	Lags 1-2	AC	0.0352	0.0719	0.0805	0.0521	0.0805
Ukraine						0.0000	0.0000	0.0000	0.0000	0.0000
Vietnam	2.246	0.001	0.001	Lags 1-10	AC	0.0597	0.0906	0.0840	0.0781	0.0906
HIEs										
Australia	2.510	0.000	0.000	Lags 1-8	AC	0.0992	0.0361	0.0363	0.0345	0.0363
Austria	2.101	0.417	0.415	Nil	NAC	0.0282	0.0000	0.0000	0.0217	0.0282
Canada	1.862	0.282	0.280	Nil	NAC	0.0978	0.0000	0.0000	0.0837	0.0978
Chile	2.149	0.246	0.245	Nil	NAC	0.0544	0.0000	0.0000	0.0365	0.0544
Czech	2.121	0.311	0.310	Lags 2-10	NAC	0.0068	0.0000	0.0000	0.0059	0.0068
Denmark	2.273	0.027	0.028	Lag 1	NAC	0.0045	0.0000	0.0000	0.0035	0.0045
Germany	1.498	0.000	0.000	Lags 1-10	AC	0.0819	0.0539	0.0597	0.0689	0.0689
Hong Kong					AC					
Hungary	1.757	0.072	0.072	Lags 2, 6-8	NAC	0.0684	0.0621	0.0634	0.0623	0.0634
Israel	1.977	0.874	0.873	Nil	NAC	0.0897	0.0000	0.0000	0.0825	0.0897
Italy	1.885	0.377	0.375	0.3751	NAC	0.0795	0.0000	0.0000	0.0719	0.0795
New Zealand	2.133	0.288	0.286	Nil	NAC	0.0065	0.0000	0.0000	0.0058	0.0065
Norway	1.507	0.000	0.000	Lags 1-10	AC	0.0043	0.0042	0.0048	0.0051	0.0051
Poland	1.774	0.071	0.071	Nil	NAC	0.0361	0.0000	0.0000	0.0294	0.0361
Portugal	1.904	0.442	0.439	Nil	NAC	0.0342	0.0000	0.0000	0.0331	0.0342
Saudi Arabia	2.084	0.606	0.603	Nil	NAC	0.1540	0.0000	0.0000	0.2421	0.1540
Singapore	1.694	0.021	0.022	Lags 1-3	AC	0.0079	0.0093	0.0101	0.0096	0.0101
South Korea	1.714	0.192	0.189	Lags 7-10	NAC	0.0144	0.0000	0.0000	0.0150	0.0144
Spain	2.039	0.753	0.752	Nil	NAC	0.0343	0.0000	0.0000	0.0282	0.0343
Sweden	1.676	0.009	0.010	Lags 1-3	AC	0.0587	0.0454	0.0489	0.0461	0.0489
Taiwan	2.324	0.073	0.073	Nil	NAC	0.0162	0.0000	0.0000	0.0180	0.0162
UK	2.090	0.433	0.430	Nil	NAC	0.0369	0.0000	0.0000	0.0304	0.0369

Note: Morocco, Pakistan, Ukraine, and Hong Kong have no data available for this analysis.

Source: The Author's calculation from Bloomberg MOSB data

Table 3-8: Inventory-Holding Cost Ratios (IHC Ratios) of MATBs

	Number of obser-vations (a)	Ave. BA spread (b)	SD of log daily returns (%) (c)	Per-day IHC (ρ =1.00) (%) (d) = 2ρc	Number of daily ave. trades (e)	Liquidity factor κ (f) = √ 1/e	Per-trade IHC (%) (g) = d*f	BA spread net of IHC (%) (h) = d-g	IHC Ratio (i)=g/d
LMEs									
Egypt	124	0.758	1.530	3.061	1.91	0.724	2.216	-1.459	293%
Ghana	33	0.984	0.266	0.531	0.51	1.403	0.746	0.238	76%
India	81,224	0.024	0.595	1.189	1,249.60	0.028	0.034	-0.009	138%
Indonesia	4,528	0.932	0.674	1.349	69.66	0.120	0.162	0.770	17%
Kenya	194	0.635	0.832	1.665	2.98	0.579	0.964	-0.329	152%
Morocco	57	-	-	-	0.88	1.068	-	-	-
Nigeria	1,292	-	-	-	19.88	0.224	-	-	-
Pakistan	223	1.634	-	-	3.43	0.540	-	1.634	-
Philippines	1,494	0.434	0.690	1.379	22.98	0.209	0.288	0.146	
Sri Lanka	573	0.761	0.602	1.205	8.82	0.337	0.406	0.355	53%
Ukraine	7		0.000	-	0.11	3.047	-	-	-
Vietnam	3,331	1.590	1.364	2.729	51.25	0.140	0.381	1.209	24%
HIEs									
Australia	203	1.105	0.573	1.147	3.12	0.566	0.649	0.456	59%
Austria	794	0.350	0.455	0.909	12.22	0.286	0.260	0.090	74%
Canada	23,827	0.086	1.577	3.154	366.57	0.052	0.165	-0.079	191%
Chile	2,196	0.184	0.840	1.679	33.78	0.172	0.289	-0.105	157%
Czech	933	0.370	0.109	0.218	14.35	0.264	0.058	0.313	16%
Denmark	718	0.097	0.072	0.144	11.05	0.301	0.043	0.054	45%
Germany	1,561	0.566	1.108	2.216	24.02	0.204	0.452	0.114	80%
Hong Kong	-	0.000	-	0.000	-	-	0.000	0.000	-
Hungary	909	0.909	1.100	2.200	13.98	0.267	0.588	0.321	65%
Israel	25,905	0.291	1.274	2.549	398.54	0.050	0.128	0.163	44%
Italy	1,535	1.650	1.266	2.532	23.62	0.206	0.521	1.129	32%
New Zealand	915	0.011	0.103	0.206	14.08	0.267	0.055	-0.044	504%
Norway	1,096	0.107	0.083	0.165	16.86	0.244	0.040	0.067	38%
Poland	914	0.130	0.577	1.154	14.06	0.267	0.308	-0.177	236%
Portugal	1,627	0.088	0.551	1.103	25.03	0.200	0.220	-0.133	251%
Saudi Arabia	11	3.494	1.905	3.810	0.17	2.431	9.262	-5.768	265%
Singapore	1,046	0.100	0.162	0.325	16.09	0.249	0.081	0.019	81%
South Korea	61,299	0.075	0.141	0.282	943.06	0.033	0.009	0.066	12%
Spain	1,682	0.063	0.553	1.106	25.88	0.197	0.217	-0.154	345%
Sweden	127,611	1.059	0.788	1.577	1,963.25	0.023	0.036	1.023	3%
Taiwan	1,110	-	0.179	0.359	17.08	0.242	0.087	-0.087	-
UK	1,074	0.064	0.595	1.190	16.52	0.246	0.293	-0.229	460%

Notes: The time range of data is from December 1, 2018 to November 30, 2019 or a shorter period if the shortage is reasonable and long enough for statistical processing. The minimum time range is 57 trading days for Sri Lanka. Morocco, Nigeria, Pakistan, Ukraine, Hong Kong, and Taiwan do not have the data sets necessary for IHC Ratio calculation.

* Only the central bank makes a market with no spread

Source: The Author's calculation from Bloomberg MOSB data

Table 3-9: Simulations of IHC Ratios

Indonesia

IHC Ratios		Initial Fixed-cost Share				
		20%	40%	60%	80%	100%
Multiples of the Current Trade Numbers	1	17%	17%	17%	17%	17%
	5	9%	11%	15%	22%	39%
	10	7%	9%	12%	20%	55%
	15	6%	7%	10%	18%	67%
	20	5%	6%	9%	16%	78%

Source: The Author's calculation from Bloomberg MOSB data

Vietnam

IHC Ratios		Initial Fixed-cost Share				
		20%	40%	60%	80%	100%
Multiples of the Current Trade Numbers	1	24%	24%	24%	24%	24%
	5	13%	16%	21%	30%	54%
	10	9%	12%	16%	27%	76%
	15	8%	10%	14%	24%	93%
	20	7%	9%	12%	22%	107%

Source: The Author's calculation from Bloomberg MOSB data

Appendix A

Derivation of Adverse-selection cost Model

Assume that the terminal value v of a stock has a binary distribution, taking v^H and v^L at time *t-1* with probabilities θ_{t-1} and $1-\theta_{t-1}$, respectively. Denote ask, bid, and mid-quote at time *t* as a_t, b_t, and μ_{t-1}, respectively, and informed traders' share in trading as π. Market-making dealers lose to better informed traders but gain from uninformed traders. The gains and the losses have to be balanced for the market-making to be sustainable. Then, the balances with respect to a_t and b_t are expressed as follows:

$$\pi\theta_{t-1}(v^H - a_t) = \frac{1}{2}(1-\pi)\,(a_t - \mu_{t-1})$$

$$\pi(1-\theta_{t-1})(v^L - b_t) = \frac{1}{2}(1-\pi)\,(b_t - \mu_{t-1})$$

Solving these equations for a_t and b_t yields:

$$a_t = \mu_{t-1} + \frac{\pi\theta_{t-1}}{\pi\theta_{t-1} + \frac{1}{2}(1-\pi)}(v^H - \mu_{t-1})$$

$$b_t = \mu_{t-1} + \frac{\pi(1-\theta_{t-1})}{\pi(1-\theta_{t-1}) + \frac{1}{2}(1-\pi)}(v^L - \mu_{t-1})$$

These equations give the bid-ask spread s_{as} as follows:

$$s_{as} = a_t - b_t$$

$$= \pi\theta_{t-1}(1-\theta_{t-1})\left(\frac{1}{\pi\theta_{t-1} + (1-\pi)\frac{1}{2}} + \frac{1}{\pi(1-\theta_{t-1}) + (1-\pi)\frac{1}{2}}\right)(v^H - v^L)$$

Appendix B

Derivatives of Order-Processing and Inventory-Holding Costs

Equations (3.2.5) and (3.4.1) express the per-trade order processing and inventory-holding costs, respectively. Let η be the aggregate order-processing cost $(F^d(\hat{C} - C^a) - \hat{E})) + \hat{G})$ in Equation (3.4.1). Since s_{ih} is smaller than s_{op} for a low-liquid security,

$$2\rho\sigma_d\sqrt{\frac{1}{\lambda}} < \frac{\eta}{\lambda} \tag{B.1}$$

We can rewrite this inequation as follows:

$$\eta > 2\rho\sigma_d\sqrt{\lambda} \tag{B.2}$$

Differentiating Equations (B.1) and (B.2) with respect to λ gives:

$$\frac{d}{d\lambda}S_{op} = -\eta\,\lambda^{-2}\,, \tag{B.3}$$

and,

$$\frac{d}{d\lambda}S_{ih} = -\rho\sigma_d * \lambda^{-\frac{3}{2}}\,. \tag{B.4}$$

We can substitute Inequation (B.2) for Equation (B.3) to obtain:

$$\frac{d}{d\lambda}S_{op} = -\eta\,\lambda^{-2} < -2\rho\sigma_d\sqrt{\lambda} * \lambda^{-2} = -2\rho\sigma_d\lambda^{-\frac{3}{2}} \tag{B.5}$$

By substituting Equation (B.4) for the right term of Inequation (B.5), I obtain:

$$\frac{d}{d\lambda}S_{op} < 2\frac{d}{d\lambda}S_{ih}\,. \tag{D.5}$$

Since both $\frac{d}{d\lambda}S_{op}$ and $2\frac{d}{d\lambda}S_{ih}$ are negative, this inequation (B.5) of the cost components' sensitivities to the spreads indicates that per-trade order-processing costs decline more than

twice as fast as per-trade inventory-holding costs in their ratios to the bid-ask spreads as the trade frequency rate λ (liquidity) increases.

Market-making's commercial viability would be highly sensitive to the risk-averse coefficient (ρ) and the trade frequency rate (λ). In other words, the PD's ability to make a market is subject to a low risk-averseness (opportunistic market-making) or a high disregard for market risk (reckless inventory-holding) and dependent on market liquidity, at least in low-liquid GSMs. The risk-averseness is in line with the non-compliance with the two-way market-making obligation. The models (3.2.5), (3.4.1), and (3.4.5) for the order processing and inventory-holding costs have portrayed the role of liquidity.

4 Endogenous Market Development for Government Securities in Lower-income Economies

4.1 Introduction

The government securities market (GSM) is a core economic infrastructure for modern economic management. Hence, the international development community (IDC), including the World Bank and IMF, established a comprehensive policy framework for GSM development in the early 2000s (the conventional policy framework−CPF) and undertook GSM development initiatives for more than twenty years. However, the results are disappointing for lower-income economies (LIEs).[32] The secondary markets of most LIEs remain illiquid or considerably low liquid. (Endo, 2020) Nonetheless, no efforts have so far been made to review the CPF.

Hence, this research questions if there can be any policy set for GSM development in lower-income economies that is necessary, implementable, and low-cost in a GSM's development phase and if there can be any policy framework to identify and formulate policy sets so that they may fit different development phases. These questions aim at finding a new way for the GSM in a lower-income economy to facilitate and reinforce its macroeconomic and social achievements. In answer to these questions, I propose a “Two-Dimensional Policy Framework for GSM Development" (TDPF) (Table 4-1 and Figure 4-1) to enable the GSM policymaker to focus on endogenous GSM development). In this study, I test the TDPF for its real-world applicability with the Indian GSM’s development path.

Endogenous market development is a way for the GSM policymaker to develop its GSM by actively working on endogenous policy variables. The TDPF is a policy tool for endogenous market development. This alternative framework is phase-differentiated so that facilities policymakers may work on the effective endogenous policy variables. The TDPF divides

[32] For the definitions of low-income economies (LIEs) and lower-middle income economies (LMEs), see Footnote 1.

emerging GSMs into four groups by market development phases (phase-differentiation) and organizes CPF-policies[33] by market components to form a two-dimensional matrix table. The TDPF's phase- and local-fitness helps policymakers and practitioners identify and bundle GSM policies coherently, align deviated GSM policies timely with the rest of phase-coherent policy sets, or adjust an extant policy set without delay to a new economic or social environment

The GSM policymaker's work on endogenous policy variables through the TDPF would be significantly practical, though not perfect, for GSM development. The GSM policymaker needs to manage endogenous policies systematically to ride on favorable environments for successful GSM development. To put it another way, the CPF-policies primarily address endogenous market variables. However, this fact has not been well recognized, and the policies have been left unorganized to meet individual GSMs needs.

In contrast, the CPF was derived primarily from gap analyses between advanced markets and emerging markets. Policy assessors typically compare their target emerging markets with "best practices" or "global standards" to identify gaps as impediments to market development. The gaps tend to be too substantial for LIEs. Nonetheless, they advise their client governments to fulfill or narrow those gaps. Advised governments usually attempt to implement the advice but end up implementing it only halfway. Their GSMs remain illiquid or low-illiquid.

The CPF implicitly conflated GSMs that were in different development phases. As such, inadvertent mismatches between adopted policies and LIE realities have often misled GSM development in LIEs. The blind reliance on a PD system is an example of those mismatches. Many LIEs have PD systems in place, but the systems are barely functioning (Endo, 2020). The phase-differentiated and phase-coherent TDPF would mitigate this kind of mismatch risk.

Testing the TDPF for its practicality can be ex-ante and ex-post. This study assumes that building credibility in the TDPF by ex-post testing with a successful case would be essential to let CPF-trapped LIEs and CPF-obsessed practitioners buy in TDPF-based programs. This is

[33] Policies formulated, advised and implemented under various CPF programs. Most of them are found in World Bank and IMF (2001), World Bank (2007a, 2007b) and the World Bank/IMF's financial sector program documents, such as Financial Sector Assessment Program (FSAP) reports.

because ex-ante testing of the policy framework is its test application over at least several years and requires cooperation from the governments and stakeholders of tested GSMs. Most GSMs in LIEs have been CPF-trapped and unsuccessful in GSM development (Endo, 2020). By contrast, the Indian GSM is a rare successful LIE case and suitable for ex-post testing of the TDPF.

India showcases the effectiveness of phase-fit and locally-fit policies in its early GSM development phases.[34] The introduction of innovative market infrastructure and practical market microstructure (collectively “market structure”) in the early 2000s accentuated the effectiveness of phase-fit and locally-fit market development. The new market structure achieved the "transparency and ease" of trading. India built an integrated market structure electronically linked from order display to settlement with local technology to meet local needs. Before the country began a series of GSM reform initiatives in 2001 (the GSM Reform), the Indian GSM was more like a negotiated market (dealers club market) than an OTC market, though it had PDs. In a negotiated market, a small number of dealers traded over a communication device, such as the phone, for themselves or their customers,[35] though it is locally called an "OTC market." The Reserve Bank of India (RBI) practically refrained from adopting a quote-driven market-making PD system (PD system), which the IDC typically recommends to emerging GSMs. First, the RBI developed a screen-based order-driven trading platform or the Negotiated Dealing System-Order Matching (NDS-OM) in 2005 with local IT technology. Second, the central bank imposed a continuous two-way firm quote (market-making) obligation for order-driven trading on PDs but has left the two-parameter (the spread and volume) obligation not strictly enforced.

Earlier, the RBI organized state-owned financial institutions and private banks to set up the Clearing Corporation of India (CCIL) in 2001, built the Negotiated Dealing System (NDS) in 2002, and assigned its operation to the CCIL. The NDS, equipped with a central counterparty

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[34] For the scarcity of GSM development success among lower-income economies, see Endo (2020) (Chapter 3)

[35] A negotiated market (dealers’ club market) is a small decentralized market. Dealers usually quote prices upon request rather than a priori. They do not make a market. If they quote a priori, the quotes are more occasional than continuous and smore indicative than firm. Dealers agree on prices and other trade terms through negotiation for each deal, subject to market conventions or regulations. Dealers rely on the network of fellow dealers to source information and tradable securities. It may be viewed as an OTC market in the sense that it has no physically centralized marketplace or electronically connected trading platform. (Table 4-1)

(CCP) function, was designed to automate government securities trades' clearing and settlement. The CCIL linked the NDS-OM to the NDS to achieve straight-through processing (STP). These innovative policies and sophisticated market structure enabled the GSM to increase turnover until 2015 (Figure 4-2).

Thus, the South Asian country caught the momentum of its increasingly favorable macroeconomic, fiscal, and monetary settings for GSM development with phase-fit policy sets. The country launched an economic transformation from a socialistic regime to a market-based one in 1991. The factors exogenous to the market became increasingly favorable for India's GSM development by the early 2000s. Then, the country's GSM policymakers did not miss out on those improvements of exogenous factors. Its GDP growth sustained between 5.24 percent and 8.49 percent (except for 3.09 percent in 2008), with an average of 7.09 percent, from 2003 to 2018. The national consensus for fiscal discipline resulted in the Fiscal Responsibility and Budget Management Act of 2003. The country's public debt to GDP peaked off at 84.2 percent in 2003 and stayed between 66.0 percent and 68.8 percent from 2010 to 2018. Since the GSM Reform started in 2001, the inflation rate had been reasonably low before it climbed from 6.7 percent in 2006 to 12.3 percent in 2009. Subsequently, the rate decelerated below 5 percent since 2015 and below 4 percent since 2017.

After its remarkable success in market growth, the initial policy sets have been running out of steam in recent years. For instance, the turnover growth rate appears to have peaked off. Trading in the GSM does not spread out across maturities but concentrates on one or two ten-year issues and the interbank market (Figure 4-15).

A utility is another concept to capture the development of an early-phase market. In the GSM development context, a utility refers to the trader’s or the investor’s preference, or value that the trader or the investor subjectively obtains from trading or a market structure relative to alternatives, regarding trading objects, quantities, qualities, timings, modes, counterparts, and other trading behavior attributes. Its preference criteria inevitably involve non-monetary or psychological values, such as reliability, functionality, and convenience in consuming trading services. It is usually not objectively measurable but subjectively exploitable. This study refers to it as utility value, utility amount, or utility quantity when its measurement matters.

This chapter contributes to local policymakers, academics, and practitioners, including those in the development community. The study’s introduction of phase-differentiation through the

TDPF first reifies the conflated and muddled concept of GSMs into an addressable and analyzable concept. This reification brings a GSM closer to local policymakers. Consequently, policy issues associated with GSMs should become more addressable for LIE governments than before. Second, the study opens a new research theme, GSM development in early-phase markets, for academics. The knowledge gaps regarding the research theme include endogenous causality in scarce resource economies, the properties and effects of utilities, and the interactions between exogenous and endogenous factors. Third, this study provides practitioners, including the development community, with a new perspective and a guideline for program formulation.

The rest of the chapter is structured as follows:[36] Section 4.2 overviews the Indian GSM. Section 4.3 presents a descriptive analysis of the CPF in the light of emerging economies. Section 4.4 lays out the TDPF. Section 4.5 explores the causalities of phase-fit and locally fit policy variables to market development of the Indian GSM. Section 4.6 discusses the TDPF 's implications and India's experience as relates to GSM development in lower-income economies. Section 4.7 concludes this chapter.

4.2 The Indian Market

4.2.1 Primary market

On behalf of the central government or state governments, the RBI issues government securities through auctions and underwriting. In consultation with the central government, the central bank issues indicative half-yearly auction calendars and subsequently updates them with more precise information. Auctions take place for Treasury bills and government bonds on Wednesdays and Fridays, respectively. Accepted bids settle on a T+1 basis. Auctions are open to all investors. Commercial banks, PDs, insurance companies, and other institutions that have funds accounts and securities accounts (Subsidiary General Ledger (SGL) accounts) with the RBI bid on the E-Kuber, that is, the RBI's Core Banking Solution (CBS) platform. Other investors or intermediaries bid through commercial banks or PDs called Aggregators/Facilitators (Fleming, Sareen & Saggar, 2015, 2016; RBI, 2019).

[36] The literature survey of this chapter has moved to Chapter 2.

The central government and state governments have issued a substantial amount of debt. The total government debt outstood at 68.1 percent of the 2018 GDP.[37] Government securities, Treasury bills, and state development loans outstanding amounted to INR[38] 57,913 billion, INR 5,410 billion, and INR 28,158 billion, respectively, at the end of November 2019.[39] They accounted for 28.85 percent, 2.88 percent, 14.40 percent of 2018-19 GDP, respectively. The outstanding balance of state government loans also grew fast (Figure 4-4(2) and Figure 4-6(2)).

4.2.2 Secondary market

The vast majority of the outstanding government securities trade on the NDS-OM. Other trading platforms include the "OTC market"[40] and stock exchange platforms such as BSE Direct[41] and the NSE's Negotiated Trade Reporting Platform[42] and Order Matching Platform[43]. The NDS-OM quickly overtook the "OTC market" from 49.64 percent of trades in 2004-05 to 91.21 percent in 2012-13, and 93.29 percent in 2019-20 (up to November 2019). The outstanding balances grew steadily over the years (Figure 4-4(2) & Figure 4-6(2))). Outright trades increased from 77,060 trades and INR 5,134 billion in 2004-5 to 804,146 trades and INR 93,410 billion in 2018-19 at average compound annual rates of 18.24 percent 23.03 percent, respectively. Meanwhile, the OTC tends to trade larger-sized orders than the NDS-OM. In 2019-20 (up to November 2019), the OTC's average order size was INR 423.9 million compared to INR 113.6 million for the NDS-OM.[44]

The clearing and settlement are secured and efficient in the Indian GSM. The NDS-OM is STP-connected with the NDS. The RBI requires traders to report trades executed on other

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[37] IMF. "total government debt" is "General government gross debt" as IMF defines at https://www.imf.org/external/datamapper/GGXWDG_NGDP@WEO/IND?year=2020

[38] The Indian Rupee. Spot rate: INR 71.73 per USD at the close of November 29, 2019. Retrieved from https://www.rbi.org.in/scripts/WSSView.aspx?Id=23407

[39] Table 5: Outstanding-Government Securities, Treasury Bills, and State Development Loans. (CCIL, 2019a)

[40] See Footnote 35.

[41] https://www.bseIndia.com/static/markets/debt/ncbGsec.html

[42] https://www.nseIndia.com/products/content/debt/wdm/reporting_system.htm

[43] https://www1.nseIndia.com/products/content/equities/slbs/trading.htm

[44] Calculated from the data in Table 27: Trading Platform Analysis of Outright Trades. (CCIL, 2019)

platforms to the NDS in 15 minutes of their execution and clear and settle them on the NDS (RBI, 2015, Articles 8.4 and 15.1).

4.2.3 Primary Dealer System

The RBI introduced PDs in 1996 following auctions for primary issuance that began in 1992. The RBI licensed nine PDs, subject to asset and performance criteria. Since the interest rate reverted upward in 2003-4 after consecutive eight years of decline, severe market losses made most PDs financially unsustainable. They had been highly leveraged. The FRBM Act of 2003 ended the RBI's intervention in auctions and made the issuance of government securities fully market-based in 2006. Subsequently, the RBI strengthened the PD system by reorganizing it under dual business models in 2006: three standalone PDs and ten bank PDs (Rajaram & Ghose, 2015). As of the end of December 2019, the GSM has seven standalone PDs (three foreign-owned PDs and four domestic PDs) and fourteen bank PDs (six foreign banks, three domestic private banks, and five public sector banks).

The PD system in India's primary market is a hybrid of underwriting and competitive bidding. The issuance procedure of government securities is in two steps. First, the RBI sets and announces a "minimum underwriting commitment (MUC)" amount equal to 50 percent of the issue amount or more.[45] The RBI's Master Direction requires each PD to underwrite the MUC amount equally (a twenty-first of the MUC amount, at present). Second, the RBI auctions the remaining amount or additional competitive underwriting (AUC) amount. The Master Direction requires each PD to bid for at least its MUC amount (a twenty-first of the MUC amount) up to thirty percent of the AUC amount and an "underwriting commission" rate for its AUC bid amount. Bidding can be in uniform- or multiple-price form or on a price- or yield basis, as the RBI determines for each issuance. The RBI pays an "underwriting commission" to successful AUC bidders. The RBI also pays the AUC bidders who have won four percent or more of the issue amount a commission on their underwritten MUC amounts at the average rate of auctioned AUC "underwriting commission" rates weighted by accepted AUC bid amounts (RBI, 2019).

In the Evolving Phase, it is often observed that the market regulator does not fully enforce the

[45] Currently, the RBI sets the MUC at 50 percent of the issue amount.

PD’s market-making in the secondary market. Strict enforcement of a two-way firm quote obligation exposes market makers to market risk unmanageable in most emerging markets. The RBI's Master Direction requires each PD to offer two-way firm quotes (market-making) and trade government securities outright annually five times or more than its average month-end stock (RBI, 2019).

India's selective enforcement of the PD’s market-making obligations is sensible and effective in exploiting the primary market and simultaneously activating the secondary market (Endo, 2020). Table 4-2 lists a typical set of PD obligations. The RBI entices PDs into bidding or underwriting with fees and competitive pressures. The central bank enforces the trading volume norm for the secondary market but not the continuous firm bid-ask quoting obligation. PDs' market-making through two-way firm quoting is meant to help non-PD dealers, brokers, and end-investors trade with trading immediacy to meet their diverse needs. However, the Indian financial market was and is bank-centric. The RBI has not enforced the obligation on PDs unnecessarily.

4.3 Conventional Policy Framework (CPF)

The Framework that the World Bank and IMF jointly developed in the early 2000s considerably disseminated knowledge about GSMs to emerging economies. However, its unwitting bias for advanced economies suffered from some shortcomings for GSM development in lower-income economies. Firstly, it fails to differentiate GSMs by macroeconomic settings when working out policies for GSM development. This shortcoming may be called the single-universe problem. Secondly, it fails to distinguish market components (endogenous factors) from fiscal and monetary preconditions (exogenous factors). This shortcoming may be called the indistinction problem. Thirdly, it fails to identify the coherent groups of interconnected market components. That is the incoherence problem. Fourthly, it fails to address dynamic feedback loops of interconnected market development processes. This shortcoming may be called the standalone-component problem**.**

The single-universe problem does not heed the policy's local specificity, such as the level, size, or properties of an economy. Usually, the level of household savings and the market structure dictates the potential of trading volume and market liquidity. The government's limited capacities and resources in an LIE may understandably compel GSM development to

share capacities and resources with many other political, economic, and social objectives. Complex and high-cost market operations and development would be impractical in a lower-income economy.

The indistinction problem does not distinguish endogenous market development issues from exogenous ones. This problem blurs the boundaries of responsibilities among fiscal, monetary, and GSM development authorities. The GSM policymaker for GSM may miss out on market development opportunities.

The incoherence problem likely comes from the practice that market development efforts are piecemealed or assigned discretely to individual specialists without overall coordination. This practice makes GSM development frictional, disorderly, or inefficient since a market component's workings are often bound by or pre-conditional to some other market components. For example, an electronic trading platform needs dematerialization. A central counterparty function requires novation. Grouping operationally or economically coherent features of market components as a policy set makes market development efficient.

The standalone-component problem may ignore the dynamic nature of market development processes. The processes are interdependent and looped, and they are likely to have different carrying capacities. Accordingly, they have to be managed so that no structural breaks occur in market development. A precedent process in interconnected processes needs to produce only as much output as economically and operationally acceptable to its dependent process or processes. Simultaneously, a dependent process can accept as much input as it may economically and operationally accept. Excessive output or input may be wasteful or harmful to a connected process or processes. Therefore, market development simultaneously involves multiple market components and is multifaceted, dynamic, and nonlinear. It is incremental, gradual, transtemporal, and comprehensive.

4.4 The Analytical Framework

4.4.1 GSM Development in Two-Dimensions

This research argues that GSM development can be viewed in two dimensions (Figure 4-1). The two dimensions form a ballpark policy matrix, as shown in the TDPF. The horizontal dimension is the Exogenous Dimension. It consists of factors exogenous to a GSM. Those

factors include macroeconomic, fiscal, and monetary policies or conditions under which a GSM operates or develops. This Exogenous Dimension broadly divides the universe of emerging markets into four development phases: the Nascent, Evolving, Advanced, and Highly-advanced Phases. GSMs in most lower-income economies fall in the Nascent or Evolving Phase. Each development phase forms a policy set paradigm[46] for market operations and development. By contrast, the vertical dimension is the Endogenous Dimension and comprises factors endogenous to a GSM. The GSM policymaker can usually manage these endogenous factors[47]. They include market components, such as accounting rules, legal rules, primary market, secondary market, money market, debt and cash management, clearing and settlement, and derivative and futures market. Thus, the two dimensions form a matrix of market components by market development phases.

A development phase on the Exogenous Dimension gives the GSM policymaker a realistic perspective on its GSM development horizon. The GSM policymaker is almost always part of a development phase. The policymaker can hardly upgrade its economy for GSM development in its capacity and during its tenure. A macroeconomic policy effect would be uncertain, and its response lag would be too long. An economy's position on the Exogenous Dimension spectrum generally sets the exogenous conditions of a GSM. These potentials and limitations shape a policy paradigm in which market components can coherently operate and develop. Fiscal and monetary policies or conditions are also exogenous to the market but less firmly preconditional to GSM development than macroeconomic ones. Thus, the Exogenous Dimension is a solution for a single-universe problem.

The TDPF provides the GSM policymaker with a practical and manageable policy space. The policymaker can improve upon its GSM by endogenously influencing the parameters of market components. The parameters are policies consisting of goals and measures manageable for the policymaker. Thus, the policymaker can practically contribute to GSM development.

Vertically grouped policies in the TDPF form policy sets and are inter-connected. They are a

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[46] An operational framework of coherent policies set and its associated activities

[47] An endogenous (exogenous) factor in this study is an endogenous (exogenous) economic category that includes a numeric or string variable. By comparison, an endogenous (exogenous) variable is numeric.

guideline for implementable policy sets in a given GSM development phase. The phase-coherent grouping selects the economically and operationally connected policies, least frictional in their interfaces, or least stressful on their connected processes. Thus, phase-coherently grouped policies are mutually congruent. Connecting policies should be neither too rudimentary nor too sophisticated, relative to their precedent and dependent policies. In this way, the Endogenous Dimension can mitigate an incoherence problem and a standalone-component problem.

The TDPF does not base its development phase classification on numerical parameters. Instead, the framework determines a market's development phase by comparing its functioning policies and institutional settings horizontally and vertically. A country can develop a GSM in a single development phase (intra-phase market improvement). A country's market may rarely shift from a development phase to another unless its economy goes through a significant structural change (inter-phase transition). The four phases, policy sets, and policies are reference guidelines. The policymaker should flexibly apply them to their GSM in the local context. A country's market may implement policies that the matrix table assigns to the next or previous phase. Economies can also have different developmental goals. Every economy may not always want to advance to the highest possible market development phase. The pace of policy implementation may also vary, depending on actual market development and unfolding circumstances.

4.4.2 The Indian GSM in the Two-Dimensional Framework

The Indian GSM was in the Nascent Phase before starting the financial market deregulation in 1991 (the Deregulation). It entered the Evolving Phase after the Deregulation. The launch of the GSM Reform in the early 2000s enabled the GSM to leap. The catalysis was the CCIL, NDS, and NDS-OM. The World Bank recategorized the country from a lower-income country to a lower-middle income country in 2007.

Not many emerging economies can shift their market development phase over a decade or two. Nevertheless, India moved up the Exogenous Dimension to the Evolving Phase. After the move-up, the country substantially improved the GSM. As of the late 2010s, the country is about to enter the Advanced Phase. However, it did not follow the CPF. It implemented policy goals and measures suitable for the Evolving Phase. In the early 2000s, the RBI

revamped its policy goals and measures to meet the economy's imminent needs and set realistic goals. India's financial market was bank-centric, and public sector banks were predominant. This financial market structure is common in Africa, Asia, and other emerging markets. Despite this market structure, the RBI needed to ensure market-based issuance of government securities and enhance secondary market liquidity.

The strategic core of its GSM development program was the NDS or the automated clearing and settlement system with a CCP function and the NDS-OM or the screen-based order-driven trading platform. They came into operation in 2001 and 2005, respectively, under the CCIL's management. The country supplemented a telephone-voiced, quote-driven OTC market with a screen-based order-driven market as government securities' principal marketplace. Continuous order-driven order-matching, that is, a typical order-matching system on stock exchanges, fits well with the market features of a GSM in the late Evolving or early Advanced Phase. The trading volume of the Indian GSM rose remarkably from 2005 to 2013 (Figure 4-3(1) and Figure 4-4(1)).

The simplicity of government securities trading in an early development phase allowed the RBI to capitalize on the order-driven trading platform that the National Stock Exchange (NSE) successfully deployed in the 1990s.[48] The narrow trading choice largely balanced the supply and demand for immediacy (Grossman & Miller, 1988) and lessened the necessity of two-way quoting. Thus, I may view the NDS and the NDS-OM as an extension of the NSE market structure (Patil, 2001). Stock trading is mostly issuer-specific, and stock selection is hardly substitutable. Once a trader has picked up a stock, its trading decision parameter is mainly the price. Likewise, trading decisions in emerging GSMs, in contrast to advanced GSMs, are simple since the government is the only issuer, and liquid outstanding issues and trading strategies are considerably limited.

India has developed a GSM on its bank-centricity rather than on a capital market. Neither was its investor base broad and deep, nor its non-bank intermediaries were well-capitalized. It was impractical for India's policymakers to transform their financial market structure for GSM

[48] The NSE's market structure pointedly addressed the concern of the Indian investment community in the 1990s in the advent of the Harshad Mehta scandal in 1992. The concern centered on the certainty, reliability, and safety of their trading and settlement.

development instantly. Bank-centricity is a typical financial market structure in the Nascent and Evolving Phases. The PD reform in 2006 further reinforced bank-centricity in the GSM by reducing standalone PDs and creating bank PDs. Of 21 licensed PDs, seven and fourteen PDs are standalone and banks, respectively, as of the end of December 2019 (Table 4-3).

India's GSM developmental path occasionally deviated from the Framework model favorably or unfavorably. It may deviate in the future as well. The country equipped its NDS with a CCP function when the market was still in the Evolving Phase. Given India's market development history, the CCP was an integral part of its strategic market structure. Many other countries may consider installing a CCP in the Highly-Advanced Phase. On the other hand, the Indian market has not fully adopted a mark-to-market accounting rule that the framework places as a policy measure of accounting in the Advanced Phase. Its attempt to run STRIPS and When-Issued on the market has not gained momentum.

4.5 Causality Analyses

4.5.1 The target variable

This section investigates endogenous market factors' causality to the trade volume growth in the Evolving Phase of the Indian GSM. As such, the trade volume is the target variable or dependent variable in this analysis.

4.5.2 Trading costs

The analysis indicates that the central bank fittingly employed the market growth policies from 2005 to 2013. The RBI's policies achieved trading "transparency and ease," repo market development, and competitive bid-ask spreads, among other things. The NDS and the NDS-OM have made GSM trading transparent and easy. Repo market development has been providing PDs with additional money management tools. The trading volume requirement imposed on PDs, which the RBI linked to auction and underwriting privileges, pressured and incentivized PDs to narrow bid-ask spreads competitively.

The reduction of trading costs resulting from these policies appears to have substantially increased trade volumes. Trading costs are inversely correlated to market liquidity (Madhavan,1992). Chaumont (2018) points to "a trade-off between the transaction costs and

the trading probability" in the secondary market for sovereign bonds. These trading costs were observed in advanced markets where utilities necessary for trading were unquestionably available. In early phase markets, however, trading costs may be viewed as including bid-ask spreads and unavailable utilities. Accounting usually does not recognize the unavailable utility elements of trading costs. However, they significantly affect trading decisions in India's case.

Indian PDs' trading behavior reflects this broader concept of trading costs. I conducted semi-structured interviews with PDs in the Indian GSM and surveyed their market-making practices in September and October 2019. The interviewees were trading heads and traders of 17 out of 21 PDs. The written survey followed the interviews, and ten PDs voluntarily answered the survey. Table 4-4 summarizes their responses.

The interviewed traders unanimously attributed their general preference for the NDS-OM over the telephone-voiced OTC market to "ease and transparency." Table 4-5 decomposes "ease and transparency" and relates its utility elements to the various trading cost components that the NDS-OM and the NDS are considered to have reduced. It is not straightforward to quantify these utility values in monetary terms, mainly because their benefits scatter across activities and facilities associated with trading. However, the increased prevalence of the NDS-OM and the narrowed bid-ask spreads on the platform suggest that the benefits of reducing total trading costs (bid-ask spreads plus unavailable utility values) exceeded the overall costs of the automated platform (market centralizing costs). Accordingly, my causality analyses proxy for the degrees of trading "transparency and ease" using NDS-OM trading percentages.

4.5.3 Data

This causality analysis sources the raw market data of the Indian GSM mainly from the CCIL. The CCIL published the time series data from August 2005 to March 2019 in CCIL (2019a, 2019b), and the CCIL individually provided the same time series from April 2013 and October 2019. All the sample variables are monthly averages of their daily values that the CCIL observed on its system. Table 4-6 lists the sources and time ranges of the data.

Given the suspected autocorrelations of my time series variables, I have three hypothesized

causal relationships to model the behavior of the trade volume: the vector autoregression (VAR), vector error correction (VEC), and autoregressive distributed lags (ARDL) models. I select an appropriate model and specify the chosen model by examining the sample variables' properties and determining their order of integration. To this end, I test the sample variables for multicollinearity, autocorrelation, optimal lag orders, and unit roots.

At first, I normalize the sample values of the variables relative to 100 at the beginning of each of the two subperiods, January 2007 and April 2013, as will be defined. The values are different in unit, and it is difficult to compare the degrees of their changes and capture their interactions in the raw values. The normalization (indexation) makes their behaviors directly comparable. The symbol of each normalized variable is prefixed with “i” as its first-order difference is additionally prefixed with “d.” (*e.g.*, *itrd* for the normalized value of a trade volume and *ditrd* for the first difference value of a normalized trade volume.) Table 4-7 provides the summary statistics of the raw as well as normalized data.

I split the sample period from August 2005 and October 2019 into two subperiods: January 2007 to March 2013 (the first-half period) and April 2013 to October 2019 (the second-half period) for three reasons. I drop the 17 months from August 2005 to December 2006 since the period lacks bid-ask spread data. First, the percentage of NDS-OM trading underwent a structural change in April 2013, presumably due to policy intervention. The graphs in Figure 4-3 illustrate the structural change. For instance, the relationship between the trade volume (*itrd*) and the NDS share (*indsom_pct*) changed radically (Figure 4-3(2)). The percentage of NDS-OM trading reached 90.2 percent in March 2007 and hovered between 87 and 95 percent after April 2013. Second, the two subperiods' separate analyses are likely to reveal the variable’s behaviors specific to each of the two subperiods unambiguously. Third, I have two time series for bid-ask spreads, and neither of them runs through the entire data sample period. The first and second-time series cover the periods from January 2007 to December 2014 and from April 2013 to October 2019. The first time-series averages the bid-ask spreads of all transactions, while the second one averages the bid-ask spreads of only "liquid"

government securities as categorized by the CCIL.[49] Therefore, the split keeps the time series of bid-ask spreads coherent in each sub-period. I name the variable as *ioldsprd* and *inewsprd* for the first- and second-half periods, respectively.

I decompose composite variables in my raw data into observed component ones for my analyses, where the component ones may indicate market dynamics better. My dataset has three such cases. First, the trade value (*ivals*) consists of the trade volume (*itrd*) and the trade size (*itrdsize*). The trade volume is redundant, and the trade size mirrors the trader's behavior straightforwardly. The second case is the turnover ratio. The variable is the composite indicator of the trade value (*ivals*) and the variable for the outstanding balance of government securities (*igsec*), both uniquely represented. I use the turnover ratio only when necessary. Third, the repo ratio (*irepos_pct)* is the ratio of the repo volume (*irepo*) to the trade volume (*itrd*).

I check the independent variables' multicollinearity since I estimate regression models with the trade volume (*itrd*) as the dependent variable. Table 4-8 shows the correlation coefficients among variables. No correlation coefficients exceed 0.95 in the first-half period. Therefore, I keep all the variables to consider for modeling for the first-half period. For the second-half period, however, the repo trade (*irepo*) has a correlation coefficient of 0.9545 with the outstanding balance of government securities (*igsec*), exceeding the threshold correlation coefficient of 0.95. I drop the repo trade (*irepo*) for modeling for the second-half period. As a result, I have the independent variables of *igsec, indsom_pct, irepo, itrdsize,* and *ioldsprd* for the first-half period, and *igsec, indsom_pct, itrdsize,* and *inewsprd* for the second half period.

Figures 4-4, 4-5, 4-6, and 4-7 represent the level, first difference variables for the first-half period and the second-half period. The level graphs have the baseline at 100 (Figure 4-4and Figure 4-6) and the first difference ones at zero (Figure 4-5 and Figure 4-7). In the first-half period, the *igsec* level variable follows an upward drift trend, and the level variables of the *itrd*, *indsom_pct*, *irepo*, and *itrd*size, also exhibit some upward trends. By contrast, that of the *ioldsprd* shows occasional positive clusters (Figure 4-4(6)). The *igec* first difference variable

[49] Every month, CCIL categorizes outstanding issues into the liquid, semi-liquid, and illiquid securities, subject to the RBI's approval, and announces the list of categorized issues. There is no way to reconcile the two datasets for the first- and second half periods into a single time series with data available to this study.

appears to fluctuate around a positive linear constant, while the other first difference variables are largely stationary around the zero mean (Figure 4-5). In the second-half period, the *igec* level variable continues to follow an upward drift trend (Figure 4-6(2)), but the other level variables no longer show an upward trend. Instead, the *itrd*, *itrd*size, and *inewsprd* level variables look like showing some cyclical trends (Figure 4-6(1), (4) and (5)) while the *indsom_pct* level variable stays close to the index value of 100 (94.81 percent in the raw value) with occasional dips (Figure 4-6(3)). Their first difference variables appear largely stationary around the zero mean except for the *igsec* first difference variable being stationary around a positive constant (Figure 4-7).

My investigation of the sample variables' properties starts by testing them for autocorrelation.[50] I ran Durbin's alternative test (code: estat durbinalt) and plotted the autocorrelation functions. The majority of the level and first difference variables are autocorrelated, and so AR(1) models to fit the variables cannot be estimated. Table 4-9 summarizes the results of Durbin's alternative test for the first-half and second-half periods. Figure 4-8, Figure 4-9, Figure 4-10, and Figure 4-11 display the plots of the variables' autocorrelations over the first 20 autocorrelations against the confidence level of 95 percent.

I selected optimal lag orders of the level variables for the causality models by the Vector Auto-Regressive Specification Order Criterion (varsoc). I ran the varsoc on each variable with the highest lag order (maxlag) incrementally from two to eight.[51] According to the Akaike information criterion (AIC) and the Schwarz–Bayesian information criterion (SBIC), the result tables present optimal lag orders (Table 4-10). Since the sample sizes of the time series are not large (75 and 79 for the first-half and second-half subperiods, respectively), I focus on the SBIC for optimal lag order selections (Ventzislav & Lutz, 2005).

I performed the Augmented Dickey-Fuller test and the DF-GLS test (the modified Dickey-Fuller *t*-test) for unit root in the level and first difference variable time series. For the Augmented Dickey-Fuller test, I assign lag orders of 4 and 3 to the level and first difference variables for the first-half period and 1 and 2 to the level and first difference variables for the

[50] My statistical software for these analyses is Stata version 16.

[51] Designating other variables as the exogenous variable option besides the constant in the vasoc command makes no material difference in the lag order selection statistics for my datasets.

second-half period, respectively, according to the varsoc calculation on the *itrd* variable (Table 4-11). Furthermore, I optionally include a trend or drift term in the Augmented Dickey-Fuller test regression or exclude the constant from the regression, based on the visual observations of Figure 4-4, Figure 4-5, Figure 4-6, and Figure 4-7.

For the DF-GLS unit-root test, I optionally added a maxlag order of 11, as chosen by the Schwert criterion. Also, since DF-GLS unit-root test regressions include a trend term by default, I optionally included a notrend option in all the DF-GLS unit-root test regressions except for those level *igsec* or first difference d.*igsec* variables, as visually observed in Figure 4-4, Figure 4-5, Figure 4-6, and Figure 4-7.

Finally, I performed the HEGY test on the *itrd* and *indsom_pct* variables for a seasonal unit root. The former is the dependent variable (the target variable) of this causality analysis, and its seasonality may, if any, mask the true market growth path. The latter is possibly the most influential independent variable as its correlation coefficient with the *itrd* variable suggests (Table 4-8), and the visual inspection shows its seasonal dip in every March or the last month of every fiscal year in India (Figure 4-12). Since the variables are monthly, I set the maxlag order at 12. I also specified the deterministic part of the test for "seasonal dummies and linear trend" and "seasonal dummies" for the first- and second-half periods, respectively, from a visual inspection of their line graphs in Figure 4-4(1) and Figure 4-4(3) and Figure 4-6(1) and Figure 4-6(3)

4.5.4 Methodologies

I estimated the ARDL model and its error correction (EC) process (ARDL/EC model) to assess the variables' causality to the target variable. At first, I identified the likely lag order combinations for the valid ARDL/EC model. Then, the likely lag order combinations underwent the bounds tests to determine the possible presence of cointegration (long-run regressive relationship among the level variables) as well as their post estimation tests for the satisfaction of the assumptions underlying the ARDL/EC model (the integration conditions of I(0) and I(1) but not I(2)).[52] The post estimation tests include the Durbin-Watson test (code:

[52] The residuals of the ARDL/EC model are homoscedastic, serially uncorrelated, and stable over time (no structural change). (Kripfganz & Schneider, 2018, and others)

estat dwatson) and the Breusch-Godfrey test (code: estat bgodfrey) for autocorrelation in the residuals, White's test for homoskedasticity (code: estat imtest, white), and the cumulative sum test for parameter stability (code: estat sbcusum).

A general representation of an ARDL(*p, q*) model is:

$$y_t = c_0 + c_1 t + \sum_{i=1}^{p} \phi_i \, y_{t-\mathrm{i}} + \sum_{i=0}^{q} \beta'_i \, \boldsymbol{x}_{t-\mathrm{i}} + \varepsilon_t \,, \tag{4.1}$$

where $\boldsymbol{x}_t$is a k x 1 vector of variables in a time series , and *p* and *q* are optimal lag orders, and its ARDL/EC model is:

$$\Delta y_t = c_0 + c_1 t - \alpha(y_{t-1} - \boldsymbol{\theta} \boldsymbol{x}_t) + \sum_{i=1}^{p-1} \psi_{yi} \Delta y_{t-i} + \sum_{i=0}^{q-1} \psi'_{xi} \Delta \boldsymbol{x}_{t-i} + u_t \,, \tag{4.2}$$

where the speed-of-adjustment coefficient $\alpha = 1 - \sum_{j=1}^{p} \phi_i$ and the long-run coefficients are $\boldsymbol{\theta} = \frac{\sum_{j=0}^{q} \beta_j}{\alpha}$ (Kripfganz & Schneider, 2018). $\boldsymbol{\theta}$ or the long-run coefficients that bring back deviations to the long-run equilibrium, and ψ and ψ' or the short-run coefficients cause short-run fluctuations of the dependent variable *itrd* (the target variable).

I expanded Equations (4.1) and (4.2) to model my datasets. The dependent variable for the first-half period is *itrd,* and its independent variables were *igsec*, *indsom_pct*, *irepo*, *itrd*size, and *ioldsprd*, which I denote *itr, ig, in, ir, its,* and *ios* for simple representation and prefix their summation index *i* with "." to distinguish them from those variable indices. The ARDL/EC model for the first-half period is:

$$\Delta itr = c_0 + c_1 t - \alpha(itr_{t-1} - \boldsymbol{\theta x}_t) + \sum_{i=1}^{p-1} \psi_{itr.i}\, \Delta \boldsymbol{itr}_{t-i} + \sum_{i=0}^{q_{ig}-1} \psi'_{ig.i}\, \Delta \boldsymbol{ig}_{t-i}$$
$$+ \sum_{i=0}^{q_{in}-1} \psi'_{in.i}\, \Delta \boldsymbol{in}_{t-i} + \sum_{i=0}^{q_{ir}-1} \psi'_{ir.i}\, \Delta \boldsymbol{ir}_{t-i}$$
$$+ \sum_{i=0}^{q_{its}-1} \psi'_{its.i} \Delta\, \boldsymbol{its}_{t-i} + \sum_{i=0}^{q_{ios-1}} \psi'_{ios.i}\, \Delta \boldsymbol{ios}_{t-i} + u_t. \qquad (4.3)$$

For the second-half period, by omitting *irepo* and replacing *ioldsprd* (*ios*) with *inewsprd* (*ins*), I obtained the following ARLD/EC model:

$$\Delta itr = c_0 + c_1 t - \alpha(itr_{t-1} - \boldsymbol{\theta x}_t) + \sum_{i=1}^{p-1} \psi_{itr.i}\, \Delta \boldsymbol{itr}_{t-i} + \sum_{i=0}^{q_{ig}-1} \psi'_{ig.i}\, \Delta \boldsymbol{ig}_{t-i}$$
$$+ \sum_{i=0}^{q_{in}-1} \psi'_{in.i}\, \Delta \boldsymbol{in}_{t-i} + \sum_{i=0}^{q_{its}-1} \psi'_{its.i} \Delta\, \boldsymbol{its}_{t-i}$$
$$+ \sum_{i=0}^{q_{ins-1}} \psi'_{ins.i}\, \Delta \boldsymbol{ins}_{t-i} + u_t. \qquad (4.4)$$

I ran Equations (4.3) and (4.4) on the sample variables with selected lag order combinations to estimate the model's long-run and short-run parameters.

The ARDL/EC model's specification sensitivity centers on selecting lag orders for the sample variables or lags($p\ q_{ig}\ q_{in}\ q_{its}\ q_{ir}\ q_{ios}$) for the first-half period and lags($p\ q_{ig}\ q_{in}\ q_{its}\ q_{ins}$) for the second-half period. Stata's ARDL software module automatically assigned lag orders for each of the dependent and independent variables. Their results did not necessarily clear the post-estimation tests. Therefore, I also applied the lag order combinations that the varsoc test identified by Schwarz's Bayesian information criteria (SBIC) (Table 4-10 and Table 4-11) or empirically assigned varying combinations to determine the optimal combinations of lag orders that passed all the post estimation tests.

Finally, I estimated the impact of the *igec* and *indsom_pct* variables on the ARDL/EC

regression's explanatory power by dropping them in sequence and verifying lag order combinations with post estimation tests. The differences that dropping a variable from the regression makes in R-squared are expected to measure the variable's impact on the *itrd* variable or the trade volume (stepwise method).

4.5.5 Results

The results shown in Table 4-9 and Figure 4-8 to Figure 4-11 confirm my sample variables' autoregressiveness either in level or in first difference or both. Notably, the *indsom_pct* variable was non-autoregressive in level but autoregressive in first difference for the first-half period.

Table 10 shows the optimal lag orders that the varsoc suggested for the max-lag orders from 2 to 8. Table 4-11 summarizes the results shown in Table 4-10. I applied these suggested optimal orders to the Augmented Dickey-Fuller test and the DF-GLS unit-root test for unit root.

Table 4-12 and Table 4-13 report the DF-GLS test results, and Table 4-14 reports the Augmented Dickey-Fuller test results for unit root. These results confirm that the sample variables were integrated of order 0 (I(0)) or order 1 (I(1)).

The HEGY test results for seasonal root indicate they had unit roots individually but not jointly and had non-seasonal unit roots (unit roots at the zero-frequency) (Table 4-15). The results are not entirely consistent with those of the Augmented Dickey-Fuller test (Table 4-14) and the DF-GLS unit-root test. The dubious monthly seasonality in the variables does not seem as significant as it may affect the long-run causality.

The above findings are consistent with the ARDL/EC modeling assumptions subject to the post estimation tests. The confirmed mixed presence of unit roots disqualifies either a VAR model or a VEC model for modeling my data.

The estimation of the ARDL/EC model parameters with likely lag order combinations was subjected to the post estimation tests. Table 4-16 summarizes the results of the post-estimation tests. The cumulative sum test confirms no structure breaks either in the first-half period or in the second-half period (Figure 4-13 and Figure 4-14). All the results suggest that

the best-fit lag combinations were lags(*2 1 1 1 1 1*) and lags(*1 1 0 1 0*) for the first- and second-half periods, respectively.

Table 4-17 presents the ARDL/EC's parameters estimated with the best-fit lag combinations. In the first-half period, the R-squared was 51 percent, explaining the independent variables' contribution to the *itrd* or the dependent variable. A long-run level relationship was evident, but no statistically significant short-run relationships were present except for the *igsec*. In the long-run error correction term, only the *igec* and the *indsom_pct* were statistically significant. Their coefficients indicate that one-percent increases of the *indsom_pct* and the *igsec* raised the *itrd* by 4.71 percent and 1.24 percent, respectively. The *igsec* had a standard error of 0.32 and a *t*-statistic of 3.89, while the *indsom_pct'*s standard error and t-value were 2.32 and 2.03.

In the second-half period, the R-squared was 49 percent. The speed of adjustment weaned to -0.64. The *igsec* no longer contributed to the *itrd* growth either in the long run or in the short run. Instead, the *indsom_pct* remained statistically significant in coefficient to the *itrd,* and the *itrdsize* so became. The *indsom_pct*'s coefficient increased to as large as 10.82 while its standard error changed little at 2.31. Its *t*-statistic jumped accordingly. No short-run relationship was found.

The impacts of the government securities balance and the NDS-OM variables are summarized in Table 4-19 and Table 4-20. Excluding the *igec* variable from the regression lowered the R-squared from 51 percent to 40 percent for the first half period and from 49 percent to 42 percent for the second-half period (Table 4-19(1) and Table 4-20(1)). Further, ignoring the *indsom_pct* variable reduced the R-squared from 40 percent to 18 percent[53] for the first half period and from 40 percent to 25 percent for the second-half period (Table 4-19(2) and Table 4-20(2)).

4.6 Discussion

The CPF for GSM development has so far failed to deliver expected results in lower-income economies. This research attempts to improve upon the CPF. It questions how effective policy sets can be developed for GSM development in lower-income economies and if any policy

[53] At 18% for the R-squared, the bounds test failed against the 1% critical value of t-statistic.(Table 4-19)

framework helps formulate the policy sets. These questions aim to find a way for a GSM to facilitate and reinforce the macroeconomic advancement that an LIE has achieved.

The results evidence endogenous market factors' significant contribution to market development in its early phases. This study measured the contribution of an independent variable in terms of differences in R-squared values calculated by stepwise methods. The GSM policymaker can make the most of them. In India's case, all the independent variables explained 51 percent of the trade volume (*itrd*) growth in the first-half period (Table 4-17). The balance of government securities (*igsec*) is a fiscal policy variable. Excluding it, the endogenous variables explained 40 percent (Table 4-19(1)). The 51 percent can be broken down into 10 percent for the government securities' balances (*igsec*), 22 percent for the market infrastructure innovation (the NDS-OM percentages) (*indsom_pct*), and 18 percent for the rest of the variables (Table 4-19(2)). These weights should not be taken as independent since they are cointegrated. Also, more precisely, they contributed to changes but not necessarily growth in the trade volume. Nonetheless, I view their positive changes as contributions to growth. By contrast, the second half period manifested a fiscal policy variable's limitation. The continued growth of the government securities balance could not pull up the trade volume. All the independent variables explained 49 percent of the trade volume changes when its growth was almost flat (Table 4-18). The NDS-OM percentages and the other endogenous variables together accounted for 42 percent, separately 16 percent and 26 percent, respectively (Table 4-20). The balance of government securities was no longer statistically significant at a p-value of 0.065, and its coefficient was even negative (Table 4-18).

The NDS-OM in India's context had two implications: a locally and phase-fit market structure and hidden utility value exploitation. Firstly, adopting the new market structure was timely and fitting for the GSM in the Evolving Phase. The Indian GSM adopted an order-driven model for its automated trading platform instead of a quote-driven model, which most advanced markets use and the development community usually recommends. In an early development phase, the trading choice is relatively narrow as liquid issues are limited in number, the investor base is small or homogeneous, and trading and investment techniques are simple. The relative simplicity more likely balances the supply and demand for immediacy (Grossman & Miller, 1988). India could extend its locally developed and

successfully implemented stock market model to the GSM.

Secondly, the NDS-OM also meant uncovering hidden “universal” utilities embedded in the Indian GSM’s market structure. Utilities are economic agents’ perceptions, and they are objectively unmeasurable but may be exploitable. They can be grouped into universal utility values and trader-specific ones. The former affects all traders across the market as the trading “transparency and ease” did in the Indian GSM. The NDS-OM as a component of a market structure delivers "universal" utility values. It may also take the form of the elimination or reduction of social or political rent, which may also be viewed as a market structure component. They are more apparent in the early stages than the later ones of a market development phase before most traders become price-takers. By contrast, the latter is specific to particular individuals or groups to satisfy their individual non-yield-seeking needs. The trader-specific utility values are what Harris (2003) analyzes as utilitarian trading benefits (pp.178-194). Trader-specific utility values are more often observable in a highly liquid market, where most traders are price-takers. Also, many heterogenic traders participate in trading and take trader-specific behaviors in the Highly Advanced Phase. Utilitarian traders may be willing to pay a premium for trading. In this context, “traders” are investors or proprietary traders rather than intermediaries.

Consumption theories developed in the real economy suggest the dominant role of utilities in early development phases of the Indian GSM. The observed role of utilities in motivating the investor to trade in the early phases of the Indian GSM is a common case with industrial and retail consumers’ buying behaviors in imperfect markets. It is known that non-pecuniary values, such as functionality, reliability, or convenience, dominate industrial or retail consumers’ buying decisions in early phases of their product life cycles or imperfect markets (Christensen, 1997a, 1997b; Gurowitz, 2012; Horton, n.d.; Moore, 2014). The Indian investor’s behavioral evolution over time in the Evolving Phase is also consistent with consumption theories. Its utility consumption was gradual, accelerated, decelerated, and stalled in the NDS-OM’s capacity life cycle. This pattern fits Roger’s (2003, pp. 168-218) innovation-decision process model and Moore’s (2014, pp. 11-17) technology adoption cycle model.

Consequently, the bid-ask spread’s insignificance suggests that implicit and indirect trading costs (utility values) could or should be addressed before bid-ask spreads. The bid-ask spread

narrowing did not significantly increase the trade volume throughout the observation period, though the spread narrowed to as small as one to three basis points (Table 4-7(2)). The bid-ask spread, which is an explicit and direct trading cost, is inversely correlated with the trading volume in advanced securities markets (Chaumont, 2018; Madhavan,1992). GSMs in lower-income economies, as the Indian GSM exemplifies, are likely to contain implicit trading costs or utility values abundantly.

Effective policies are phase-fit, phase-dependent, and path-dependent. The policymaker most likely finds high-leverage policies or their variations in the column of its development phase in the TDPF. India's introduction of a screen-based automated trading platform in 2005 typified a phase-fit policy measure after the country had fostered market environments in the 1990s and the early 2000s. Relevance, timeliness, sequence, and coherence are crucial to overall policy effectiveness in the local context. Table 4-21 shows the general alignment of India's policy measures and the TDPF.

A high-leverage policy's strength would, like India's NDS-OM, be temporal and conditional. Environmental changes or intrinsic conditions may dwindle the policy's effectiveness. Thus, the high-leverage policy may shift, even in the same development phase. Subsequently or even preemptively, the policymaker may also have to reset market development targets or goals to keep up with the changes. Despite its continued statistical significance, the NDS-OM that had saturated the market structure's carrying capacity could not raise the trade volume in the second half period. Since the government securities balance continued to grow, the structure of India's financial market seems responsible for the market growth lull (Figures 4-6(1), (2), and (3)). This lull suggests that an endogenous market development policy is subordinate to exogenous policies and environments.

Nonetheless, market environments may not always be rigidly exogenous to the market. Fiscal and monetary settings are likely to be less unmanageable than macroeconomic ones though they are exogenous to the market. The legal or working relationships among market development, fiscal, and monetary authorities can make fiscal and monetary environments less rigid. An example is India's Fiscal Responsibility and Budget Management Act of 2003 (Table 4-21).

The NDS-OM case exemplifies the manageability of endogenous market factors for the GSM

policymaker. The fiscal-year-end dips of the NDS-OM trading and the maintenance of a residual space for OTC market trading illustrate the policymaker's ability to control market development processes to meet its policy or operational objectives. The GSM policymaker is not responsible for macroeconomic policies. Their policy effects are holistic, and their policy lags are long, as the TDPF's vertical dimension indicates. Monetary and fiscal policies are closer to the GSM policymaker, but they usually are outside the GSM policymaker's responsibility. Their objectives are not GSM development. The GSM policymaker is accountable for endogenous market factors. They can be well-focused under the GSM policymaker's control, and their effects can be somewhat foreseeable, if not instant.

Policy consistency pays off —it respects the mid- to long-term and coherent grouping of policy goals and measures in a development phase. Even endogenous market improvement in a development phase may take a few decades. It is a long time relative to the policymaker's tenure in office. The Indian GSM took 22 years to level off in 2013 and 28 years to reach this research point in 2019. Nonetheless, I can hardly say that the Indian GSM has fully graduated from the Evolving Phase and has entered the Advanced Phase.

India's successful GSM development has left some problems unresolved or given rise to unintended consequences for the next phase. For instance, the quality of liquidity is an issue facing the Indian GSM, often the case with other GSMs in the Nascent or Evolving Phases. The three most actively traded issues accounted for 67 to 87 percent of all trades in 2019. Two ten-year issues are almost always predominant (Figure 4-15). These concentration features presumably led to unusually narrow bid-ask spreads (Table 4-7 Summary of Variables(2)). The liquidity-centric trading in a bank-centric market, unlike yield-seeking trading, tends to converge on a few GS issues through a feedback (self-reinforcing) effect and consequently keep the liquidity inside the interbank market.

Though not uncommon in the Nascent and Evolving Phases, these concentrations are undesirable for a GSM of capital market type. First, the concentration may cause non-PD and non-bank traders to perceive adverse selection and information asymmetry problems. These problems may discourage them from actively trading in the GSM though their participation would bring in heterogeneous views and improve the GSM's price discovery efficiency. Second, the liquidity concentration and the spread squeeze form an "entry barrier" in the GSM. The entry barrier would keep it more challenging for non-PD institutions to enter the

market and extend financial efficiency beyond the interbank market or across the economy. Third, it may also segment the term structure of interest rates and weaken the transmission mechanism.

The next leap of India's GSM may have to wait for its financial market structure to deepen, broaden, and diversify further. The leap may have already started as the *trdsize* increased and became statistically significant (Table 4-18). A financial market structure is a long-term set of institutions, policies, laws, and regulations aligned for financial transactions or the way they are organized. A government builds and maintains a particular financial market structure to achieve its policy or political goals in the long run. India's current financial market structure is bank-centric. The TDPF suggests broadening the investor base and deepening the financial market structure, among other things, for the next phase.

This research has several limitations. First, it has tested the TDPF only with the Indian GSM's development path. Empirical studies of other lower-income markets may present different perspectives. Second, my observed endogenous variables are exclusive but not necessarily exhausive. Other unobserved variables may become measurable. Endogenous factors' interactions with exogenous ones were not addressed. Third, most of my data were monthly averages of daily observed values, and their daily changes had been smoothed out. Nevertheless, since my focus is on the long-run relationships, I assume that the monthly averaging had a minimal impact on my research results.

Another caution is that India might have had some lucks for GSM development uniquely. Its lucks may include a successful stock market reform experience just before the GSM reform, a pool of local IT talents, and traditional intellectual independence. All lower-income economies may not equally share such lucks.

4.7 Conclusion

This research has explored the endogenous policy sets and the policy framework for GSM development in lower-income economies. It has proposed the TDPF to answers these challenges systematically. The framework is designed to coherently develop a GSM to facilitate or reinforce its macroeconomic and social achievements. It is also expected to help the academic and policy advisor conceptualize market development programs for the

policymaker.

Lower-income economies need a practical framework of implementable policy sets to translate economic and social achievements into tangible policies for GSM development or connect tangible policies endogenously as well as exogenously. The key concepts underlying the proposed policy framework are sensible differentiation of GSMs by their development phases (phase-differentiation) and endogenously coherent policy sets for phase-differentiated GSMs (phase-coherency).

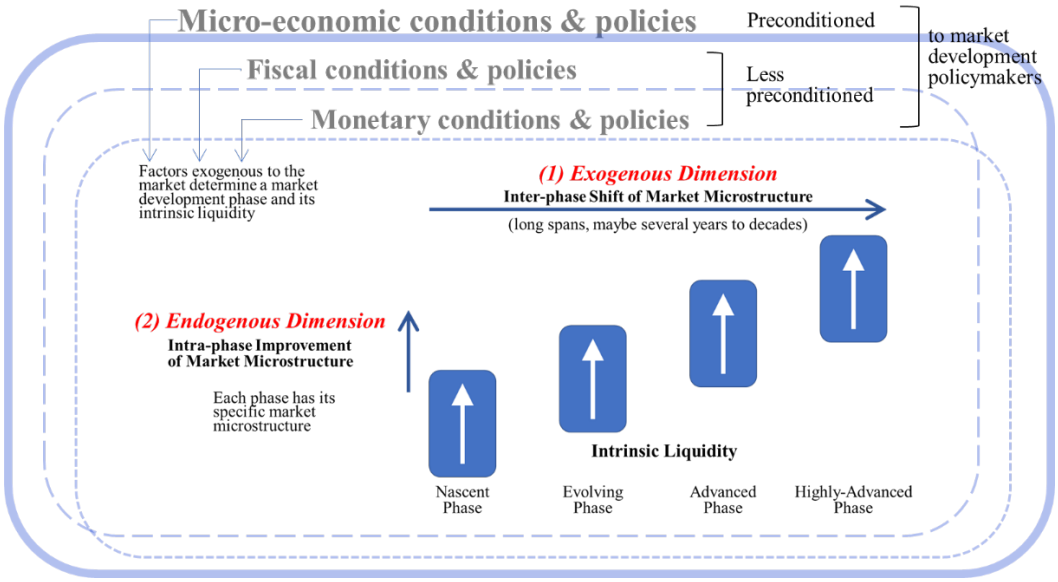
The Indian GSM showcased that endogenous market factors explained about 40 percent of the trade volume growth. India's leading variable was the phase-fit and locally-fit automated market structure, which released embedded universal utility values. Its contribution is estimated at 22 percent of the trade volume growth. These laudable contributions of endogenous market factors compel us to organize known GSM policy sets for lower-income economies into the TDPF. The framework can be a Treasure Island map for lower-income economies when they systematically develop or improve their GSMs.

The absence of a phase-fit, locally-fit approach and endogenously phase-coherent policy sets would keep lower-income economies financially inefficient.

Besides further improving the framework, further research may include incorporating other unobserved endogenous variables and managing dynamic processes of market development. The role of utilities in GSM development is also worth exploring.

Figures

Figure 4-1: Two-Dimensional Market Development



Source: The Author

Figure 4-2: Turnover Growth and Lull

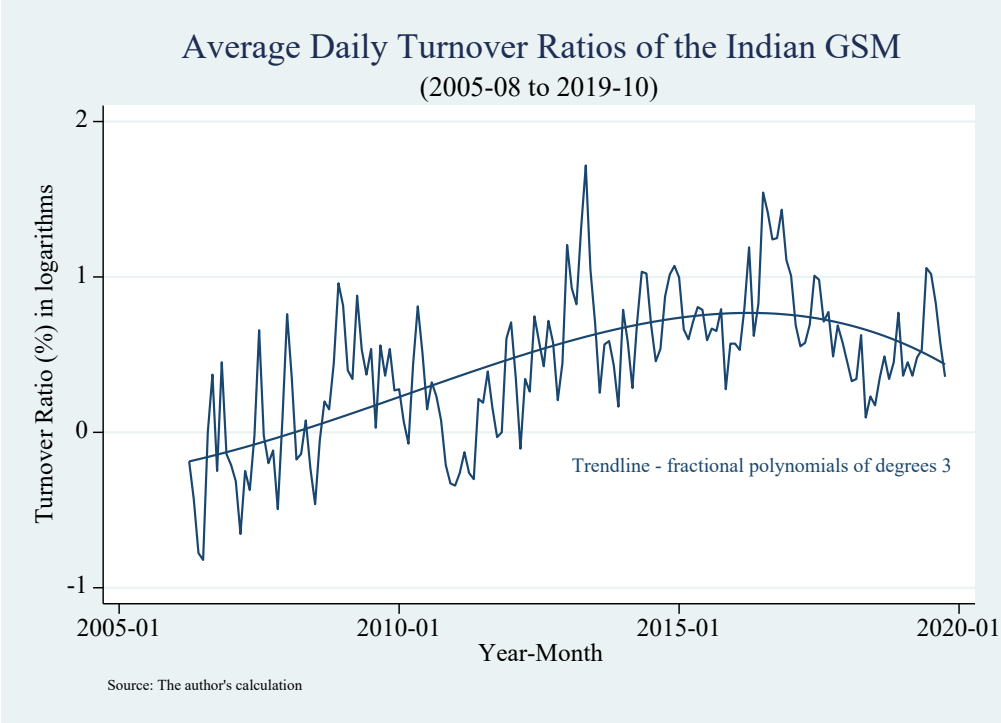
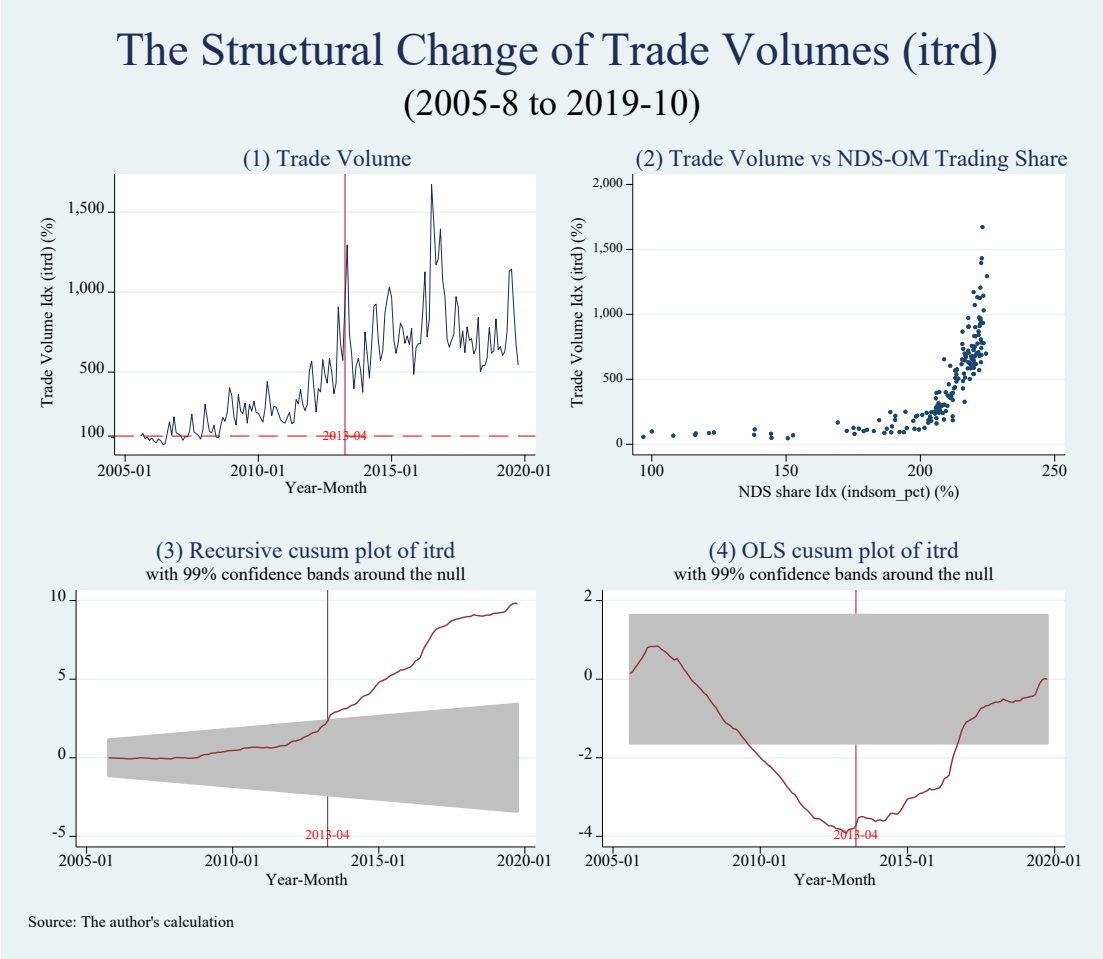
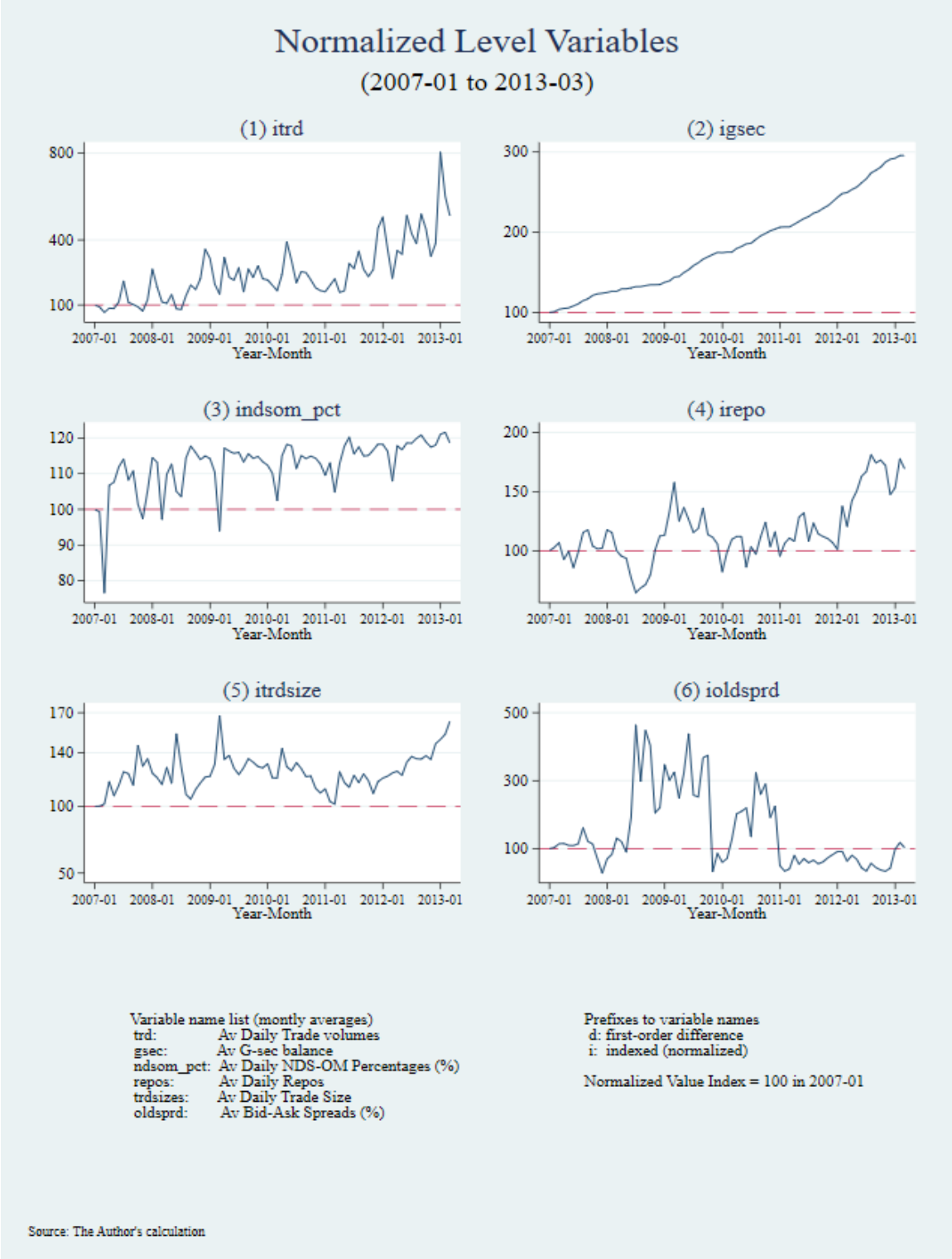


Figure 4-3: The Structural Change of the Indian GSM in April 2013



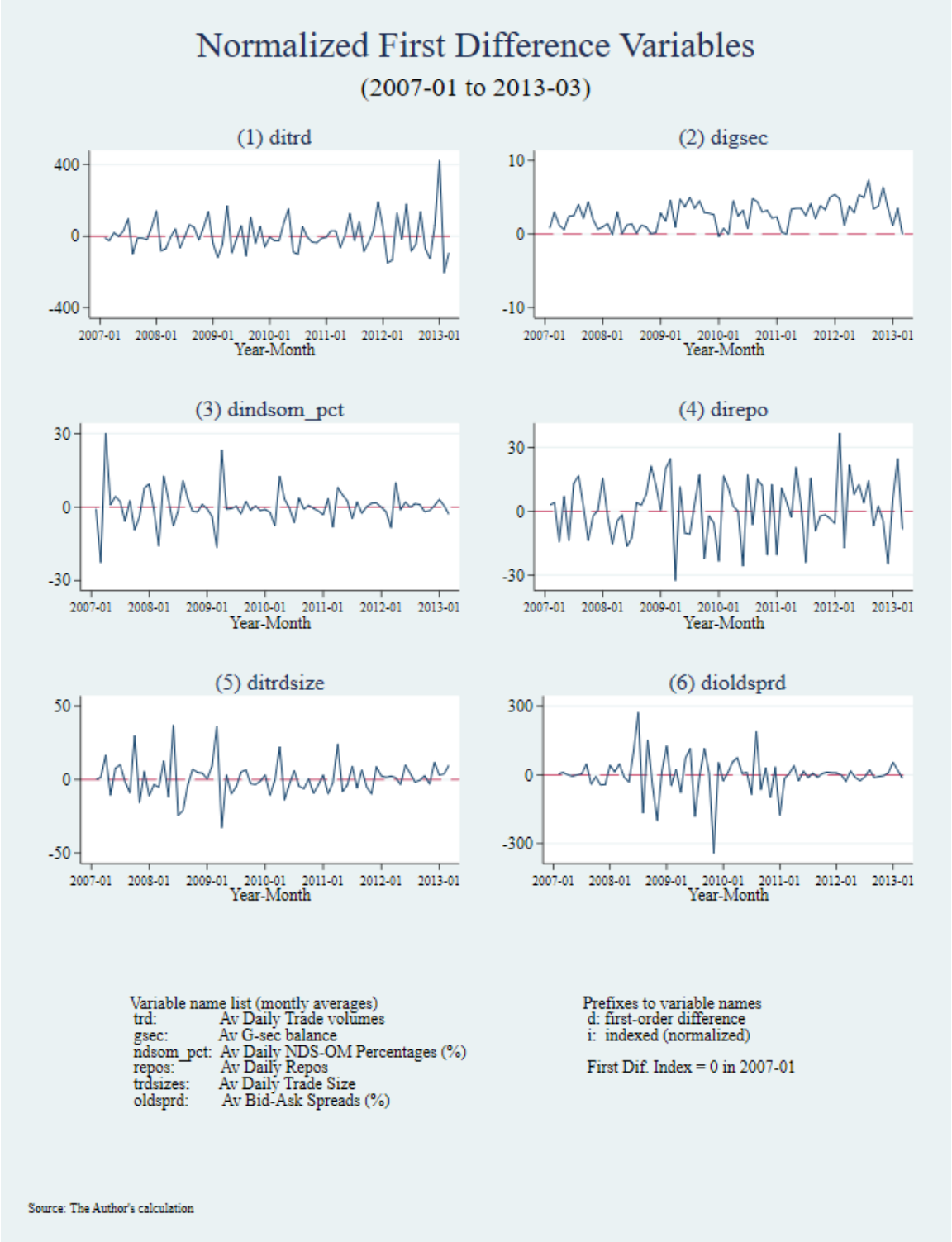
Source: The author's calculation

Figure 4-4: Normalized Level Variables
for the First-half Period (2007-01 to 2013-03)



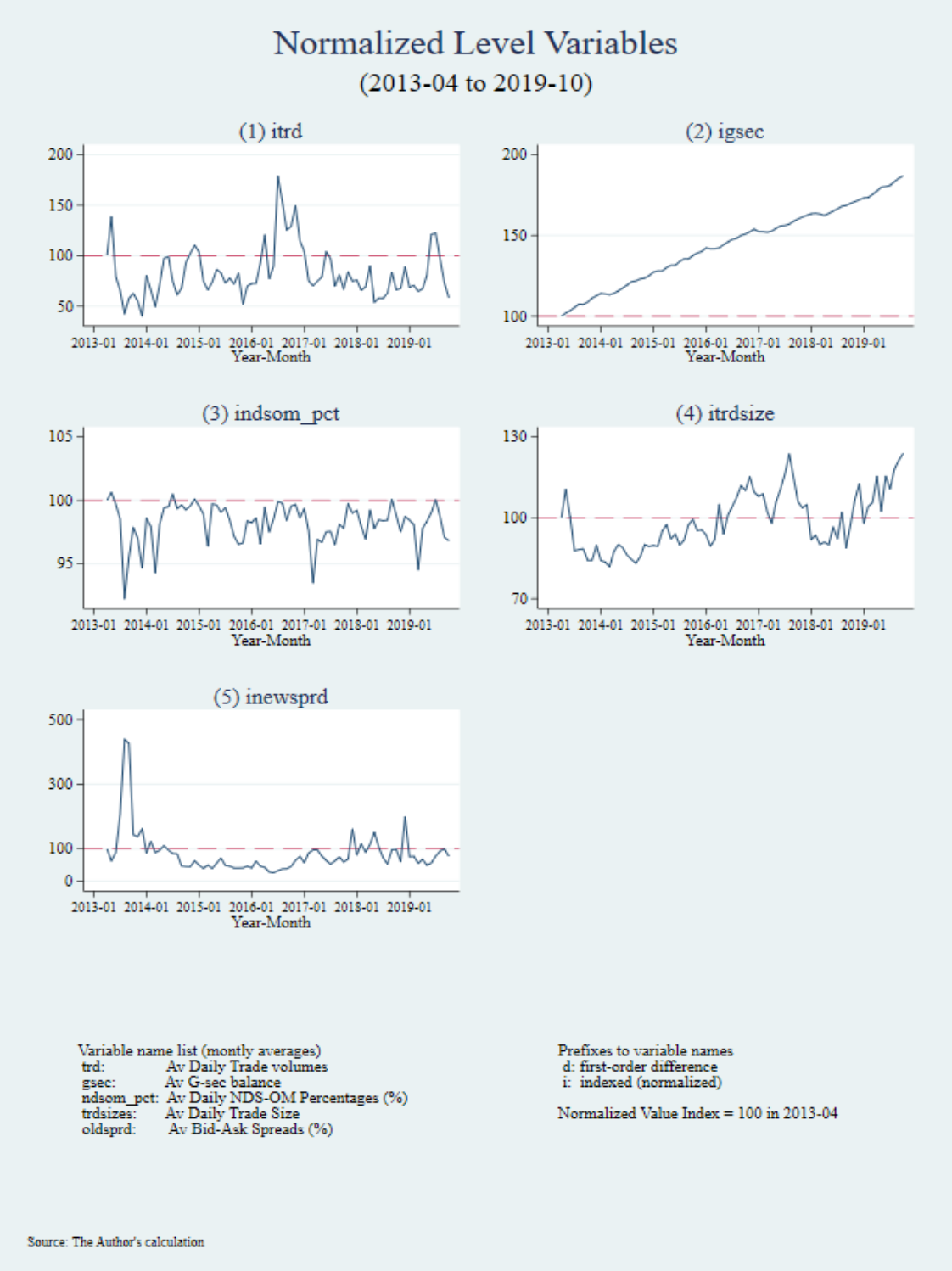
Source: The Author's calculation

Figure 4-5: Normalized First Difference Variables
for the First-half Period (2007-01 to 2013-03)



Source: The Author's calculation

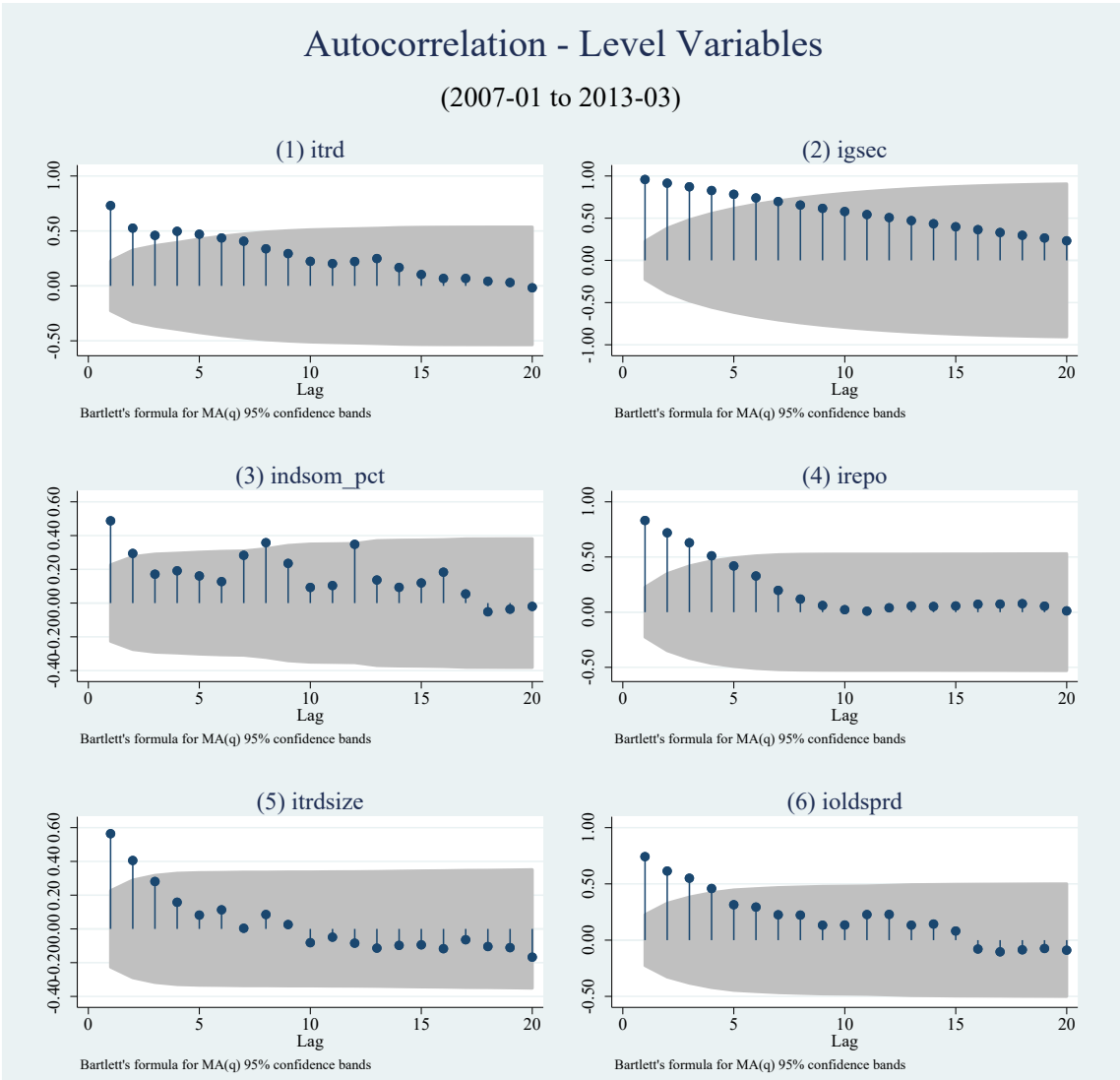
Figure 4-6: Normalized Level Variables
for the Second-half Period (2013-04 to 2019-10)



Source: The Author's calculation

Figure 4-7: Normalized First Difference Variables
for the Second-half Period (2013-04 to 2019-10)

Figure 4-8: Autocorrelation Plots - Level Variables
for the First-half Period (2007-01 to 2013-03)

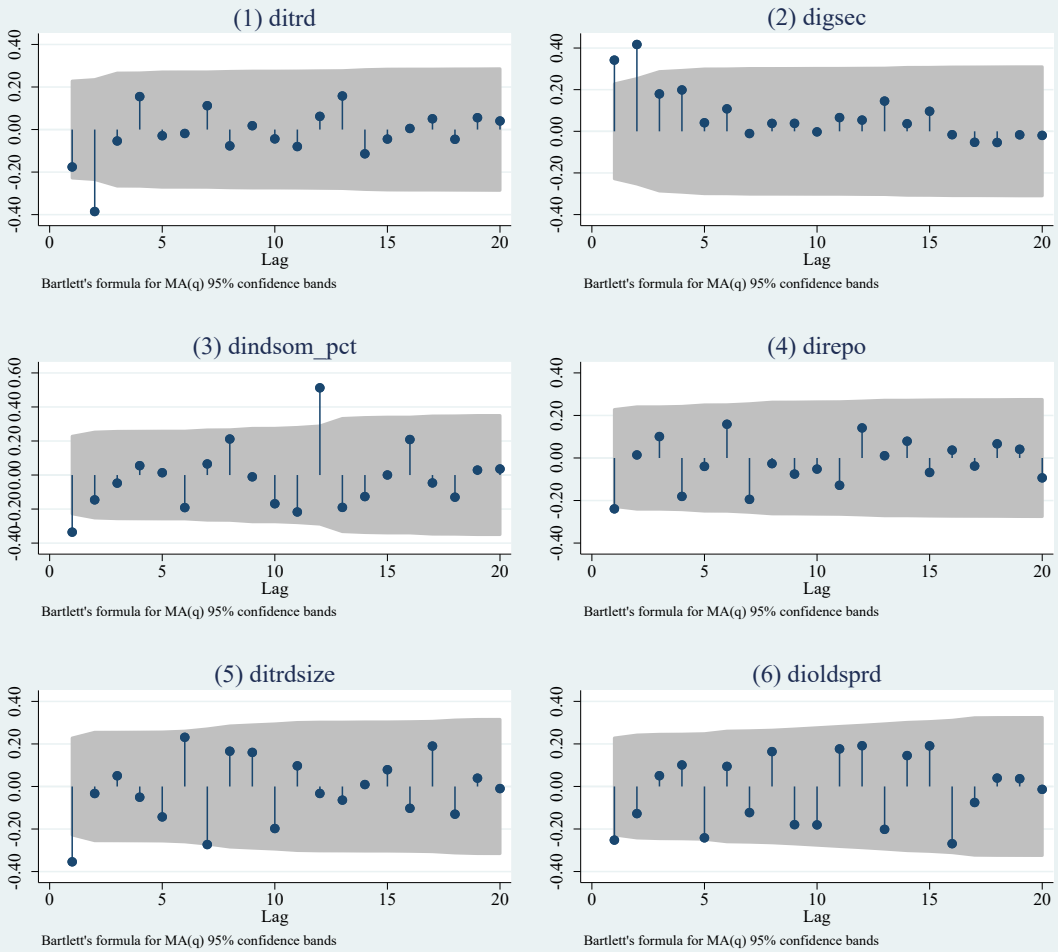


Variable name list (montly averages)
trd: Av Daily Trade volumes
gsec: Av G-sec balance
ndsom_pct: Av Daily NDS-OM Percentages (%)
repos: Av Daily Repos
trdsizes: Av Daily Trade Size
oldsprd: Av Bid-Ask Spreads (%)

Prefixes to variable name
d: first-order difference
i: indexed (normalized)

Source: The Author's calculation

Figure 4-9: Autocorrelation Plots - First Dif. Variables for the First-half Period (2007-01 to 2013-03)

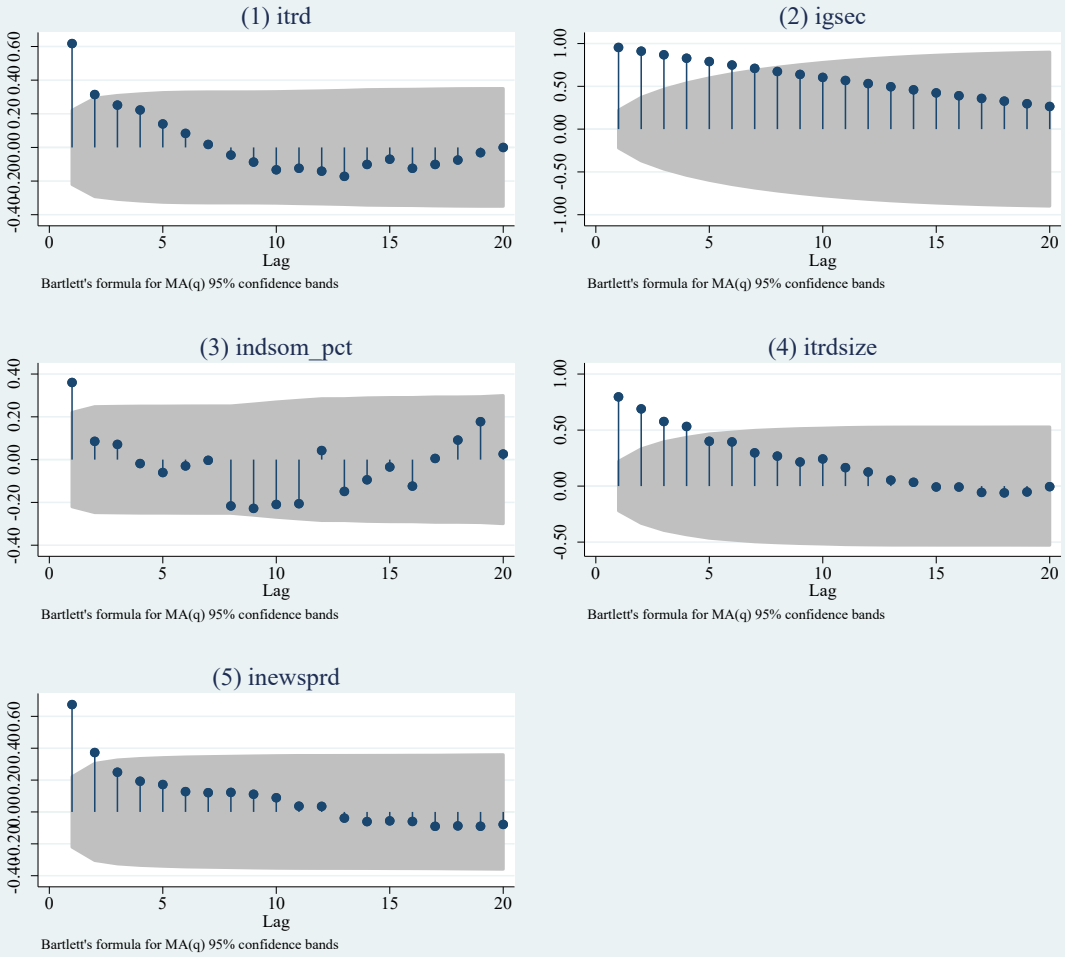


Variable name list (montly averages)
trd: Av Daily Trade volumes
gsec: Av G-sec balance
ndsom_pct: Av Daily NDS-OM Percentages (%)
repos: Av Daily Repos
trdsizes: Av Daily Trade Size
oldsprd: Av Bid-Ask Spreads (%)

Prefixes to variable name
d: first-order difference
i: indexed (normalized)

Source: The Author's calculation

Figure 4-10: Autocorrelation Plots - Level Variables for the Second-half Period (2013-04 to 2019-10)

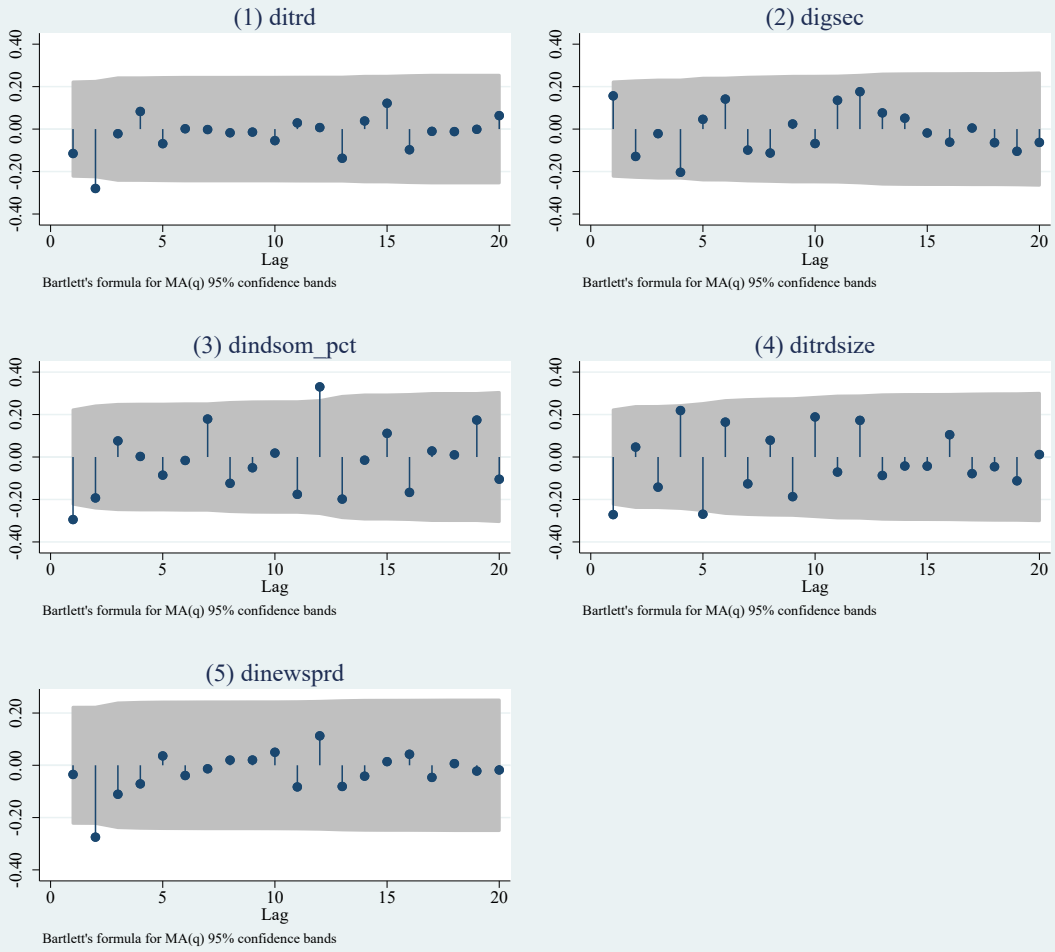


Variable name list (montly averages)
trd: Av Daily Trade volumes
gsec: Av G-sec balance
ndsom_pct: Av Daily NDS-OM Percentages (%)
trdsizes: Av Daily Trade Size
newsprd: Av Bid-Ask Spreads (%)

Prefixes to variable name
d: first-order difference
i: indexed (normalized)

Source: The Author's calculation

Figure 4-11: Autocorrelation Plots – First Dif. Variables for the Second-half Period (2013-04 to 2019-10)

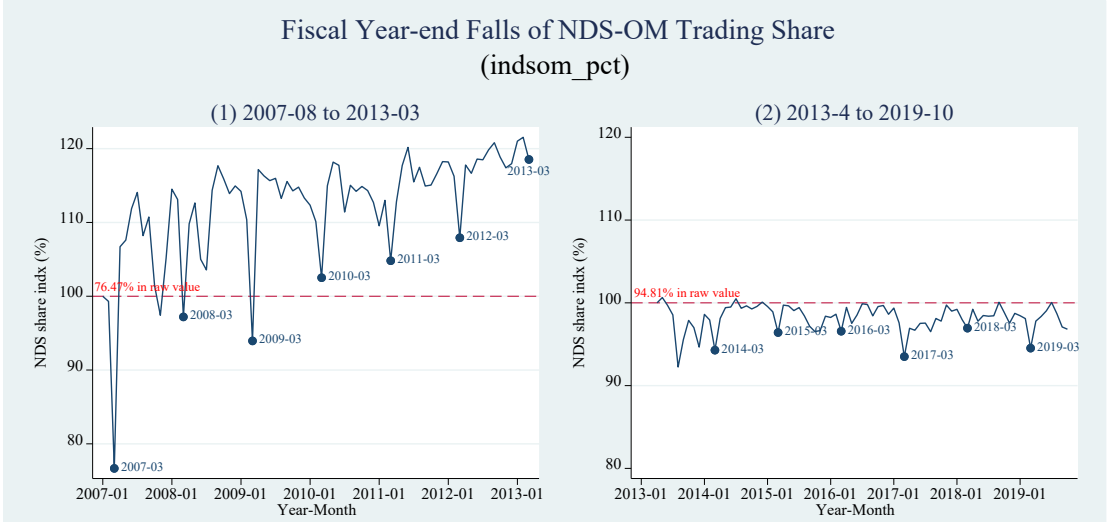


Variable name list (montly averages)
trd: Av Daily Trade volumes
gsec: Av G-sec balance
ndsom_pct: Av Daily NDS-OM Percentages (%)
trdsizes: Av Daily Trade Size
newsprd: Av Bid-Ask Spreads (%)

Prefixes to variable name
d: first-order difference
i: indexed (normalized)

Source: The Author's calculation

Figure 4-12:Fiscal Year-end Dips of NDSOM Trading Share



Source: The author's calculation

Figure 4-13: Parameter Stability for the First-half Period (2007-01 to 2013-03)

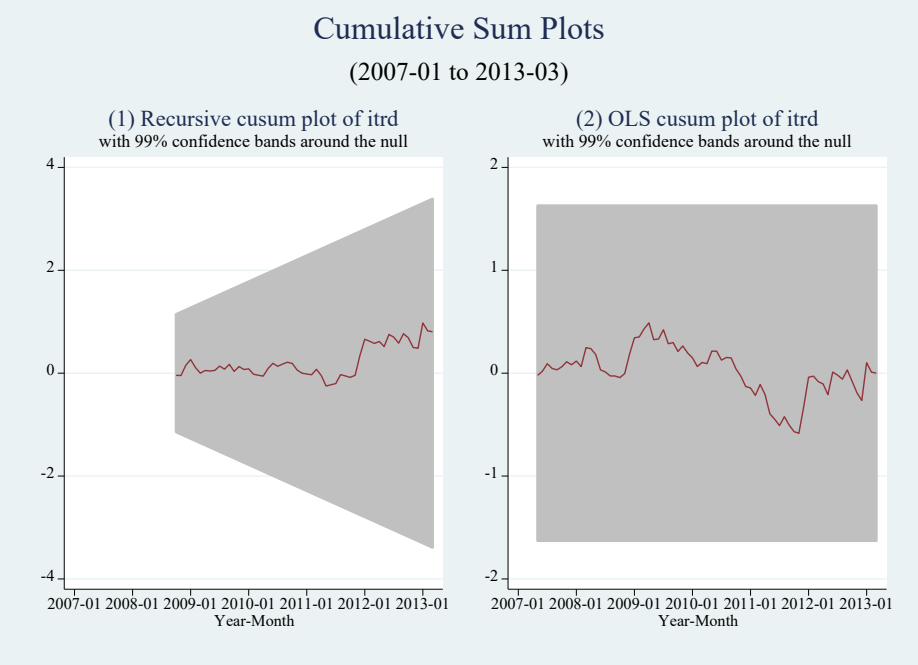


Figure 4-14: Parameter Stability for the Second-half Period (2013-04 to 20193-10))

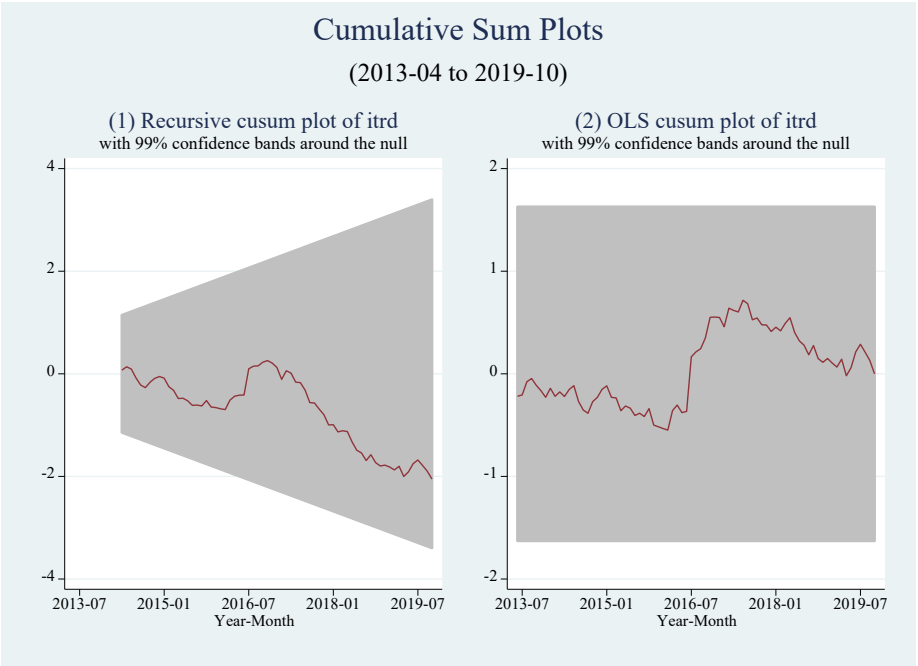
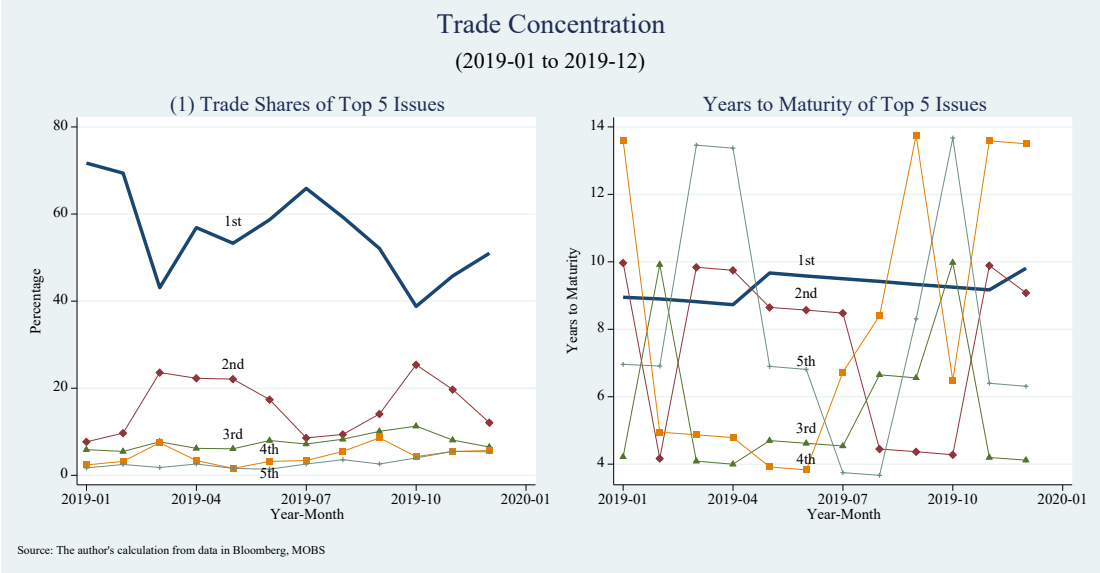


Figure 4-15: Trade Concentration (2019)



Tables

Table 4-1 Two-Dimensional Policy Framework for Government Securities Market Development

April 2, 2021

Market Development phase		**1**	**2**	**3**	**4**
		Nascent	**Evolving**	**Advanced**	**Highly-Advanced**
Investor base (minor investors)		Mainly captive/state Commercial banks State pension fund State insurance companies (Retail investors) (Corporate investors)	Less captive/state Commercial banks Pension funds Insurance companies (Retail investors) (Corporate investors)	Private sector dominant Yield-seeking Pension funds Life insurance companies Cooperatives Foreign investors Mutual funds Commercial banks	More private sector dominant Competitive performance Pension funds Life insurance companies Cooperatives Foreign investors Mutual funds Hedge funds Commercial banks
Policy principles	Policy Measures	Simple Minimum Low cost	Focused Efficiency-seeking, Local Scalable	Competitive Efficient Beyond the banking sector Equal footing	Sophisticated Internationally competitive Prudential Resilient
	Goals	Visibly fundamental and functional	Essential to a national economy	Influential across the yield curve	Internationally compatible
Functioning Market Component					
Accounting	Policy Measures	Disclosure and governance of institutional investors and intermediaries	Amortization	Mark-to-market (Fair value)	Hedge accounting

Market Development phase		1	2	3	4
		Nascent	**Evolving**	**Advanced**	**Highly-Advanced**
	Goals	Trust building in financial intermediation	Reduced price distortion,	Better performance evaluation of asset management Better risk management Competition for better asset management performance More active trading	Derivatives for risk management
Legal affairs	Policy Measures	Modern business law Modern banking law Public debt law Securities Law Immobilization or depository regulation	Trade failure Trade finality Netting arrangements Dematerialization Code of conduct	Payment system law Novation Securities lending Liquidation of collateral and pledged assets Master repo agreement Enhanced prudential supervision and regulation	International harmonization Jurisdictional (re)alignment Legal and jurisdictional coordination regulators
	Goals	Legal basis for debt securities issuance and trading	Certainty and efficiency of trading	International comparability, Legal basis for trading efficiency, settlement certainty, and risk management Enhanced resilience to shocks	International comparability and connectivity
Primary market	Policy Measures	Preannounced auctions Non-competitive bidding Designated/prequalified bidders Treasury bills Short-term maturities	Issue calendar Reopening or buy-back or switching Tap issuance Bidding open to the public Short- to medium-term maturities	Larger issue amounts Syndicate underwriting Long-term maturities Treasury bills for sterilization	Product innovation (like STRIPS)
	Goals	Introduction of market-based public finance	Lower debt cost by pooling liquidity Lower secondary market prices by consolidating issues Broadening of the investor base	Adaptation to institutional investors Liquidity enhancement Extending the benchmark yield curve	A more reliable yield curve (a zero-coupon yield curve)

Market Development phase		1	2	3	4
		Nascent	**Evolving**	**Advanced**	**Highly-Advanced**
Debt and cash management*	Policy Measures	Cleanup of public or quasi-public arrears Public debt issuance legislation DM office Timely & accurate debt record keeping The separation between front- and back-office activities	Increase in domestic borrowing DM strategy and reporting Consolidation of DM functions Sensible balancing or separation between DM and monetary policy operation (e.g., agency agreement) Partial risk management Sovereign credit rating	Treasury single account Cash flow forecasting Integrated debt recording system with the rest of the public financial management system Middle office (integrated sovereign risk management, etc.)	Assets and liabilities management framework (integrated approach)
	Goals	Explicit authorization to borrow Clear delegation of responsibilities Confidence building in public finance Timely debt service	Mitigation of the "original sin." Reduced refinance or liquidity risks Enhanced accountability of public debt Transparency	Better controlled refinance or liquidity risks	Increased natural hedging of the state's balance sheet
Secondary market	Policy Measures	Negotiated (dealers' "Club") market Telephone voice trading	Screen-based electronic trading platform Call auction or continuous order-driven Market convention Market surveillance	Electronic OTC market (quote-driven) Continuous trading Partial PD market making Market transparency rules Interdealer brokers	Full-scale PD market-making Connectivity Interdealer brokers
	Goals	Occasional trading	Trade transparency Periodic/regular price discovery Centralized marketplace	Liquid trading Extend price discovery to the medium- and long-term segments	Continuous price discovery across the yield curve High-volume trading
Monetary policy framework**		Reliance on rules-based instruments	Introducing money market instruments	Increasing open market operations	Full reliance on money market operations
Money market	Policy Measures	Treasury bills Call market Reserve averaging	Standing facilities (Central bank repos) Interest rate corridor Bank repos Sporadic open market repos	Repos among financial and non-financial institutions (open repo market) Commercial papers	Forward-rate agreements

Market Development phase		1	2	3	4
		Nascent	**Evolving**	**Advanced**	**Highly-Advanced**
	Goals	Reduced volatility of money market rates	Reduced volatility of money market rates Even distribution of fund liquidity Anchoring the yield curve at the short end Introduction of market-based monetary operations	Lower and more stable inventory holding costs for non-bank intermediaries Facilitating a shift from direct instruments to indirect ones	Enhanced hedging function
Derivatives or futures	Policy Measures			Interest rate swaps	Interest futures and options Currency futures and options
	Goals			Interest rate hedging	Higher price discovery and liquidity Reinforced price discovery (yield curve)
Clearing and settlement	Policy Measures	Book-entry CSD	Dematerialization DVP Rolling settlement Multiple-net settlement SWIFT Automation	Integration of payment and securities settlement systems RTGS Central bank money STP	CCP Link to international CSDs Special collateral repos
	Goals	No physical delivery Ownership management	Enhanced Backoffice efficiency Closer market monitoring	Systemic risk reduction	Globalization

Source: The Author

Notes:

* Policy measures for debt management in this Table are those for domestic government debt market development. Emerging economies often resort to external debt before or while their domestic government debt markets develop. Their external debt issuance may require the debt issuing economies to put in place more advanced debt management systems in earlier stages than their domestic debt does.

** Based on the author's interpretation of Laurens, J. Bernard.2005. Monetary policy implementation at different stages of market development. IMF Occasional paper No. 244. Washington, D.C.: International Monetary Fund, 2005. Available at http://www.imf.org/external/pubs/nft/op/244/op244.pdf

(1) A country's market may shift from a development phase to another as its economy goes through a major structural change (inter-phase transition), while most market development likely occurs in a single development phase (intra-phase market improvement).

(2) Listed policy measures are, in principle, new policy measures that should be considered in a particular development phase. The four phases and their policy measures and goals are ballpark guidelines. They should be flexibly applied in the local context. A country's market may be implementing some policy measures that the two-dimensional Table specifies for the next or previous phase.
(3) The Table does not base its development phase classification on numerical parameters. A market's development phase can be determined by comparing its policy measures and institutional settings horizontally or vertically.
(4) Countries can have different developmental goals. Every economy may not always want to advance to higher market developmental stages.
(5) The pace of policy implementation may vary depending on actual market development and unfolding circumstances.
(6) Some policy measures listed in a development phase may conflict.
CCP = central counterparty; CSD = central securities depository; DM = debt management; DVP = delivery vs. payment; OTC = over-the-counter (market); PD = primary dealer; RTGS = real-time gross settlement; STP = straight-through processing; STRIPS =Separate Trading of Registered Interest and Principal of Securities; SWIFT =Society for Worldwide Interbank Financial Telecommunication**.**

Table 4-2: A Typical Set of Primary Dealers' Obligations

	Primary Market	**Secondary Market**
Roles	Facilitating Issuance	Market liquidity
Functions	Distribution	Market making
Obligations	Auction participation /Underwriting	Trading volume/value Continuous firm bid-ask quoting
Expected benefits	Low-cost, stable, and low-risk public financing	Price discovery (Financial efficiency) Monetary policy operations

Source: The Author

Table 4-3: PD Interviews & Surveys Statistics

	Licensed	**Interviewed**	**Answered to survey**
PDs	21	17	10
Standalone	7	5	3
Domestic	4	3	2
Foreign	3	2	1
Banks	14	12	7
Domestic	8	8	6
Public	3	3	3
Private	5	5	3
Foreign	6	4	1

Source: The Author

Table 4-4: PD Surveys about Market Making – Questions and Aggregated Answers

Survey Questions	Aggregated Answers
(1) Do you calculate the cost of market-making to determine the spread?	Six PDs follow "market trend." Four PDs look to repos or market liquidity.
(2) Do you build up and hold an inventory of bonds for market-making purposes?	Seven PDs hold an inventory. By contrast, two PDs deny holding any inventory and instead rely on the repo market.
(3) If you take into account the inventory holding costs, do you include: **• Interest expenses (funding cost) of the inventory** **• Market risk costs of the inventory**	Five PDs take into account funding costs and market risk. Two foreign PDs look to repo rates.
(4) When the market volatility increases, what do you do? **• Widen the spread** **• Withdraw your orders from the market, or** **• Others.**	Five PDs withdraw their quotes. Four PDs widen their quotes.
How often do you withdraw your offers?	Two of them frequently (multiple times a day), and another rarely withdraw their quotes.
Do you withdraw your orders for: **• RBI-predetermined benchmark issues,** **• Normally, most liquid issues, or** **• Both?**	Of five PDs withdrawing quotes, three withdraw both RBI-designated benchmark issues and most liquid issues. Two withdraw quotes from most liquid issues only
(5) What is the distribution of trades between interbank and non-interbank customers? **• 90:10** **• 80:20** **• 70:30** **• 60:40** **• Other.**	The ratio of interbank trades ranges from 60 to 95 percent. Active PDs tend to be more interbank-oriented. Public bank PDs tend to have more customer transactions than others.

Source: The Author

Table 4-5: The Utilities of the NDS-OM

Traders' expressions	**Facilitated Functions**	**Positive Effects**	**Reduced Costs**
"Ease"	Standardized order format	Standardized trade execution, settlement, clearing, depository, and reporting	Order processing costs
	Electronic connectivity (vertically integration)	• Reduced human intermediation • Straight-through processing	
	Shorter execution time	Enhanced trade immediacy	Opportunity costs
	Central counterparty	No fails, no counterparty risk, settlement certainty	Information (credit) search costs Order processing costs Opportunity costs
"Transparency"	Centralized marketplace	Ensured best execution	Information search costs
	Displayed pre-trade information (limited order book)		Dealers' oligopoly rents
	Immediately reported post-trade information	Shorter trading cycle	Opportunity costs

Source: The Author

Table 4-6: Sources and Time Span of Data

Monthly Averages of Daily Variable Values	**Observation Ranges**	**Sources**
Outright trade volume, Outright trade value, and Repo trade volume	From August 2005 through October 2019	Table 11[a] in CCIL (2019a) and its back numbers
Outstanding balances of government securities and state development loans	From April 2006 to through October 2019	Table 5[b] in CCIL (2019a)
Percentages of NDS-OM trading	From August 2005 through October 2019	Table 27[c] in CCIL(2019a) and its issue and back numbers
Bid-ask spreads	From January 2007 through December 2014	Executed prices of all government securities, CCIL database
	From April 2013 through October 2019	Spreads (paisa) of liquid securities in the CCIL's Market Liquidity Indicators[d]
Turnover ratios	From April 2013 through October 2019	Calculated from the outstanding balances, outright trade volumes, and outright trade values (also available in the CCIL's Market Liquidity Indicators[d])
Ratios of repos to outright trades	From April 2013 through October 2019	Repos in the CCIL's Market Liquidity Indicators[d]

a Table 11: CCIL SETTLEMENT DETAILS and its equivalent tables before the October 2012 issue
b Table 5: OUTSTANDING - GOVERNMENT SECURITIES, TREASURY BILLS AND STATE DEVELOPMENT LOANS
c Table 27: TRADING PLATFORM ANALYSIS OF OUTRIGHT TRADES and varying table numbers before the January 2016
d https://www.ccilIndia.com/Research/Statistics/Pages/MarketLiquidityIndicator.aspx

Table 4-7 Summary of Variables

(1) The First-half Period

Variable	Variable Label	Obs	Mean	Std. Dev.	Min	Max
Raw Variables						
trd	Av Daily Trades	75	1,447.11	809.66	383.00	4,689.00
gsec	G-securities Balance (INR bil)	75	18,671.38	5,899.67	10,203.50	30,173.60
ndsom_pct	Av Daily NDS-OM Percentages (%)	75	85.96	5.62	58.63	92.94
trdsize	Trade Value Size	75	0.09	0.01	0.07	0.12
oldsprd	Av Old Bid-Ask Spreads (%)	75	0.24	0.18	0.04	0.72
repo	Av Daily Repos	75	204.48	46.66	113.00	317.00
Normalized Variables						
itrd	Trade Volume indx (%)	75	248.64	139.12	65.81	805.67
igsec	G-securities Balance indx (%)	75	182.99	57.82	100.00	295.72
indsom_pct	NDS share indx (%)	75	112.41	7.35	76.67	121.54
itrdsize	Trade Value Size indx (%)	75	125.61	13.70	100.00	167.81
ioldsprd	Old spread indx (%)	75	151.90	115.95	28.06	463.90
irepo	Repo indx (%)	75	116.85	26.66	64.57	181.14

(2) The Second-half Period

Variable	Variable Label	Obs	Mean	Std. Dev.	Min	Max
Raw Variables						
trd	Av Daily Trades	79	4,004.66	1,235.44	1,936.00	8,647.00
gsec	G-securities Balance (INR bil)	79	44,215.38	7,248.60	30,623.60	57,227.70
ndsom_pct	Av Daily NDS-OM Percentages (%)	79	93.11	1.52	87.46	95.42
trdsize	Trade Value Size	79	0.12	0.01	0.10	0.15
newsprd	New Bid-Ask Spread (%)	79	0.03	0.03	0.01	0.18
Normalized Variables						
itrd	Trade Volume indx (%)	79	82.81	25.55	40.03	178.80
igsec	G-securities Balance indx (%)	79	144.38	23.67	100.00	186.87
indsom_pct	NDS share indx (%)	79	98.20	1.60	92.25	100.64
itrdsize	Trade Value Size indx (%)	79	98.77	10.80	81.84	123.95
inewsprd	new spread indx (%)	79	85.51	67.16	26.05	438.96

Source: The Author's calculation

Table 4-8: Correlation Coefficients among Variables

(1) The First-half Period (2007-01 - 2013-03)

	itrd	*igsec*	*indsom_pct*	*itrdsize*	*ioldsprd*	*irepo*
itrd	1					
igsec	0.7798	1				
indsom_pct	0.6621	0.5881	1			
itrdsize	0.4196	0.3352	0.2008	1		
ioldsprd	-0.2083	-0.3947	-0.0134	0.0575	1	
irepo	0.6615	0.6926	0.361	0.5126	-0.2851	1

(2) The Second-half Period (2013-04 - 2019-10)

	itrd	*igsec*	*indsom_pct*	*itrdsize*	*inewsprd*	*irepo*
itrd	1					
igsec	0.0638	1				
indsom_pct	0.5592	-0.0089	1			
itrdsize	0.3881	0.6401	0.0145	1		
inewsprd	-0.3578	-0.2566	-0.428	-0.2194	1	
irepo	0.0742	0.9545	0.0394	0.6324	-0.2174	1

Source: The Author's calculation

Table 4-9: Durbin's alternative test for Autocorrelation

(1) The First-half Period (2007-01 - 2013-03)

		lags(p)	chi2	df	Prob>chi2	Autocorrelation
Level	*itrd*	1	17.500	1	0.0000	Present
	igsec	1	1028.693	1	0.0000	Present
	indsom_pct	1	3.383	1	0.0659	Not present
	irepo	1	97.241	1	0.0000	Present
	itrdsize	1	35.748	1	0.0000	Present
	ioldsprd	1	71.556	1	0.0000	Present
First difference	*d.itrd*	1	2.342	1	0.1259	Not present
	d.igsec	1	3.234	1	0.0721	Not present
	d.indsom_pct	1	9.051	1	0.0026	Present
	d.irepo	1	4.568	1	0.0326	Present
	d.itrdsd.ize	1	10.289	1	0.0013	Present
	d.ioldsprd	1	4.857	1	0.0275	Present

(2) The Second-half Period (2013-04 - 2019-10)

		lags(p)	chi2	df	Prob>chi2	Autocorrelation
Level	*itrd*	1	47.542	1	0.0000	Present
	igsec	1	250.153	1	0.0000	Present
	indsom_pct	1	11.532	1	0.0007	Present
	itrdsize	1	75.380	1	0.0000	Present
	inewsprd	1	57.643	1	0.0000	Present
First difference	*d.itrd*	1	1.003	1	0.3165	Not present
	d.igsec	1	1.857	1	0.1730	Not present
	d.indsom_pct	1	7.132	1	0.0076	Present
	d.itrdsd.ize	1	6.676	1	0.0098	Present
	d.inewsprd	1	0.092	1	0.7612	Not present

Source: The Author's calculation

Table 4-10: varsoc for Optimal Lag Order Selection

(1L) The First-half Period (2007-01 - 2013-03) - Level

Selected Lag Order	***itrd* 4**		igsec **3**		***indsom_pct* 1**		***irepo* 1**		***itrdsize* 1**		***inoldsprd* 1**	
maxlag	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC
2	1	1	2	2	1	1	2	1	2	1	1	1
3	3	3	3	3	1	1	2	1	2	1	1	1
4	4	4	3	3	1	1	2	1	2	1	1	1
5	4	4	3	3	1	1	2	1	2	1	1	1
6	6	4	3	3	1	1	1	1	1	1	1	1
7	6	4	3	3	7	1	1	1	2	1	1	1
8	6	4	3	3	8	1	2	1	2	1	1	1

(1F) The First-half Period (2007-01 - 2013-03) - First Difference

Selected Lag Order	***ditrd* 3**		***digsec* 2**		***dindsom_pct* 3**		***direpo* 0**		***ditrdsize* 1**		***dioldsprd* 1**	
maxlag	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC
2	2	2	2	2	2	2	1	1	2	1	2	1
3	3	3	2	2	3	3	1	0	2	1	2	1
4	3	3	2	2	3	3	1	0	2	1	2	1
5	5	3	2	2	3	2	1	0	2	1	2	1
6	3	3	2	2	6	3	1	0	2	1	2	1
7	3	3	2	2	7	7	1	0	2	1	2	1
8	3	3	2	2	7	7	1	0	2	1	2	1

(2L) The Second-half Period (2013-04 - 2019-10) - Level

Selected Lag Order	***itrd* 1**		***igsec* 1**		***indsom_pct* 1**		***itrdsize* 1**		***inewsprd* 1**	
maxlag	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC
2	1	1	1	1	1	1	2	1	1	1
3	1	1	1	1	1	1	2	1	3	1
4	1	1	1	1	1	1	2	1	1	1
5	3	1	5	1	1	1	2	2	1	1
6	3	1	5	1	1	1	2	2	3	3
7	3	1	5	1	1	1	2	2	2	2
8	3	1	5	1	1	1	2	2	3	2

(2F) The Second-half Period (2013-04 - 2019-10) - First Difference

Selected Lag Order	***ditrd* 2**		***digsec* 0**		***dindsom_pct* 2**		***ditrdsize* 1**		***dinewsprd* 0**	
maxlag	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC	AIC	SBIC
2	2	0	0	0	2	2	1	1	2	0
3	2	2	0	0	2	2	1	1	2	0
4	2	2	4	0	2	2	1	1	4	2
5	2	2	0	0	2	2	1	1	5	4
6	2	2	4	0	2	2	1	1	1	1
7	2	2	4	0	2	2	1	1	2	1
8	2	2	4	0	2	2	1	1	2	1

Source: The Author's calculation

Table 4-11: Optimal Lag Orders

		trd	*gsec*	*ndsom_pct*	*repo*	*trdsize*	*old/newsprd*
First-half	Level	4	3	1	1	1	1
	First dif.	3	2	3	0	1	1
Second-half	Level	1	1	1		1	1
	First dif.	2	0	2		1	0

Source: The Author's calculation

Table 4-12: DF-GLS Tests for the first-half period (2007-1 to 2013-3)

(1) Level for the first-half period (2007-1 to 2013-3)

(1-1) Lag order by the Schwert criterion

variable	*itrd*		*igsec*		*indsom_pct*		*irepo*		*itrdsize*		*ioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
11	-1.198	-2.718	-1.241	-2.718	-0.767	-2.718	-1.246	-2.718	-1.765	-2.718	-1.060	-1.993
10	-1.445	-2.761	-1.101	-2.761	-1.530	-2.761	-1.620	-2.761	-1.635	-2.761	-1.032	-2.011
9	-1.476	-2.805	-1.271	-2.805	-1.637	-2.805	-1.622	-2.805	-1.786	-2.805	-1.475	-2.030
8	-1.191	-2.849	-1.147	-2.849	-1.543	-2.849	#-2.004	-2.849	-1.519	-2.849	-1.709	-2.051
7	-1.298	-2.892	-1.163	-2.892	-1.582	-2.892	#-2.295	-2.892	-1.535	-2.892	-1.490	-2.072
6	-1.123	-2.934	-1.323	-2.934	-1.906	-2.934	#-2.483	-2.934	-1.895	-2.934	-1.806	-2.094
5	-1.298	-2.975	-1.230	-2.975	#-2.469	-2.975	-1.949	-2.975	-1.824	-2.975	-1.774	-2.115
4	-1.724	-3.013	-1.376	-3.013	#-2.735	-3.013	#-2.268	-3.013	#-2.106	-3.013	#-2.145	-2.136
3	-1.868	-3.048	-1.189	-3.048	#-2.803	-3.048	#-2.550	-3.048	#-2.292	-3.048	-1.890	-2.156
2	#-2.621	-3.079	-1.279	-3.079	#-3.893	-3.079	#-2.087	-3.079	#-2.382	-3.079	-1.937	-2.174
1	#-4.664	-3.107	-0.577	-3.107	#-5.194	-3.107	#-2.092	-3.107	#-2.665	-3.107	#-2.340	-2.191

DF-GLS = DF-GLS tau test statics / cv 5% = critical value at 5%

(1-2) Lag order calculated by varsoc on the *itrd* variable

variable	*itrd*		*igsec*		*indsom_pct*		*irepo*		*itrdsize*		*ioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
4	-1.853	-3.001	-1.295	-3.001	#-3.625	-3.001	#-2.353	-3.001	-1.899	-3.001	#-2.237	-2.121
3	#-2.07	-3.031	-1.166	-3.031	#-3.801	-3.031	#-2.677	-3.031	-1.991	-3.031	-1.983	-2.138
2	#-2.852	-3.059	-1.272	-3.059	#-4.481	-3.059	#-2.289	-3.059	#-2.013	-3.059	#-2.028	-2.155
1	#-4.949	-3.083	-0.585	-3.083	#-5.163	-3.083	#-2.306	-3.083	#-2.399	-3.083	#-2.439	-2.169

DF-GLS = DF-GLS tau test statics / cv 5% = critical value at 5%

(2) First Difference for the first-half period (2007-1 to 2013-3)

(2-1) Lag order by the Schwert criterion

variable	*ditrd*		*digsec*		*dindsom_pct*		*direpo*		*ditrdsdize*		*dioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
11	-1.042	-1.994	#-2.222	-2.715	-1.637	-1.994	#-3.049	-1.994	#-2.169	-1.994	#-2.758	-1.994
10	-1.277	-2.012	#-2.47	-2.758	#-3.002	-2.012	#-3.632	-2.012	#-2.107	-2.012	#-3.521	-2.012
9	-1.231	-2.031	#-2.852	-2.803	#-2.183	-2.031	#-3.304	-2.031	#-2.497	-2.031	#-4.239	-2.031
8	-1.412	-2.052	#-2.562	-2.848	#-2.454	-2.052	#-3.664	-2.052	#-2.482	-2.052	#-3.332	-2.052
7	-1.917	-2.074	#-2.942	-2.892	#-3.039	-2.074	#-3.458	-2.074	#-3.642	-2.074	#-3.143	-2.074
6	#-2.193	-2.096	#-3.014	-2.935	#-4.118	-2.096	#-3.300	-2.096	#-4.327	-2.096	#-4.076	-2.096
5	#-3.384	-2.117	#-2.807	-2.976	#-4.529	-2.117	#-3.311	-2.117	#-3.777	-2.117	#-3.766	-2.117
4	#-4.174	-2.139	#-3.063	-3.015	#-4.416	-2.139	#-4.271	-2.139	#-5.054	-2.139	#-4.387	-2.139
3	#-4.893	-2.159	#-2.913	-3.050	#-5.417	-2.159	#-4.077	-2.159	#-4.968	-2.159	#-4.073	-2.159
2	#-7.187	-2.178	#-3.306	-3.083	#-7.972	-2.178	#-4.026	-2.178	#-5.562	-2.178	#-5.613	-2.178
1	#-9.243	-2.194	#-3.322	-3.110	#-9.304	-2.194	#-6.289	-2.194	#-7.558	-2.194	#-7.58	-2.194

DF-GLS = DF-GLS mu test statics / cv 5% = critical value at 5%

(2-2) Lag order calculated by varsoc on the *itrd* variable

variable	*ditrd*		*digsec*		*dindsom_pct*		*direpo*		*ditrdsdize*		*dioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
3	#-5.133	-2.138	#-3.131	-3.031	#-5.915	-2.138	#-4.643	-2.138	#-5.027	-2.138	#-4.355	-2.138
2	#-7.303	-2.155	#-3.499	-3.059	#-7.498	-2.155	#-4.602	-2.155	#-5.924	-2.155	#-5.95	-2.155
1	#-9.443	-2.169	#-3.497	-3.083	#-8.875	-2.169	#-6.710	-2.169	#-8.120	-2.169	#-8.021	-2.169

DF-GLS = DF-GLS mu test statics / cv 5% = critical value at 5%

Reject Ho (unit root)
Source: The Author's calculation

Table 4-13: DF-GLS Tests for the second-half period (2013-4 to 2019-10)

(1) Level for the second-half period (2013-4 to 2019-10)

(1-1) Lag order by the Schwert criterion

variable	*itrd*		*igsec*		*indsom_pct*		*itrdsize*		*ioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
11	#-2.243	-1.991	-1.313	-2.731	-1.593	-1.991	-1.621	-1.991	-1.435	-1.991
10	#-2.225	-2.009	-1.061	-2.772	#-2.257	-2.009	-1.583	-2.009	-1.519	-2.009
9	#-2.474	-2.027	-1.151	-2.813	#-2.485	-2.027	-1.288	-2.027	-1.433	-2.027
8	#-2.455	-2.047	-1.050	-2.854	#-2.732	-2.047	-1.504	-2.047	-1.415	-2.047
7	#-2.626	-2.068	-1.203	-2.894	#-2.805	-2.068	-1.544	-2.068	-1.429	-2.068
6	#-2.51	-2.088	-1.343	-2.933	#-2.648	-2.088	-1.733	-2.088	-1.447	-2.088
5	#-2.507	-2.108	-1.265	-2.971	#-2.741	-2.108	-1.550	-2.108	-1.469	-2.108
4	#-2.649	-2.127	-1.164	-3.006	#-2.901	-2.127	-1.790	-2.127	-1.568	-2.127
3	#-2.791	-2.146	-1.453	-3.038	#-3.307	-2.146	-1.482	-2.146	-1.757	-2.146
2	#-2.864	-2.163	-1.397	-3.067	#-3.382	-2.163	-1.762	-2.163	-1.867	-2.163
1	#-3.884	-2.178	-1.591	-3.093	#-3.876	-2.178	-1.672	-2.178	#-2.265	-2.178

DF-GLS = DF-GLS mu test statics / cv 5% = critical value at 5%

(1-2) Lag order calculated by varsoc on the *itrd* variable

variable	*itrd*		*igsec*		*indsom_pct*		*itrdsize*		*ioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
1	#-3.89	-2.151	-1.905	-3.063	#-3.811	-2.151	-1.491	-2.151	-1.846	-2.151

DF-GLS = DF-GLS mu test statics / cv 5% = critical value at 5%

(2) First Difference for the second-half period (2013-4 to 2019-10)

(2-1) Lag order by the Schwert criterion

variable	*ditrd*		*digsec*		*dindsom_pct*		*ditrdsdize*		*dioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
11	-0.343	-1.991	-0.960	-1.991	-1.212	-1.991	-0.876	-1.991	0.113	-1.991
10	-0.352	-2.009	-1.076	-2.009	-1.942	-2.009	-0.822	-2.009	-0.171	-2.009
9	-0.345	-2.028	-1.357	-2.028	-1.669	-2.028	-0.811	-2.028	-0.241	-2.028
8	-0.372	-2.048	-1.438	-2.048	-1.817	-2.048	-0.893	-2.048	-0.479	-2.048
7	-0.443	-2.069	-1.755	-2.069	-1.876	-2.069	-0.918	-2.069	-0.731	-2.069
6	-0.494	-2.089	-1.854	-2.089	#-2.133	-2.089	-1.018	-2.089	-0.818	-2.089
5	-0.648	-2.110	-1.946	-2.110	#-2.926	-2.110	-1.051	-2.110	-0.949	-2.110
4	-0.887	-2.129	#-2.407	-2.129	#-3.528	-2.129	-1.389	-2.129	-1.169	-2.129
3	-1.195	-2.148	#-3.212	-2.148	#-4.508	-2.148	-1.460	-2.148	-1.687	-2.148
2	-1.912	-2.165	#-3.289	-2.165	#-5.074	-2.165	#-2.19	-2.165	#-2.344	-2.165
1	#-3.469	-2.181	#-4.452	-2.181	#-6.873	-2.181	#-2.861	-2.181	#-3.883	-2.181

DF-GLS = DF-GLS mu test statics / cv 5% = critical value at 5%

(2-2) Lag order calculated by varsoc on the *itrd* variable

variable	*ditrd*		*digsec*		*dindsom_pct*		*ditrdsdize*		*dioldsprd*	
lag order	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%	DF-GLS	cv 5%
2	#-2.317	-2.142	#-3.348	-2.142	#-5.876	-2.142	#-2.706	-2.142	#-5.019	-2.142
1	#-3.879	-2.156	#-4.776	-2.156	#-8.489	-2.156	#-3.514	-2.156	##-6.67	-2.156

DF-GLS = DF-GLS mu test statics / cv 5% = critical value at 5%

Reject Ho (unit root)
Source: The Author's calculation

Table 4-14: Augmented Dickey-Fuller test for Unit Root

(1) The First-half Period (2007-01 - 2013-03)

Order	Variable	Lag	Option	Z(t) Interporated Dickey-Fuller Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon approximate p-value for Z(t)	Unit-root presence (Stationary/Non-stationary)
Level	*itrd*	4	trend	-1.581	-4.106	-3.480	-3.168	0.7998	Stationary
	igsec	4	drift	1.277	-2.386	-1.669	-1.295	0.8969	Stationary
	indsom_pct	4	trend	-5.464	-4.106	-3.480	-3.168	0.0000	Non-stationary
	irepo	4	trend	-2.358	-4.106	-3.480	-3.168	0.4021	Stationary
	itrdsize	4	trend	-2.212	-4.106	-3.480	-3.168	0.4832	Stationary
	ioldsprd	4	trend	-2.366	-3.552	-2.914	-2.592	0.1517	Stationary
First difference	*d.itrd*	3	noconstant	-6.035	-2.612	-1.950	-1.610		Stationary
	d.igsec	3		-2.900	-3.552	-2.914	-2.592	0.0453	Stationary
	d.indsom_pct	3	noconstant	-6.390	-2.612	-1.950	-1.610		Stationary
	d.irepo	3	noconstant	-4.564	-2.612	-1.950	-1.610		Stationary
	d.itrdsd.ize	3	noconstant	-4.917	-2.612	-1.950	-1.610		Stationary
	d.ioldsprd	3	noconstant	-4.359	-2.612	-1.950	-1.610		Stationary

(2) The Second-half Period (2013-04 - 2019-10)

Order	Variable	Lag	Option	Z(t) Interpolated Dickey-Fuller Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon approximate p-value for Z(t)	Unit-root presence (Stationary/Non-stationary)
Level	*itrd*	1		-4.378	-3.542	-2.908	-2.589	0.0003	Stationary
	igsec	1	drift	-0.371	-2.378	-1.666	-1.293	0.3559	Non-stationary
	indsom_pct	1		-5.225	-3.542	-2.908	-2.589	0.0000	Stationary
	itrdsize	1		-1.436	-3.542	-2.908	-2.589	0.5649	Non-stationary
	inewsprd	1		-4.043	-3.542	-2.908	-2.589	0.0012	Stationary
First difference	*ditrd*	2		-6.653	-3.545	-2.910	-2.590	0.0000	Stationary
	digsec	2		-5.003	-3.545	-2.910	-2.590	0.0000	Stationary
	dindsom_pct	2		-6.958	-3.545	-2.910	-2.500	0.0000	Stationary
	ditrdsdize	2		-6.364	-3.545	-2.910	-2.590	0.0000	Stationary
	dinewsprd	2		-6.927	-3.545	-2.910	-2.590	0.0000	Stationary

Source: The Author's calculation

Table 4-15: HEGY test for Seasonal Unit Root

(1) The First-half Period

tested for		***itrd***		***indsom_pct***	
Deterministic variables :		Seasonal dummies and linear trend (strend)		Seasonal dummies and linear trend (strend)	
Lags tested:		12		12	
	Cycles per year	Stat	5% critical	Stat	5% critical
t[0]		-0.652	-2.991	-1.125	-2.985
t[π]	6	-1.558	-2.480	-1.905	-2.474
F[π/6]	1	3.855	5.154	2.484	5.135
F[π/3]	2	2.373	5.154	4.997	5.135
F[π/2]	3	4.247	5.154	1.666	5.135
F[2*π/3]	4	4.278	5.154	3.736	5.135
F[5*π/6]	5	1.763	5.154	3.033	5.135
F[All seas]		#5.282	4.507	#7.113	4.510
F[All]		#4.945	4.818	#7.989	4.824

Reject Ho (seasonal unit root)

(2) The Second-half Period

tested for		***itrd***		***indsom_pct***	
Deterministic variables :		Seasonal dummies		Seasonal dummies	
Lags tested:		12		12	
	Cycles per year	Stat	5% critical	Stat	5% critical
t[0]		-2.294	-2.505	#-3.594	-2.505
t[π]	6	-2.452	-2.520	-1.994	-2.520
F[π/6]	1	4.701	5.273	4.833	5.273
F[π/3]	2	3.526	5.273	5.247	5.273
F[π/2]	3	5.143	5.273	#11.441	5.273
F[2*π/3]	4	5.092	5.273	#10.270	5.273
F[5*π/6]	5	4.912	5.273	#6.794	5.273
F[All seas]		#16.977	4.533	#25.656	4.533
F[All]		#15.944	4.546	#24.994	4.546

Reject Ho (seasonal unit root)

Source: The Author's calculation

Table 4-16: Bounds testing for cointegration) and Postestimation Tests

(1) The First-half Period (2007-01 - 2013-03)

Lag order combination	Bounds testing for cointegration (estat ectest)		Durbin-Watson test for autocorrelation (estat dwatson)	Breusch–Godfrey test for autocorrelation (estat bgodfrey, lags(1))	White's test for homoskedasticity (estat imtest, white)
	F	t	Normal 1.5 - 2.5	Ho: No autocorrelation	Ho: homoskedasity
	Reject Ho (no level relationship) at				
2 1 0 0 0 0	10%, 5%, 1%	10%, 5%, 1%	1.9291	0.9694	#0.0201
2 1 1 1 1 1	**10%, 5%, 1%**	**10%, 5%, 1%**	**1.9131**	**0.8772**	**0.4449**
3 3 1 1 1 1	10%, 5%, 1%	10% , 5%	1.9801	0.8581	0.4445
4 3 1 1 1 1	10%	Nil.	1.9271	0.0847	0.4442

Reject Ho; Stata commands are in parentheses.

(2) The Second-half Period (2013-04 - 2019-10)

Lag order combination	Bounds testing for cointegration (estat ectest)		Durbin-Watson test for autocorrelation (estat dwatson)	Breusch–Godfrey test for autocorrelation (estat bgodfrey, lags(1))	White's test for homoskedasticity (estat imtest, white)
	F	t	Normal 1.5 - 2.5	Ho: No autocorrelation	Ho: homoskedasity
	Reject Ho (no level relationship) at				
1 0 0 0 0	10%, 5%, 1%	10%, 5%, 1%	1.5445	#0.0132	0.9287
1 1 0 0 0	10%, 5%, 1%	10%, 5%, 1%	1.5927	#0.0282	0.9845
1 1 0 0 1	10%, 5%, 1%	10%, 5%, 1%	1.5879	#0.0198	0.9702
1 1 0 1 0	**10%, 5%, 1%**	**10%, 5%, 1%**	**1.7479**	**0.1512**	**0.9946**
1 1 1 0 0	10%, 5%	10%, 5%, 1%	1.7715	0.1453	0.9933
1 1 1 1 1	10%, 5%	10%, 5%	1.9131	0.7735	0.9958
2 0 0 0 0	10%, 5%, 1%	10%, 5%, 1%	#1.48172	#0.0022	0.7640
2 1 1 1 1	10%	10%	1.9247	0.9608	0.8362

Reject Ho; Stata commands are in parentheses.
Source: The Author's calculation

Table 4-17: Stata output - Cointegration Relationship of itrd and independent variables for The First-half Period (2007-01 - 2013-03)

The First-half Period (2007-01 - 2013-03)

ARDL(2,1,1,1,1,1) regression

Sample: 2007-03 - 2013-03	Number of obs	=	73
	R-squared	=	**0.5107**
	Adj R-squared	=	0.4128
Log likelihood = -410.93335	Root MSE	=	74.3172

D.*itrd*	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ADJ						
itrd						
L1.	-0.963828	0.1596048	-6.04	0.000	-1.283085	-0.64457
LR						
igsec	1.238424	0.3184949	3.89	0.000	0.6013392	1.875508
indsom_pct	4.71427	2.321337	2.03	0.047	0.070905	9.357634
irepo	0.9855633	0.6519742	1.51	0.136	-0.3185794	2.289706
itrdsize	1.90578	1.046627	1.82	0.074	-0.1877863	3.999347
ioldsprd	0.0476454	0.1083383	0.44	0.662	-0.1690634	0.264354
SR						
itrd						
LD.	0.2718715	0.12608	2.16	0.035	0.0196739	0.524069
igsec						
D1.	-9.161366	6.217188	-1.47	0.146	-21.59759	3.274862
indsom_pct						
D1.	0.5674625	1.729826	0.33	0.744	-2.892704	4.027629
irepo						
D1.	0.2449174	0.7173015	0.34	0.734	-1.189899	1.679734
itrdsize						
D1.	-0.744683	0.9562347	-0.78	0.439	-2.657437	1.168071
ioldsprd						
D1.	-0.0049948	0.1183265	-0.04	0.966	-0.2416831	0.231694
_cons	-817.1547	252.2628	-3.24	0.002	-1321.755	-312.554

Source: The Author's calculation

Table 4-18: Stata output - Cointegration Relationship of itrd and independent variables for The Second-half Period (2013-04 - 2019-10)

The Second-half Period (2013-04 - 2019-10)

ARDL(1,1,0,1,0) regression

Sample: 2013-05 - 2019-10	Number of obs	=	78
	R-squared	=	**0.4876**
	Adj R-squared	=	0.4363
Log likelihood = -325.95736	Root MSE	=	16.6783

D.*itrd*	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ADJ						
itrd						
L1.	-0.6381263	0.095634	-6.67	0.000	-0.8288622	-0.44739
LR						
igsec	-0.3353774	0.1787872	-1.88	0.065	-0.6919573	0.021202
indsom_pct	10.81974	2.306342	4.69	0.000	6.219886	15.4196
itrdsize	1.168602	0.4117613	2.84	0.006	0.3473701	1.989834
inewsprd	-0.0286854	0.0512199	-0.56	0.577	-0.1308402	0.07347
SR						
igsec						
D1.	-2.892274	2.199252	-1.32	0.193	-7.278543	1.493996
itrdsize						
D1.	0.5225009	0.3435998	1.52	0.133	-0.1627873	1.207789
_cons	-663.3685	142.0962	-4.67	0.000	-946.7704	-379.967

Source: The Author's calculation

Table 4-19: R-squared and Postestimation Tests with Variables Excluded

Lag order combination*	Bounds testing for cointegration (estat ectest) F	t	Durbin-Watson test for autocorrelation (estat dwatson)	Breusch–Godfrey test for autocorrelation (estat bgodfrey, lags(1)) Ho: No autocorrelation	White's test for homoskedasticity (estat imtest, white) Ho: homoskedasity	R-squared	Ho: var = 0 *indsom_pct*	Ho: var = 0 *irepo*
	Reject Ho (no level relationship) at		Normal 1.5 -2.5					
(1) ARDL/EC model controlling for *igsec* for the First-half Period (2007-01 - 2013-03)								
1 0 0 0 0	10%, 5%, 1%	10%, 5%, 1%	1.965487	0.8438	0.0936	**0.4022**	#0.000	#0.023
1 1 0 0 0	10%, 5%	10%, 5%, 1%	1.980802	0.8762	0.3032	0.4024	#0.000	#0.027
1 1 1 0 0	10%, 5%	10%, 5%, 1%	1.972868	0.7909	0.1520	0.4027	#0.000	#0.038
1 1 1 1 0	10%, 5%	10%, 5%, 1%	1.925314	0.4517	0.1804	0.4083	#0.000	0.063
1 1 1 1 1	10%, 5%	10%, 5%	1.922488	0.4358	0.2543	0.4128	#0.000	0.068
2 0 0 0 0	10%, 5%, 1%	10%, 5%, 1%	1.964340	0.8041	0.0075	0.4058	#0.000	#0.018
2 1 1 0 0	10%, 5%	10%, 5%	1.959265	0.5055	0.0658	0.4065	#0.000	#0.028
2 1 1 1 0	10%, 5%	10%, 5%	1.910631	0.5679	0.1678	0.4132	#0.000	#0.049
2 1 1 1 1	10%, 5%	10%, 5%	1.904224	0.4511	0.4512	0.4171	#0.000	0.054
(2) ARDL/EC model controlling for *igsec* and *indsom_pct* for the First-half Period (2007-01 - 2013-03)								
1 0 0 0	10%, 5%, 1%	10%, 5%	1.964616	0.8341	0.4852	**0.1814**	Excluded	#0.015
1 1 0 0	10%	10%, 5%	1.980802	0.8762	0.3032	0.1839	Excluded	#0.016
1 1 1 0	10%	10%, 5%	1.899729	0.4570	0.0873	0.2132	Excluded	0.051
1 1 1 1	10%	10%, 5%	1.900370	0.4606	0.1283	0.2137	Excluded	0.053
2 0 0 0	10%	10%	1.964340	0.8041	#0.0075	0.1894	Excluded	#0.008
2 1 0 0	None	10%	1.988918	0.9343	#0.0183	0.1934	Excluded	#0.007
2 1 1 0	None	10%	1.946091	0.3714	#0.0266	0.2214	Excluded	#0.025
2 1 1 1	None	10%	1.945987	0.3681	0.0955	0.2217	Excluded	0.488

* In the order of *itrd, indsom_pct, irepo, itrdsize,* and i*oldsprd* for (1); and *itrd, irepo, itrdsize,* and *ioldsprd* for (2)
# Reject Ho
Source: The Author's calculation

Table 4-20: R-squared and Postestimation Tests with Variables excluded

Lag order combination*	Bounds testing for cointegration (estat ectest) F	Bounds testing for cointegration (estat ectest) t	Durbin-Watson test for autocorrelation (estat dwatson)	Breusch–Godfrey test for autocorrelation (estat bgodfrey, lags(1)) Ho: No autocorrelation	White's test for homoskedasticity (estat imtest, white) Ho: homoscedasity	R-squared	Ho: var = 0 *indsom_pct*	Ho: var = 0 *irepo*
	Reject Ho (no level relationship) at		Normal 1.5 -2.5					
(1) ARDL/EC model excluding igsec for the Second-half Period (2013-04 - 2019-10)								
1 0 0 0	10%, 5%, 1%	10%, 5%, 1%	1.553040	0.0175	0.7832	**0.4213**	#0.000	#0.008
1 1 0 0	10%, 5%	10%, 5%, 1%	1.801236	0.2873	0.8576	0.4511	#0.022	#0.041
1 1 1 0	10%, 5%	10%, 5%	1.991256	0.7260	0.9733	0.4893	#0.022	0.336
1 1 1 1	10%, 5%	10%, 5%	2.023292	0.5191	0.9601	0.4935	#0.048	0.441
2 0 0 0	10%, 5%, 1%	10%, 5%, 1%	#1.483217	#0.0005	0.8401	0.4230	#0.000	#0.010
2 1 0 0	10%, 5%	10%, 5%	1.725438	#0.024	0.9057	0.4590	0.089	0.067
2 1 1 0	10%, 5%	10%, 5%	1.902557	0.6923	0.9604	0.4879	0.077	0.371
2 1 1 1	10%, 5%	10%, 5%	1.943499	0.9288	0.9321	0.4972	0.190	0.526
1 0 0 0	10%, 5%, 1%	10%, 5%, 1%	1.553040	0.0175	0.7832	0.4213	#0.000	#0.008
(2) ARDL/EC model excluding igsec and indsom_pct for the Second-half Period (2013-04 - 2019-10)								
1 0 0	10%, 5%, 1%	10%, 5%, 1%	1.774259	0.2959	0.6403	**0.2564**	0.135	#0.043
1 1 0	10%, 5%, 1%	10%, 5%, 1%	1.890391	0.7663	0.9461	0.2927	0.549	#0.046
1 1 1	10%, 5%, 1%	10%, 5%, 1%	1.890085	0.7513	0.9623	0.2927	0.555	0.069
2 0 0	10%, 5%, 1%	10%, 5%, 1%	1.766014	#0.0312	0.8115	0.2870	0.117	0.050
2 1 0	10%, 5%, 1%	10%, 5%, 1%	1.867795	0.3191	0.9786	0.3098	0.416	0.055
2 1 1	10%, 5%, 1%	10%, 5%, 1%	1.862177	0.2415	0.8682	0.3112	0.437	0.054
2 2 0	10%, 5%, 1%	10%, 5%, 1%	1.814740	0.0720	0.9857	0.3184	0.634	0.078
2 2 1	10%, 5%, 1%	10%, 5%, 1%	1.805833	#0.0294	0.8820	0.3206	0.673	0.068

***** In the order of *itrd, indsom_pct, itrdsize,* and i*newsprd* for (1); and *itrd, itrdsize,* and *inewsprd* for (2)

Reject Ho

Source: The Author's calculation

Table 4-21: Policy Measures in Two-Dimensional Framework and India's Implementation

	1		2	
	Nascent		**Evolving**	
Market Component	**Policy measures in Two-Dimensional Framework**	**Policy measures in India's implementation**	**Policy measures in Two-Dimensional Framework**	**Policy measures in India's implementation**
Accounting	Disclosure and governance of institutional investors and intermediaries		Amortization	
Legal affairs	Modern business law Modern banking law Public debt law Securities Law Immobilization or depository regulation	The Constitution (Articles 202 and 293) The Reserve Bank of India Act (Articles 21(2) and 21A(1)(b)) SEBI Act 1992	Trade failure Trade finality Netting arrangements Dematerialization Code of conduct	The Payment and Settlement Systems (Amendment) Act, 2015 Dematerialization of Government Securities (1998) DVP-III (2004)
Primary market	Preannounced auctions Non-competitive bidding Designated/prequalified bidders Treasury bills Short-term maturities	Auction of government securities and Treasury bills (1992 and 1993) Non-competitive bidding (2009) PDs (1995)	Issue calendar Reopening or buy-back or switching Tap issuance Bidding open to the public Short- to medium-term maturities	Issuance Calendar for Marketable Dated Securities (2015) Buy-Back (2003) Conversion (Switch)(2019)
Debt and cash management*	Cleanup of public or quasi-public arrears Public debt issuance legislation DM office Timely & accurate debt record keeping The separation between front- and back-office activities	Restricted and prohibited ad-hoc T-Bills (1994 and 1997). Commonwealth Debt Recording and Management System (1986)	Increase in domestic borrowing DM strategy and reporting Consolidation of DM functions Sensible balancing or separation between DM and monetary policy operation (e.g., agency agreement) Partial risk management Sovereign credit rating	Fiscal Responsibility and Budget Management Act (FRBM) (2003) requiring the govt to report to the parliament Medium-term debt management strategy (2015)
Secondary market	Negotiated (dealers' "Club") market Telephone voice trading	Securities Trading Corporation of India (STCI) (1994)	Screen-based electronic trading platform Call auction or continuous order-driven Market convention Market surveillance	NDS-OM (2005) The Fixed Income Money Market and Derivatives Association of India (FIMMDA) (1998)
Monetary policy framework**	Reliance on rules-based instruments		Introducing money market instruments	CP (2017)
Money market	Treasury bills Call market Reserve averaging	Auction of T-bills bills (1993)	Standing facilities (Central bank repos) Interest rate corridor Bank repos Sporadic open market repos	Liquidity Adjustment Facility (LAF) (2000) Repos permitted to SGL a/c holders (1997)
Derivatives or futures				
Clearing and settlement	Book-entry CSD	Subsidiary General Ledger at RBI National Securities Depository Ltd (1995) Depositories Ordinance (1995) Depositories Act (1996)	Dematerialization DVP Rolling settlement Multiple-net settlement SWIFT Automation	Dematerialization of Government Securities (1998) A dematerialized form made mandatory for RBI-regulated entities (2003) DVP I (1995), II (2002), III (2004)

Notes: Desirable policy measures were taken from Table 1. India's Implemented policy measures are not exclusive. The years are those in which the measures were initially undertaken.
Source: The Author compiled data from CCIL (2017), Fleming *et al.* (2015), Mohan and Ray (2009), Rajaram and Ghosh (2015), RBI (2019), and the websites of NSDL, CCIL, the Department of Economic Affairs.

5 Utilities and Development Dynamics in Early-Phase Government Securities Markets

5.1 Introduction

The finding of utilities'[54] dominant role in a high-growth period of GSM development (Endo 2021a) prompts a GSM development management model for lower-income economies (LIEs).[55] Though it is still local to the Indian GSM, this finding contradicts the conventional understanding of trading motivation in securities markets, which usually focuses on trading costs (Bruno, 2005; Chaumont, 2018; Madhavan,1992) except for utilitarian trading (Harris, 2003, pp. 178-194). The traditional view about trading motivation presumably stems from the fact that the previous securities market studies centered on relatively advanced markets. The difference between the conventional view and the new findings regarding trading motivation requires GSM policymakers in LIEs to have a fresh understanding of market development dynamics in their markets.

GSM development management encompasses planning, organizing, implementing, coordinating, controlling, monitoring, and replanning. The dynamics involve utilities that a market structure embeds and then releases for the investor and evolve ownership arrangements for market infrastructure. Ownership translates into the responsibility for utility building and releasing. An economic agent owns the market structure in an economic sense. The utilities and the ownership arrangements are forces for a market structure's formation and evolution. A market structure represents a partial equilibrium

[54] In the GSM development context, a "utility" is defined as a trader's or an investor's preference, relative to alternatives, regarding trading objects, quantities, qualities, timings, modes, counterparts, and other trading behavior attributes. Its preference criteria inevitably involve non-monetary or psychological values, such as reliability, functionality, convenience in consuming trading services. It is usually neither objectively assessed nor readily exchangeable.

[55] An integrated platform for trading, clearing, and settlement in the Indian GSM reduced transactions' non-transparency, and complexity rose trading volumes from 2005 to 2013.

that the investor, the trader, and the government attain in my model. Also, in the partial equilibrium, the utility quantity is an independent variable, and the trade volume is the dependent variable.

Here, GSM development management is considered using the “Two-Dimensional Policy Framework for GSM Development." (TDPF) (Figure 5-1, Table 5-1) (Endo, 2021a). The framework divides emerging GSMs into four groups by their market development phases: the Nascent Phase, the Evolving Phase, the Advanced Phase, and the Highly Advanced Phase. This classification is designed to address local and market-specific conditions for better systematic analysis, formulation, and implementation of policies. The framework maps known policy sets in a two-dimensional matrix table: vertically from nascent to advanced macroeconomic settings and horizontally for essential market component categories. For discussion convenience, I distinguish the market structure’s infrastructure from its maintenance tasks and market components (Table 5-1) and call the former the “hard component” and the latter the “soft component.”

A market structure's ownership arrangements underpin its positive externalities provision. Unlike their counterparts in advanced economies, most modern securities markets in emerging economies have developed under public or quasi-public ownership arrangements in a relatively short period. As a result, their market structure's cost structure is considerably different from that in advanced economies (Chapter 3; Endo 2020) Figure 5-2). It is significantly dependent on government intervention. A securities market's, in particular GSM's publicness, generates positive externalities, such as price discovery, yield curves, and collaterality, for the economy (RBI, 2007; Sundararajan, Dattels, & Blommenstein, 1997), justifies and necessitates government regulation, subsidies, or direct provision.

Thus, this research addresses an overlooked area of the GSM development theory. It provides the GSM policymaker with insights into the overlooked function of utilities and a market structure's ownership arrangements. These little-explored but essential aspects help the policymaker formulate more realistic GSM development policies than before. The policymaker will be guided for a cautious restart for failed market

development or an initial careful start for market development. However, this research does not look into the market microstructure, including the negotiated market, the periodic order-driven market (call auction or call market), the continuous order-driven market, and the quote-driven market-making market (Table 5-2).

Hence, this research aims to draw out the gist of a GSM's internal dynamics essential for market development management. To this end, I capitalize on an interdisciplinary approach. For example, my analysis on utilities borrows concepts from psychology and ownership arrangements from public and club good theories, among other things. Particular examples include bilateral dependency and market growth limitation under weak governance, utility bundle introduction and replacement and a trading motivation's changeover from utility-seeking to price taking[56] under market structure lifecycle and transition, and market structure designing using a quasi-Edgeworth Box.

Finally, the trader often intermediates trades in multiple capacities. It brokers (intermediates on an agency basis) sell- or buy-orders for fees (brokerage commissions) or deal (intermediate as a principal) with their customers or their fellow intermediaries to earn spreads between their bid and ask prices (bid-ask spreads). Broker's commissions and dealer's bid-ask spread is undistinguished from trading service price or fee in this paper. In dealing, they may trade for themselves (trade proprietarily) for possible capital gains. The trader may also act as the investor. In a bank-centric market, the bank-dealer often transacts as an investor for its bank's investment account and as a trader (an intermediary) for its trading account. Consequently, the investor in this research includes a trader acting as an investor.

The rest of this chapter is organized as follows. Section 5.2 reviews the literature. In Section 5.3, I discuss this research's utility functions. Section 5.4 maps market characters that require interdisciplinary interpretations. Section 5.5 details the significance of positive externalities and the club nature of traders and investors. Section 5.6 describes the trading motivation hierarchy. Section 5.7 graphically analyses the bilateral dependency, the market structure life cycles, the contract curve in the

[56] See Footnote 62.s

quasi-Edgeworth Box. Section 5.8 discusses the results. Section 5.9 concludes.

5.2 Market Characteristics

I map the terrain before I investigate water flow distribution. I depict a stylized GSM's characteristics that affect the utilities that market development releases and flows into the market. This section is intended to establish the basis for my theoretical analyses by relating the market characteristics to theories.

The key elements that typically characterize an exchange market are economic agents, commodities to be exchanged, and a mode of exchange. The economic agents in a GSM are the investor, the trader, and the government. The investor and the trader are assumed to represent their communities and behave uniformly. The principal commodities to be exchanged in early phase markets or states of a market development phase are utilities and liquidity. The government releases utilities from a market structure while the investor generates a utility (liquidity in this case) by trading. However, the utilities are replaced with money (price) when a market matures. The mode of exchange for utilities is barter exchange.

The investor consumes the trader's trading service. The investor's trading is also the consumption of the government-released utilities for immediate use. Hence, the investor is a consumer, and its consumer status serves as a basis for applying consumer behavioral theories to my market structure analyses.

Barter characterizes the government-investor transactions of utilities. The government exchanges its utilities with the investor's liquidity (trading), and their exchange does not use a medium of exchange like money. The two commodities are tradeable (exchangeable) exclusively between the government and the investor through the trader. The two parties satisfy "double coincidence of wants," which constitutes a foundation for barter. These characteristics fit GSM trading to an Edgeworth Box analysis.

The market structure is also an impure public good for the investor and the trader (Figure 5-3). The government releases the utilities latent in the market structure that the investor values for its trading through market infrastructure investment and other

efforts. The investor's trading is what the government expects in return for the released utilities. Besides, the investor pays the trader for trading services and part of utilities if they are included in the trader's fee. The investor's access to a GSM or its utilities is excludable, though the investor's rivalry is weak until the trade volume nears the carrying capacity of the GSM's market structure before a development phase transition. The market forms an investor "club," and the market structure is an impure public good (Buchanan, 1965, pp.1-2; Cornes & Sandler, 1996, pp.4 & 57-8, 255-72, 542-3, 548). Similarly, the market structure is an impure public good for the trader, and the trader forms a trader club. The club membership is excludable, rivalrous, and subject to congestion.

The demand for trading in early-phase GSMs depends on how the investor evaluates utilities. Utilities' supply curve is almost flat, and the investor's demand for them has little constraint until it nears the market structure's carrying capacity. In this circumstance, trade volumes are more or less equal to the investor's demand.

The GSM generates positive externalities. The positive externalities justify or even necessitate the government intervention through regulation, subsidies, or direct provision of goods or services (e.g., market infrastructure) (Cornes & Sandler, 1996, pp.6-7, 39-67, 72-139, & 370-393). The positive externalities, such as price discovery, yield curve formation, and high-quality collaterality, are essential for modern economic management and development. Their beneficiaries are the public. It is sensical for the government in an LIE to bear a substantial part of the hard component (roughly the fixed cost component) of market structure costs and some soft component (the running costs of market infrastructure and market components).

5.3 Externalities and Clubs

5.3.1 Public Good and Club Good

Public-good and club-good relationships explain their members' behavioral incentives and constraints. Figure 5-3 shows public-good and club-good relationships among the trader, the investor, and the government (on behalf of the public). The trader and the investor form two distinct clubs ($Club^T$ and $Club^I$) with the market structure shared as

their common club good (impure public good) (Cornes & Sandler, 1996, p. 4). Each club's members share the impure public good for excludable trading benefits. The trader club is susceptible to congestion (rivalry), while the investor club is unlikely to be so (nearly non-rivalrous as long as the utilities are increasingly released). The trader seeks profits from trading services. The investor first seeks more utilities and later lower trading service prices for trading when the released utilities near the carrying capacity of the market structure (Figure 5-6).

The two clubs are distinct but mutually dependent through trading. The trader benefits from the impure public good (the market structure) only when the investor trades. The investor does so only when the trader provides trading services.

The government's intervention is desirable to achieve social optimality in GSM operation and development. The market structure is a public good from the government's or the public's perspective since it generates positive externalities. Though these positive externalities are vital for an economy, they tend to be underprovided because of their public good nature (Buchanan, 1968, p.67; Cornes & Sandler, 1996, pp. 24, 56, 65, 143, 147, 159,179, 198; McNutt, 1999) and stay below the Pareto-optimal allocation level for GSM operation and development (Cornes & Sandler, 1996, pp. 159).

The GSM's positive externalities and the government's positive intervention reflect the historical difference between advanced and emerging GSMs. The former started with private interests and the latter with public interests. Private membership institutions set up securities markets several decades or even a few centuries ago in most advanced economies. The economies discovered the traits of public goods in securities markets later as the rest of the economy also developed. They founded GSMs on their long histories of securities market development or modern financial market development. In other words, many advanced GSMs were built on fully depreciated economic infrastructure and social capital and shared them with the rest of the economy. Emerging GSMs, let alone LIE GSMs, do not have long histories. The rest of the economy remains far from perfect. They would have to pay for a substantial part of these costs, and market structure building would make trading prohibitively expensive.

Figure 5-2 schematically illustrates the differences.

5.3.2 Congestion Model

Clubs are subject to congestion. The congestion model of the trader club (the community of traders qualified or authorized to engage in intermediating trades in a GSM) suggests that the trader's perceived utilities affect the trader club size and stem from a GSM's market structure design and operation.

Let $U(\cdot)$ denote a function for the aggregate utility of the trader club. $U(\cdot)$ is

$$U(\cdot) = U(Y, Q, c(Q, S), G)\,, \tag{5.1}$$

where Y is the traders' non-GSM business volume, Q is their GSM trade volume, c is GSM congestion, and G is internalized positive externalities. The congestion $c(\cdot) \leq 0$ is a function of total GSM trade volume Q, and the GSM market structure level S. All these variables are a quantity per unit-time. Assume that the trader club consists of x ($x \geq 0$) homogeneous traders whose trade volume per unit-time is π ($\pi \geq 0$), and their utilities are additive across utility sources. Therefore, the aggregate GSM trade volume $Q = \pi x$, and the function of aggregate internalized positive externalities $G = g(Q) = g(\pi x) \geq 0$. For simplicity, further assume that $c(\pi x) = \pi c(x)$ and $g(\pi x) = \pi g(x)$. Let U_x denote the derivative of Equation (5.1) in respect to x, and U_x is rearranged as follows:

$$\begin{aligned} U_x &= \frac{\partial}{\partial x} U(\cdot) \\ &= \frac{\partial}{\partial x} U\big(Y, Q, c(Q, S), g(Q)\big) \\ &= \frac{\partial}{\partial x} U(\pi x) + \frac{\partial}{\partial x} U\big(c(\pi x)\big) + \frac{\partial}{\partial x} U\big(g(\pi x)\big) \\ &= \pi \frac{\partial}{\partial x} U(x) + \pi \frac{\partial}{\partial x} U\big(c(x)\big) + \pi \frac{\partial}{\partial x} U\big(g(x)\big) \\ &= \pi \frac{\partial}{\partial x} U\big(x + c(x) + g(x)\big)\,. \end{aligned} \tag{5.2}$$

When the club size x is at the maximum, $U_x = 0$ and $\pi \neq 0$. Therefore, from Equation (5.2),

$$x^* + c(x^*) + g(x^*) = \gamma,$$
$$x^* = -(c(x^*) + g(x^*)) + \gamma, \tag{5.3}$$

where γ is a constant and $\gamma > 0$. Equation (5.3) indicates the trader community's maximum size x^* depends on the congestion function $c(x^*)$ negatively and the internalized positive externality function $g(x^*)$ positively. In the iterated function (5.3), both terms $c(x^*)$ and $g(x^*)$ include monetary values and utilities. The monetary values are the trader's inhouse and outsource market structure maintenance or reinforcement costs (denoted by $s(x^*)$) to mitigate the congestion impact for $c(x^*)$ and the trader's revenue from trading service (denoted by $q(x^*)$) as a result of order-matching for $g(x^*)$. Their utilities are the order-matching hindrance chance ($u^s(x^*)$) and the order-matching chance ($u^q(x^*)$). The terms $c(x^*)$ and $g(x^*)$ can be described as

$$c(x^*) = s(x^*) + u^s(x^*), \tag{5.4}$$

$$g(x^*) = q(x^*) + u^q(x^*). \tag{5.5}$$

From Equations (5.4) and (5.5), the negative utilities ($u^s(x^*)$) and the positive utilities ($u^q(x^*)$) that the trader perceives the market structure generates affect the trader community size. Differentiating Equation (5.3) with respect to x^* gives

$$\frac{d}{dx^*}x^* = -(\frac{d}{dx^*}c(x^*) + \frac{d}{dx^*}g(x^*)),$$
$$x^{*\prime} = -(c'(x^*) + g'(x^*)). \tag{5.6}$$

Equation (5.6) indicates that the marginal maximum size of the trader club with maintaining the minimum acceptable level of the existing member traders' benefits (an aggregate of monetary values and utility values) equals the difference between the marginal internalized positive externalities $g'(x^*)$ and the marginal congestion impact $c'(x^*)$. In other words, the per-trader sensitivity of the maximum size of the trader club with maintaining the minimum acceptable level of the existing member traders' benefits (an aggregate of monetary values and utility values) equals the difference in per-trader sensitivity between congestion stress and internalized positive externalities.

This indication implies a market structure design issue. The efficacy in feedbacking the

positive externalities of trading into the market will allow the market to grow. For example, a regulatory requirement for immediate dissemination of post-trade information or an electronic post-trade information dissemination system or both is effective market development policies even in a Nascent Phase market.

5.4 Trading Motivation Hierarchy

The consumer's new product or service adoption is characterized by its nonpecuniary selection criteria and long adoption duration. In analyzing the industrial competition for consumers, Christensen (1997a; 1997b) identifies the hierarchical tendency of a new product's or service's requirements for the purchaser's buying decision.[57] Functionality, reliability, and convenience are utilities in my GSM parlance. A new technology slowly penetrates "innovators" and "early adopters" and takes time to reach "early majority" before "late majority" and "laggers" at last under price competition (Moore, 2014, p.15). The Indian GSM's trade volume growth exhibited the investor's similar preference. When a new integrated platform for trading, clearing, and settlement was phased in the Indian GSM from 2001 to 2005, the investor valued the transparency and ease that the new technology brought into the market. The new system rose trading volumes from 2005 to 2013 (Endo, 2021a). I call this hierarchy of trading decision factors a trading motivation hierarchy.

A lack of market governance intensifies bilateral dependency between the trader and the investor. The investor tends to routinely rely on the trader for trading advice and decision, even in advanced markets.[58] This tendency is accentuated in a low-liquidity and weak governance market, such as the negotiated market in the Nascent Phase. According to transaction costs economics,[59] the presence of "asset specificity" builds

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[57] Windermere Associates, a consulting firm in San Francisco, also came up with the same idea. The hierarchy is also known as the Windermere Hierarchy. (Gurowitz, 2012; Horton, n.d.)

[58] My hands-on experience and observation in the securities industry in the United States, and other advanced and emerging markets.

[59] Transaction costs economics' dichotomy between the firm vs. the market does not apply to GSMs since both transferability and tradability by design are embedded in publicly issued securities, like government

bilateral dependency between transacting parties and motivates the parties to protect the asset specificity (endowment effect) (Rubin, 2005; Williamson, 1981, 1984, 1989, 1991a, 1991b, 1992,1993, 1995, 1998, 2005, 2010). The bilateral dependency in the GSM case is a non-pecuniary or semi-pecuniary reciprocity relationship between the trader and the investor. The former seeks a secured order source and the latter a reliable trading service source, reflecting a trading motivation hierarchy.

Psychophysical findings of loss aversion are consistent with transaction cost economics theory. Regardless of their outcomes, the investor needs to be satisfied with its investment process. The investor may lose a security principal against a few to several dozens of basis points of trading service fees if trading goes wrong. Controlling risks, actual or perceived, comes before prices for the investor. Kahneman and Tversky (1984) argue "low probabilities, however, are over-weighted, and very low probabilities are either over-weighted quite grossly or neglected altogether" (p. 345). The former attitude reflects the majority of consumers and the latter "innovators" and "early adopters" in Moore (2014, p. 15). Thus, the loss aversion behavior illustrated as the nonlinearity of decision weights in Kahneman and Tversky (1984) is consistent with bilateral dependency in a weak governance environment.

5.5 Market Structure Transitions and Life Cycles

This section analyzes market structure transitions from one market development phase to another and market structure life cycles in market development phases in a partial equilibrium framework. No GSM is expected to undergo more than one phase transition without its environments being drastically changed.

5.5.1 Starting Up with Bilateral Dependency

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securities. However, the transaction that I am looking into is not securities but trading services. Also, the economics' theoretical core lies in the significance of transaction costs, which are not perfectly quantifiable, for the economic agent's choice of economic behaviors rather than just for its selection of institutional forms. Therefore, the theory's three dimensions (uncertainty, frequency, and asset specificity) for institutional choices are very suggestive for assessing the investor's motivation to deviate from pecuniary values for selecting trading services.

A bilaterally dependent relationship is shown in Figure 5-4, which presents the utility and trade volume relation in the Nascent Phase. The market microstructure is a negotiated market. The horizontal axis represents the utility quantity, a stock quantity, and the vertical axis the trade volume per unit-time, a flow quantity. $\boldsymbol{V}=\boldsymbol{v}(\boldsymbol{U}, \boldsymbol{T})$ is the trade volume's demand function (s-shaped growth curve), and the trade volume (t) is a function of the utility quantity ($\boldsymbol{u}$). At the natural market position E_0, the government's intervention is minimal, if not zero, and the trader does not solicit orders. The possible cumulative trade volume at the natural market position E_0 is represented by the small area bounded by $\{O, U_0, E_0, T_0\}$ at the bottom-left corner. The utility quantity available to the investor is initially at Point U_0 (u_0). The investor's purchase of the utilities from its "favorite," "attentive," or "caring" trader or the trader's sale to its "good" customer shifts the utility quantity to Point U_1 (u_1) on the utility axis (the vertical axis). It creates the bilateral dependency space bounded by $\{T_0, E_0, U_0, U_1, E_1, T_1\}$. The bilateral dependency lifts the trade volume from t_0 to t_1 (the boosted trade volume) on the trade volume axis (the horizontal axis) and the market from the original equilibrium E_0 to the new equilibrium E_1.

5.5.2 Evolving through Market Structure Life cycles

Utility Bundle

Market structure life cycles play out in the periodic auction (call) market, the continuous order-driven market, and the continuous quote-driven market of the Evolving, Advanced, and Highly Advanced Phases (Phases 2, 3, and 4), respectively. The government subsidizes the market structure to generate positive externalities. Market governance is reinforced. The government most likely identifies a bundle of the utilities that the investor appreciates for its trading and selects a market structure optimal to release the utility bundle. At the beginning of the market structure life cycle, the initially released utility can entice only early-adopter investors into trading. Later, other investors increasingly join and congest the investor club or the given market structure. Trade volumes ultimately approach the market structure's carrying capacity. The trade volume growth can be modeled with a logit function curve (s-shaped growth curve). Correspondingly, the marginal utilities' weight in trade decisions shapes an inverse logit

function curve. The trading motive gradually shifts from utility-seeking to price-taking in the market structure life cycle. Later in the life cycle, the investor increasingly prefers a new bundle of utilities. The utility bundle profile is renewed, and the existing market structure phases out.

Market Structure Life Cycles

I analyze the relationship between the utilities and the trade volume growth in the three phases following the Nascent Phase (the First Phase) in two steps. The first step analyzes the trade volume growth pattern that a new market structure produces. The second one explicates the diminishing marginal utility weight in trading decisions and the market structure life cycle (Figure 5-5). The Evolving Phase (the Second Phase) succeeds the Nascent Phase (the First Phase). The second, third, and fourth phases are indexed by n (2, 3, and 4) in the figures.

At the beginning of one of the three phases, the market succeeds the carryover trade volume (t_{n-1}) from the preceding phase at the utility quantity position (u_{n-1}). The new market structure introduced into the market starts undoing its embedded utility bundle for which the investor has waited. The trade volume demand curve $\boldsymbol{V}=\boldsymbol{v}(\boldsymbol{U}, \boldsymbol{T})$ can be modeled with a combination of a logit function curve (s-shaped growth curve) $\boldsymbol{V^n}=\boldsymbol{v}(\boldsymbol{U^n}, \boldsymbol{T})$ for the utilities and a rational function curve $\boldsymbol{V^\alpha}=\boldsymbol{v}(\boldsymbol{U^\alpha}, \boldsymbol{T})$ for price. The released utilities shift the utility quantity from Point U_{n-1} (u_{n-1}) to Point U_n (u_n), and the trade volume rises from Point T_{n-1} (t_{n-1}) to Point T_n (t_n) correspondingly. The investor's incremental adoption of the utilities autonomously released from the hard component of the new market structure and those that the soft component (market component improvement) adds cause the equilibrium to travel from T_{n-1} (E_{n-1}) to E_n on the trade volume growth curve $\boldsymbol{V}=\boldsymbol{v}(\boldsymbol{U}, \boldsymbol{T})$. The cumulative trade volume induced by the released utilities during the phase is represented by the hatched area bounded by $\{T_{n-1}$ or $E_{n-1}, K_n, E^l{}_n\}$. The utilities' marginal quantity declines as the utilities approach the market structure's carrying capacity.

The changeover from utility-seeking to price is not necessarily evident, at least in an early-phase market. Competitively lowering prices theoretically begin taking over

utility in inducing trades at Coordinate L_{n-1} (P_u, P_t) as approaching the market structure's carrying capacity diminishes the marginal utility. Its cumulative trade volume shapes the crossed area bounded by $\{L_{n-1}, E^1_n, E^2_n\}$. However, the Indian GSM's case exhibits the utility effect's decline, but the price's takeover is ambiguous (Endo, 2021a).

Market structures repeat a similar cycle of a phase-in, a growth, a decline, and a phase-out in market development phases. A market structure's stylized life cycle is shown in Figure 5-6, together with the relationship between the utility weight in trading decisions and the trade volume. The horizontal axis represents the utility level, a stock quantity, and the vertical axis represents the utility weight in trading decisions, a scaler quantity, and trade volume per unit-time, a flow quantity.

In the beginning, the market introduces a new market structure to solve unresolved, emerging, or foreseen problems for GSM operation and development. The new market structure, a collection of market infrastructure, technologies, business models, and other market components, embeds a utility bundle that the investor desires to consume for trading. An individual investor or trader takes time to try, adopt, and fully utilize a new market structure. Also, adoption timing, speed, or degree varies from individual to individual with the pattern of innovators, early adopters, early majority, late majority, and laggards (Moore, 2014, p.15). The new market structure built around the NDS-OM[60] took ten years from 2005 to 2015 to reach a saturation stage (Chapter 4; Endo 2021). Psychological, social, political, and economic factors delay the process.

A network effect is likely to counteract congestion's negative effect and complicate the life cycle process. The investor and trader clubs are prone to congestion's negative impact on their members' wellbeing. This impact is especially the case with the trader club. However, an increasing number of these clubs' members heightens their network effect. It drastically increases order-matching chances and mitigates, counterbalances, or

[60] Negotiated Dealing System (Order Matching). India introduced the Negotiated Dealing System (NDS) in 2001 to automate government securities' clearing and settlement in 2001, and scaped up the system with a trading platform (Order Matching – OM) in 2005.

outperforms congestion's negative effect. Therefore, congestion and order-matching form a feedback loop.

The resistance from the market structure's carrying capacity slows down the trade volume growth toward the end of the life cycle. Meanwhile, exogenous factors, such as macroeconomic changes, may require the market to scale up. Thus, the existing market structure phases out.

Lull Period

A GSM's market structure likely has one more step (Figure 5-6). The transition to the next phase may be neither instant nor smooth. I call this prolonged period a lull period. The TDPF may help market stakeholders address an issue and find a way out as a communication tool for consensus building. Regardless of the underlying problem,[61] the market structure's complex ownership arrangements – the market structure shared by the two clubs (the investor club and the trader club) as one impure public good and viewed by the public or the government as a public good with vitally positive externalities – overshadows the lull. Therefore, getting out of the lull most likely requires consensus building.

An issue unique to a successful GSM development phase, a resource dependence problem (Christensen, 2006), may cause a lull. GSM development in LIEs is so heavily resource-dependent that government intervention may be indispensable for LIEs. The government tends to manage and control the GSM through resource allocation. For example, the Reserve Bank of India (RBI) has successfully developed a GSM. The market is bank-centric and considerably efficient for monetary management. It is too bank-centric. Its trade turnover growth has stalled for several years (Endo, 2021a). The RBI and its commercial banks may see this state of the market as stable. Others may

[61] Possible reasons for the lull are complacence, status quo bias, complexity, and vested interest. In complacence, the economic agents or other stakeholders see no problems with the current market structure. With status quo bias, people recognize problems but value "do nothing" more than working on the recognized market structure problem. In complexity, the market structure problem is too complicated to solve. Vested interest causes some people to lose by solving the market structure problem.

view it as stagnant.

5.5.3 The Quasi-Edgeworth Box

I examine consensus-building interactions between the government and the investor for GSM structure development using a quasi-Edgeworth box. This analytical framework helps set GSM development goals by identifying equilibrium and disequilibrium in GSM development. My quasi-Edgeworth Box imitates an Edgeworth box. My quasi-Edgeworth Box, like a true one, two transacting agents are diagonally positioned at two corners of the Box, and the two-typed agents' two-variable vectors diagonally share the Box's square space. The agents' indifference preference-utility[62] curves with respect to the variables are mapped in the shared space. However, my quasi-Edgeworth Box does not expect multiple agents of the two types to be added. Consequently, it does not allow for coalition alternations and can neither carve out the core nor demonstrate the shrinking core (Edgeworth Conjecture) since my setting has no additional agents on either side of the Box. [63]

My quasi-Edgeworth Box has several assumptions. First, the investor would represent all trading investors, and they would behave uniformly. Second, the government would monopolistically provide or manage a market structure (the hard and soft components discussed earlier). As such, the trader's role is negligible in this analysis. Third, utilities embedded in a GSM market structure and trade volume growth would trade-off, and their quantities would be inversely related. These quantities are assessment values and involve no transactions. Fourth, as Endo (2021a) (Chapter 4) illustrates the Indian GSM development path, the market would be so imperfect that the agents' utilities rather than prices may dominate their decisions on exchanging the commodities (an imperfect

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[62] My analysis terms an economic agent's selection priority "preference-utility" to distinguish it from my "utilities," which are impecuniary values that an economic agent counts in its economic decisions. The core economy literature calls the selection priority "utility" while Edgeworth calls it "preference."

[63] The Edgeworth Conjecture may apply to existing and disappearing bilateral dependency between the trader and the investor in a relatively liquid market (see Footnote 58 and Section 5.5.1).

market). This behavior of the agents is referred to as utility-seeking as opposed to price-taking[64] in a mature market. The agents' behavioral shift from utility-seeking to price-taking will be examined in the next section.

Figure 5-7 shows my quasi-Edgeworth Box's settings. The two agents, the government and the investor, are positioned at the lower-left corner $I_0(\tilde{u}_0, t_0)$ and the upper-right corner $G_0(\tilde{u}_0, t_0)$. The Box has two variables: the trade volume growth (Δt) of outstanding government securities and the embedded utility amount ($\tilde{u}$) during a market development phase. The embedded utility amount complements the available utility amount (u) with respect to the entire utility amount.

The investor and the government have different indifference preference-utility convex curves ("indifference curves" for simplicity) with respect to market structures. The solid curves ($I^I_1, I^I_2, I^I_3, \ldots$) and the dotted curves ($I^G_1, I^G_2, I^G_3, \ldots$) are arbitrary indifference curves. These curves roughly depict the investor's or the government's perceived utility levels of the hard component, such as market infrastructure institutions and their systems, of a market structure that the government deploys. The investor's perceived utility levels move up in the order of $I^I_1, I^I_2, I^I_3, \ldots$ and the government's ones move down in the order of $I^G_1, I^G_2, I^G_3, \ldots$

The positions (*i.e.*, g and i) on an indifference curve indicate the perceived utility positions of the soft component, such as institutional capacities (*e.g.,* management or staff qualities), legal, regulatory, or accounting frameworks and their operations, or knowledge levels, that the investor or the government opportunistically adopt with respect to the indifference curve's hard component. The soft component can change the effectiveness of the hard component or their positions on an indifference curve. The investor and the government can adjust the effectiveness of the hard component (the

[64] "Price-taking" in my quasi-Edgeworth Box and Figure 4-6 is not the one resulting from the Edgeworth Conjecture because a core does not shrink in my government-investor setting. My "price-taking" occurs initially as utility provision declines (Figure 4-6), and, after the changeover, the other "price-taking" may take place as increasing coalitions in the trader-investor setting restrict the availability of preference.

utility quantity that the hard component generates) by controlling the soft component.

The investor and the government can cooperatively establish the equilibrium GSM development goal and mobilize their resources for achieving the goal most efficiently (Figure 5-8). One of the parties can improve upon[65] its disadvantageous position without impairing the other party's preference-utility position. Suppose they are initially satisfied at Intersections *P1* or *P2* as their GSM development goal balances their utility quantity and trade volume growth levels. In this position, the investor evaluates the government-installed new hard component's (market infrastructure's) utility level as Indifference Curve I^{I}_{2} while the government believes that the hard component potentially yields the utility level Indifference Curve I^{G}_{3}. However, the government can move to the common Tangency Position *P3* of Indifference Curves I^{G}_{3} and I^{I}_{3} by adjusting its soft component without impairing its preference-utility in its hard component plan (perhaps, without downgrading the overall performance of the plan). Meanwhile, the investor can improve its preference-utility level to Indifference Curve I^{I}_{3}. At the common Tangency Point *P3* or the Equilibrium Position (*E*), both parties lower the trade volume goal from Position *P1*. Consequently, they can make only necessary investments in their soft components to maximize their preference-utility achievements.

The contract curve[66], highly conceptual and hardly observable, suggests that it is essential for the government and the investor to share an understanding of their GSM's trade volume growth potential and realistic goal and cooperate in achieving equilibriums (Figure 5-9). The line running through equilibrium points (i.e., *E1*, *E2*, and

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[65] The core theory literature traditionally terms the rejection of inferior commodity reallocation through re-coalition of participating agents "blocking." Its other terminologies include "restrict" restrict (Debreu & Scarf, 1963) ,"dominate" (Telser, 1994) or "improve on" (Hildenbrand, 1974, p.129). This paper adopts "improve on" for intuitive understanding.

[66] A party to a commodity exchange contract in a disadvantageous position is motivated to recontract with the counterpart for the equilibrium terms between the two parties. Therefore, a line connecting equilibrium positions in an Edgeworth box is called a contract curve (Edgeworth, 1881, pp.40-41). Also know as a contract line.

E3) is known as the contract curve. Equilibrium *E1*, where investor's confidence in the hard component is low (I^I_1), would require the government to invest heavily in the hard component (I^G_3) to generate even a moderate trade volume growth (Δt_1). This trade volume growth level would be achievable at Point *P4* on a lower indifference curve (I^G_2). If the investor shares the government's assessment about market potentials and available resources and cooperates with the government, both parties can be better off at Equilibrium *E2*. Similarly, the government appears unrealistically conservative in the hard component investment, and the investor would be too optimistic about the hard component's capacity at Equilibrium Point *E3*. Equilibriums 1 and 3 illustrate that Equilibrium *E2* is a cooperative equilibrium for the investor and the government in the quasi-Edgeworth Box.

This cooperative equilibrium would steer the trader's planning strategies as well. The target levels of the government's market infrastructure investment and market component development would set the trader's targets of inhouse investment and capacity building. In the real world, its business commitment and expertise would likely cause the trader, rather than the investor, to face the government in GSM development planning.

Unlike a true Edgeworth Box, my quasi-Edgeworth Box cannot provide definitive information about the optimality of a market structure (Figure 5-100). The modeling for GSM market structure selection requires a maximum utility function whose factors are the released utilities ($\tilde{u}$ or u) and the trade volume growth (Δt), indifference curve functions for I^G and I^I, and a contract curve function (C). The indifference curves' properties at the equilibrium (E) are mathematically solvable from the indifference curve functions. However, I cannot legitimately model the contract curve using currently available data.

5.6 Production and Exchange Functions

The previous section analyzed the investor's relationship with the government. This section looks into the investor's trading behavior with both government and trader using production and exchange functions.

Let us denote by $u^1, u^2, u^3, \ldots u^i, u^\alpha \in \mathbb{R}^{i+1}_{\geq 0}$ the investor's non-pecuniary utility set of reliability, functionality, convenience, other utility elements (1, 2, 3, …, *i*), and the utility (α) that its trading generates for itself (*e.g.*, asset acquisition or liquidation, risk transfer, and others). In other words, u^α denotes the investor's benefit purchased from the trader. However, the government, the trader, and the investor usually do not recognize these utility elements discretely for their actions. Instead, they intuitively aggregate these utility elements into a single notion as the Indian PDs described their new system's utilities as "transparency and ease." (Endo, 2021) Therefore, this analysis also aggregates a utility element set $U_i(u^1, u^2, u^3, \ldots u^i)$ into a utility set u_i and denote by $u_1, u_2, u_3, \ldots u_n, u_\alpha \in \mathbb{R}^{n+1}_{\geq 0}$ the investor's aggregate utility set. Then, the investor's aggregate utility set $\boldsymbol{U}$ is

$$\boldsymbol{U} = \boldsymbol{U}^{n+\alpha} = \{u_1, u_2, u_3, \ldots, u_n, u_\alpha\} \tag{5.7}$$

Similarly, let denote $t_1, t_2, t_3, \ldots, t_n, t_\alpha \in \mathbb{R}^n_{\geq 0}$ the trade volumes per unit-time ("trade volume" for simplicity unless otherwise stated). The investor's trade volume $\boldsymbol{T}$ is,

$$\boldsymbol{T} = \boldsymbol{T}^{n+\alpha} = \{t_1, t_2, t_3, \ldots, t_n, t_\alpha\} \tag{5.8}$$

The trade volume demand function V is the ordered pairs of $\boldsymbol{U}$ and $\boldsymbol{T}$**,** and is written from Equations (5.7) and (5.8)

$$\boldsymbol{V} = \boldsymbol{v}(\boldsymbol{U}, \boldsymbol{T}). \tag{5.9}$$

Since the trade volume demand functions with respect to the government-provided utilities and the purchased utilities for the trading service price $\boldsymbol{V^n}$and $\boldsymbol{V^\alpha}$, the complements of $\boldsymbol{V}$ with respect to each other, are

$$\boldsymbol{V}^n = \boldsymbol{v}(\boldsymbol{U}^n, \boldsymbol{T}), \tag{5.10}$$

$$\boldsymbol{V}^\alpha = \boldsymbol{v}(\boldsymbol{U}^\alpha, \boldsymbol{T}),$$

$$\boldsymbol{v}(\boldsymbol{U}, \boldsymbol{T}) = \boldsymbol{v}(\boldsymbol{U}^n, \boldsymbol{T}) + \boldsymbol{v}(\boldsymbol{U}^\alpha, \boldsymbol{T}).$$

Equation (9) is shown in Figure 4, and Equations (5.9) and (5.10) are shown in Figure 5-5.

Efficiency and exchange efficiency functions also illustrate the investor's trading

behavior. Let denote $p_1, p_2, p_3, \ldots, p_n, p_\alpha \in \mathbb{R}^{n+1}_{\geq 0}$ the investor's perceived prices for the utilities. The investor's perceived price set for GSM trading is,

$$\boldsymbol{P} = \boldsymbol{P}^{n+\alpha} = \{p_1, p_2, p_3, \ldots, p_n, p_\alpha\} \tag{5.11}$$

From Equation (5.11) and a set of constants $\{\lambda_1, \lambda_2, \lambda_3, \ldots \lambda_n, \lambda_\alpha\} \in \mathbb{R}^{n+1}_{\geq 0}$, the investor's perceived value of the market structure is

$$\boldsymbol{P}^n = \boldsymbol{U}^n \cdot \boldsymbol{\lambda}^n = \{\lambda_1 u_1, \lambda_2 u_2, \lambda_3 u_3, \ldots, \lambda_n u_n\}. \tag{5.12}$$

From Equation (5.12), the government's utility production function is

$$S \geq \boldsymbol{P}^n = \sum_{i=1}^{n} \lambda_i u_i \tag{5.13}$$

where S is the market structure's carrying capacity to generate utilities for trading. The investor's utility consumption rises close to S as the government lets the market structure release the embedded utilities to the investor. The investor's trading is also constrained by the trader's trading service price, as shown by Inequation (5.17). Also, an exchange function can be written,

$$\sum_{i=1}^{n} \lambda_i u_i = \sum_{i=1}^{n} p_i, \qquad \forall\ i \tag{5.14}$$

Let $\tilde{P}$ denote the investor's perceived residual value of trading. From Equation (5.14), $\tilde{P}$ is

$$\tilde{P} = \sum_{i=1}^{n} \lambda_i u_i - \lambda_\alpha u_\alpha = \sum_{i=1}^{n} p_i - p_\alpha, \qquad \forall\ i \tag{5.15}$$

The investor trades only if it evaluates $\lambda_\alpha u_\alpha = p_\alpha \geq \hat{p}$ and $\tilde{P} \geq 0$, where p_α is the trader's pecuniary evaluation of the benefit from trading, and $\hat{p}$ is the trader's trading service price. Therefore, from Equation (5.14),

$$\sum_{i=1}^{n} \lambda_i u_i - p_\alpha = \tilde{P} \geq\ 0$$

$$U^n - p_\alpha \geq 0$$
$$U^n \geq p_\alpha. \quad (5.16)$$

When a trade occurs (at the intersections of the investor's and the government's indifference curves in the Quasi-Edgeworth Box in Section 6.3), $\tilde{P} = 0$. Therefore, from Inequation (5.17),

$$U^n \geq p_\alpha \geq \hat{p}. \quad (5.17)$$

where $\hat{p}$ is the trader's trading service price. Inequation (17) implies that the investor trades through "utility-seeking" as long as it evaluates the utilities (U^n) more than or equal to its trading (p_α). When it ceases to hold this view, the investor becomes "price-taking" (or "price-seeking" if the trading service is not competitive) and trades when it considers trading worth (p_α) more than or equal to the trader's trading service price ($\hat{p}$). p_α is the changeover price from utility-seeking to price-taking or price-seeking, and $\hat{p}$ is p_α's floor price. Note that the changeover price p_α is not definitive. The evaluation of the utilities and the benefit from trading and its timing are unlikely to be uniform across investors. Therefore, the changeover would be gradatory, as shown in Figure 5-5.

If the investor's benefit from trading declines below the trading service price ($p_\alpha < \hat{p}$), trading stops. If the declining benefit from trading persistently pressures the trader's trading service price below its production cost, the intermediation stops.

5.7 Discussion

This research aimed to draw out the gist of a GSM's internal dynamics essential for market development management to envisage the whole picture of GSM development policies.

The GSM's ownership arrangements affect the economic agents' behaviors. Utilities, instead of prices, considerably dominate trading motivation in early phase GSMs, in which the market structure's ownership arrangements regulate utility generation and distribution. The two clubs (the investor club and the trader club) share the market structure as one impure public good while the public or the government regard the same market structure as a public good with vitally positive externalities. Accordingly, the

government is the primary source of utilities for trading motivation, and the trader-investor relationship dictates utility distribution.

Clubs are subject to congestion. The congestion model analysis illustrates the market structure design and operation's control over utility distribution to the GSM trader club (the community of traders qualified or authorized to engage in intermediating trades). The market structure features restrain or boost the trader club's growth and trading.

GSM development is a long-term cross-sector collaborative exercise among the investor, the trader, and the government or more stakeholders. Their participation and contribution would vary in aspects, timings and durations, and degrees. More importantly, GSM development's impacts differ from sector to sector, creating the complexity of sectoral interests.

Collaboration and coordination are the keys to success. The first step is to visualize GSM development's processes, impacts, and challenges for GSM stakeholders.

My analyses strongly suggest that the stakeholders must share an understanding of the market development dynamics unique to LIEs and realistic development goals. The market development characteristics unique to LIEs include:

- positive externalities and government intervention,
- utilities' dominant role in inducing the investor to trade,
- utilities' embeddedness in a market structure,
- the utility-driven cyclicity of a market structure,
- the trader-investor bilateral dependency in a market with the weakest governance,
- counterbalancing between club congestion and network effects,
- the growth resistance from a market structure's carrying capacity,
- the trade volume's logistic and the utility weight's inverse logistic curves,
- a contract curve in the quasi-Edgeworth Box, and,
- the phase-end lull period.

These dynamic features would be better interpreted against the TDPF when problems are foreseen or rise.

The utilities primarily induce trading in early phase markets, and the trading service price takes over when the utilities' marginal effect diminishes near the market structure's carrying capacity. The changeover point theoretically exists but has yet to be investigated empirically.

This research is subject to limitations. Quantitative evidence is limited to that of the Indian GSM case (Endo, 2021a). This study's deduction heavily relies on multi-disciplinary findings and theories but not from within GSM development theories. My exploration has excluded market microstructure (Table 5-2).

5.8 Conclusion

This research has explored the characteristics of GSM development in LIEs to help the GSM policymaker manage the market development. The utilities released from the market structure are the primary fuel for market development in early phase markets. The market structure's ability to release utilities undergo a life cycle in a market development phase and declines as it approaches the carrying capacity. The GSM development policymaker needs to identify a new utility bundle to meet evolving trading needs and build a new market structure with the new utility bundle embedded therein.

This research provides no absolute conclusion. The findings and interpretations are benchmarks and milestones on a GSM development map. The map and its usage are subject to ongoing improvement.

Tables

Table 5-1 Two-Dimensional Policy Framework for Government Securities Market Development

April 2, 2021

Market Development phase		**1**	**2**	**3**	**4**
		Nascent	**Evolving**	**Advanced**	**Highly-Advanced**
Investor base (minor investors)		Mainly captive/state Commercial banks State pension fund State insurance companies (Retail investors) (Corporate investors)	Less captive/state Commercial banks Pension funds Insurance companies (Retail investors) (Corporate investors)	Private sector dominant Yield-seeking Pension funds Life insurance companies Cooperatives Foreign investors Mutual funds Commercial banks	More private sector dominant Competitive performance Pension funds Life insurance companies Cooperatives Foreign investors Mutual funds Hedge funds Commercial banks
Policy principles	Policy Measures	Simple Minimum Low cost	Focused Efficiency-seeking, Local Scalable	Competitive Efficient Beyond the banking sector Equal footing	Sophisticated Internationally competitive Prudential Resilient
	Goals	Visibly fundamental and functional	Essential to a national economy	Influential across the yield curve	Internationally compatible
Functioning Market Component					
Accounting	Policy Measures	Disclosure and governance of institutional investors and intermediaries	Amortization	Mark-to-market (Fair value)	Hedge accounting

Market Development phase		1	2	3	4
		Nascent	**Evolving**	**Advanced**	**Highly-Advanced**
	Goals	Trust building in financial intermediation	Reduced price distortion,	Better performance evaluation of asset management Better risk management Competition for better asset management performance More active trading	Derivatives for risk management
Legal affairs	Policy Measures	Modern business law Modern banking law Public debt law Securities Law Immobilization or depository regulation	Trade failure Trade finality Netting arrangements Dematerialization Code of conduct	Payment system law Novation Securities lending Liquidation of collateral and pledged assets Master repo agreement Enhanced prudential supervision and regulation	International harmonization Jurisdictional (re)alignment Legal and jurisdictional coordination regulators
	Goals	Legal basis for debt securities issuance and trading	Certainty and efficiency of trading	International comparability, Legal basis for trading efficiency, settlement certainty, and risk management Enhanced resilience to shocks	International comparability and connectivity
Primary market	Policy Measures	Preannounced auctions Non-competitive bidding Designated/prequalified bidders Treasury bills Short-term maturities	Issue calendar Reopening or buy-back or switching Tap issuance Bidding open to the public Short- to medium-term maturities	Larger issue amounts Syndicate underwriting Long-term maturities Treasury bills for sterilization	Product innovation (like STRIPS)
	Goals	Introduction of market-based public finance	Lower debt cost by pooling liquidity Lower secondary market prices by consolidating issues Broadening of the investor base	Adaptation to institutional investors Liquidity enhancement Extending the benchmark yield curve	A more reliable yield curve (a zero-coupon yield curve)

Market Development phase		1	2	3	4
		Nascent	**Evolving**	**Advanced**	**Highly-Advanced**
Debt and cash management*	Policy Measures	Cleanup of public or quasi-public arrears Public debt issuance legislation DM office Timely & accurate debt record keeping The separation between front- and back-office activities	Increase in domestic borrowing DM strategy and reporting Consolidation of DM functions Sensible balancing or separation between DM and monetary policy operation (e.g., agency agreement) Partial risk management Sovereign credit rating	Treasury single account Cash flow forecasting Integrated debt recording system with the rest of the public financial management system Middle office (integrated sovereign risk management, etc.)	Assets and liabilities management framework (integrated approach)
	Goals	Explicit authorization to borrow Clear delegation of responsibilities Confidence building in public finance Timely debt service	Mitigation of the “original sin.” Reduced refinance or liquidity risks Enhanced accountability of public debt Transparency	Better controlled refinance or liquidity risks	Increased natural hedging of the state’s balance sheet
Secondary market	Policy Measures	Negotiated (dealers' "Club") market Telephone voice trading	Screen-based electronic trading platform Call auction or continuous order-driven Market convention Market surveillance	Electronic OTC market (quote-driven) Continuous trading Partial PD market making Market transparency rules Interdealer brokers	Full-scale PD market-making Connectivity Interdealer brokers
	Goals	Occasional trading	Trade transparency Periodic/regular price discovery Centralized marketplace	Liquid trading Extend price discovery to the medium- and long-term segments	Continuous price discovery across the yield curve High-volume trading
Monetary policy framework**		Reliance on rules-based instruments	Introducing money market instruments	Increasing open market operations	Full reliance on money market operations
Money market	Policy Measures	Treasury bills Call market Reserve averaging	Standing facilities (Central bank repos) Interest rate corridor Bank repos Sporadic open market repos	Repos among financial and non-financial institutions (open repo market) Commercial papers	Forward-rate agreements
	Goals	Reduced volatility of money market rates	Reduced volatility of money market rates Even distribution of fund liquidity Anchoring the yield curve at the short end	Lower and more stable inventory holding costs for non-bank intermediaries Facilitating a shift from direct instruments to indirect ones	Enhanced hedging function

Market Development phase		1	2	3	4
		Nascent	Evolving	Advanced	Highly-Advanced
			Introduction of market-based monetary operations		
Derivatives or futures	Policy Measures			Interest rate swaps	Interest futures and options Currency futures and options
	Goals			Interest rate hedging	Higher price discovery and liquidity Reinforced price discovery (yield curve)
Clearing and settlement	Policy Measures	Book-entry CSD	Dematerialization DVP Rolling settlement Multiple-net settlement SWIFT Automation	Integration of payment and securities settlement systems RTGS Central bank money STP	CCP Link to international CSDs Special collateral repos
	Goals	No physical delivery Ownership management	Enhanced Backoffice efficiency Closer market monitoring	Systemic risk reduction	Globalization

Source: The Author

Notes:

* Policy measures for debt management in this Table are those for domestic government debt market development. Emerging economies often resort to external debt before or while their domestic government debt markets develop. Their external debt issuance may require the debt issuing economies to put in place more advanced debt management systems in earlier stages than their domestic debt does.

** Based on the author's interpretation of Laurens, J. Bernard.2005. Monetary policy implementation at different stages of market development. IMF Occasional paper No. 244. Washington, D.C.: International Monetary Fund, 2005. Available at http://www.imf.org/external/pubs/nft/op/244/op244.pdf

(1) A country's market may shift from a development phase to another as its economy goes through a major structural change (inter-phase transition), while most market development likely occurs in a single development phase (intra-phase market improvement).

(2) Listed policy measures are, in principle, new policy measures that should be considered in a particular development phase. The four phases and their policy measures and goals are ballpark guidelines. They should be flexibly applied in the local context. A country's market may be implementing some policy measures that the two-dimensional Table specifies for the next or previous phase.
(3) The Table does not base its development phase classification on numerical parameters. A market's development phase can be determined by comparing its policy measures and institutional settings horizontally or vertically.
(4) Countries can have different developmental goals. Every economy may not always want to advance to higher market developmental stages.
(5) The pace of policy implementation may vary depending on actual market development and unfolding circumstances.
(6) Some policy measures listed in a development phase may conflict.
CCP = central counterparty; CSD = central securities depository; DM = debt management; DVP = delivery vs. payment; OTC = over-the-counter (market); PD = primary dealer; RTGS = real-time gross settlement; STP = straight-through processing; STRIPS =Separate Trading of Registered Interest and Principal of Securities; SWIFT =Society for Worldwide Interbank Financial Telecommunication**.**

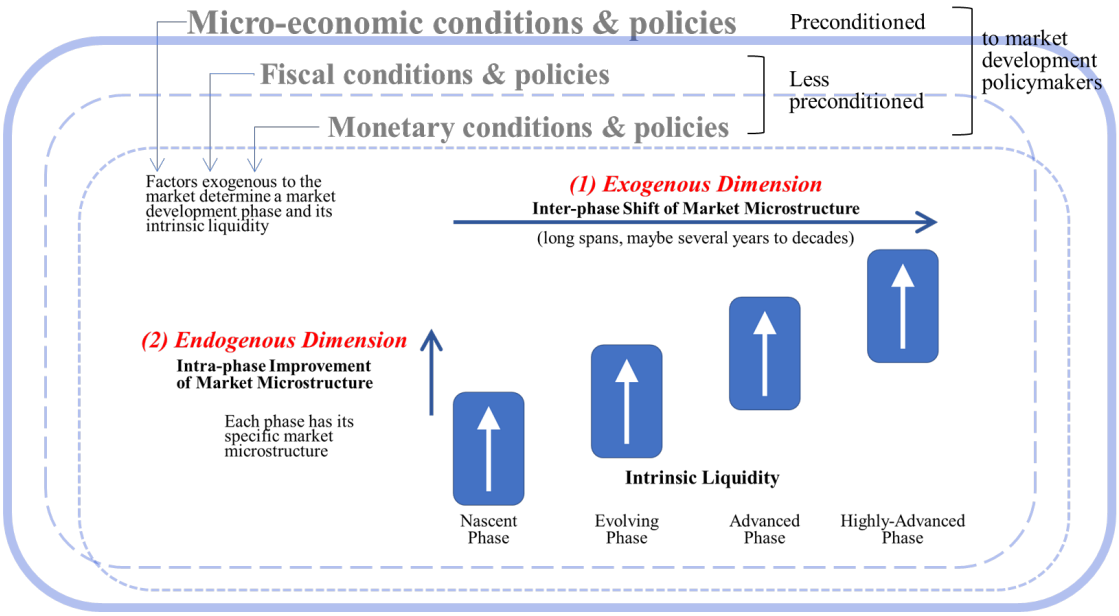
Table 5-2: Market microstructures of Securities or Commodities Trading

Trading frequency	Order-matching	Liquidity-provision	Intermediation
Continuous market	Dealer market (quote-driven)	Market making market	With or without Interdealer broker
		Non-market making market	
	Auction market (order-driven) (continuous auctions)		
Call (Batch) market	Auction market (order-driven) (discrete auctions)		

Source: The Author

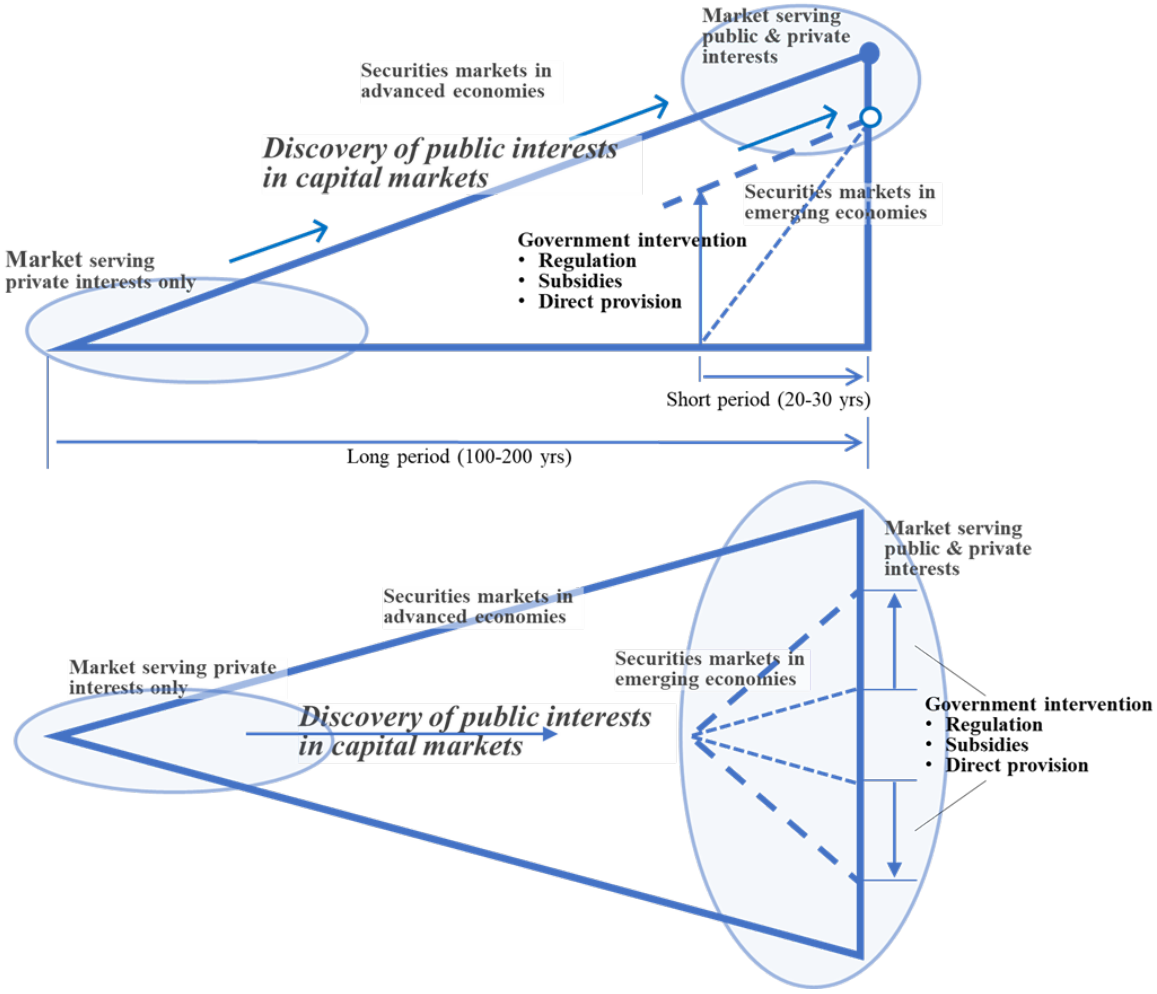
Figures

Figure 5-1: Two-Dimensional Market Development



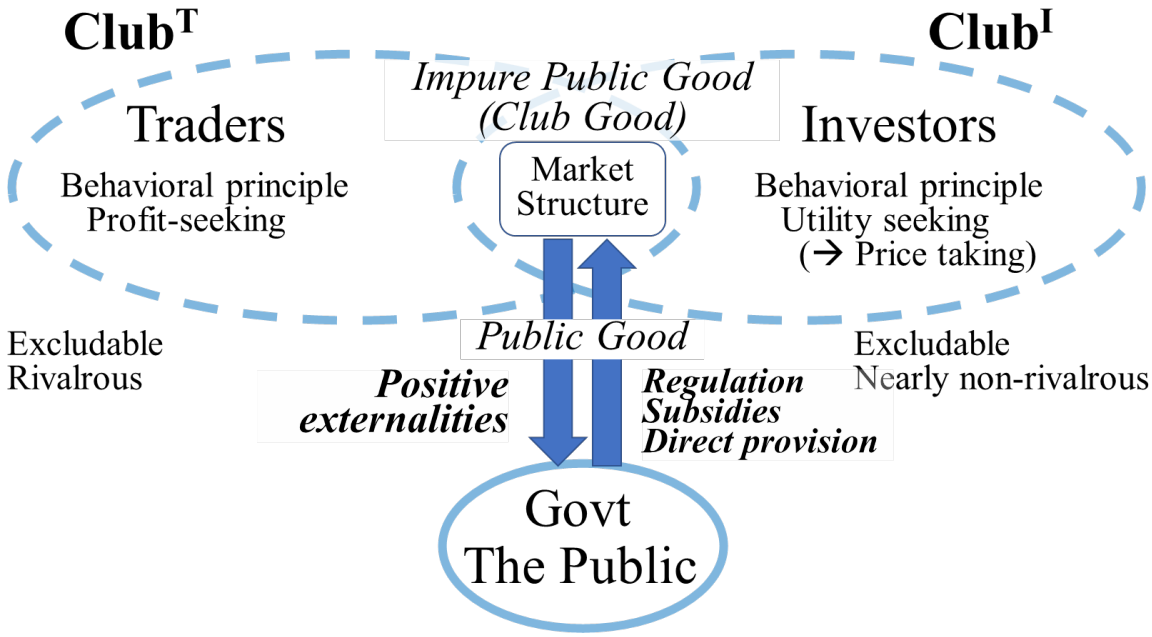
Source: Endo (2020)

Figure 5-2: Public Interests in Capital Market Development in Advanced and Emerging Economies (upper diagram: market quality; lower diagram: market scope)



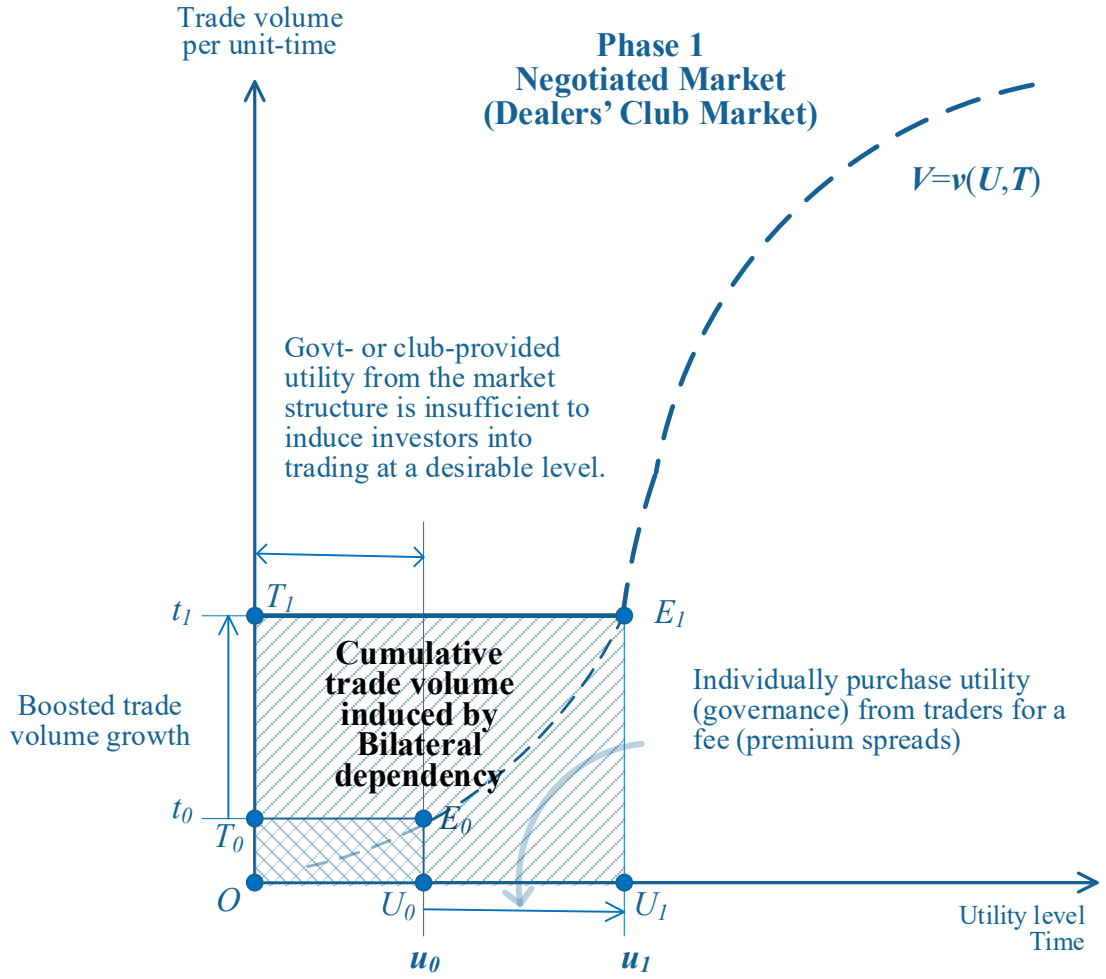
Source: The Author

Figure 5-3: Public Good, Impure Public Good, and Positive Externalities



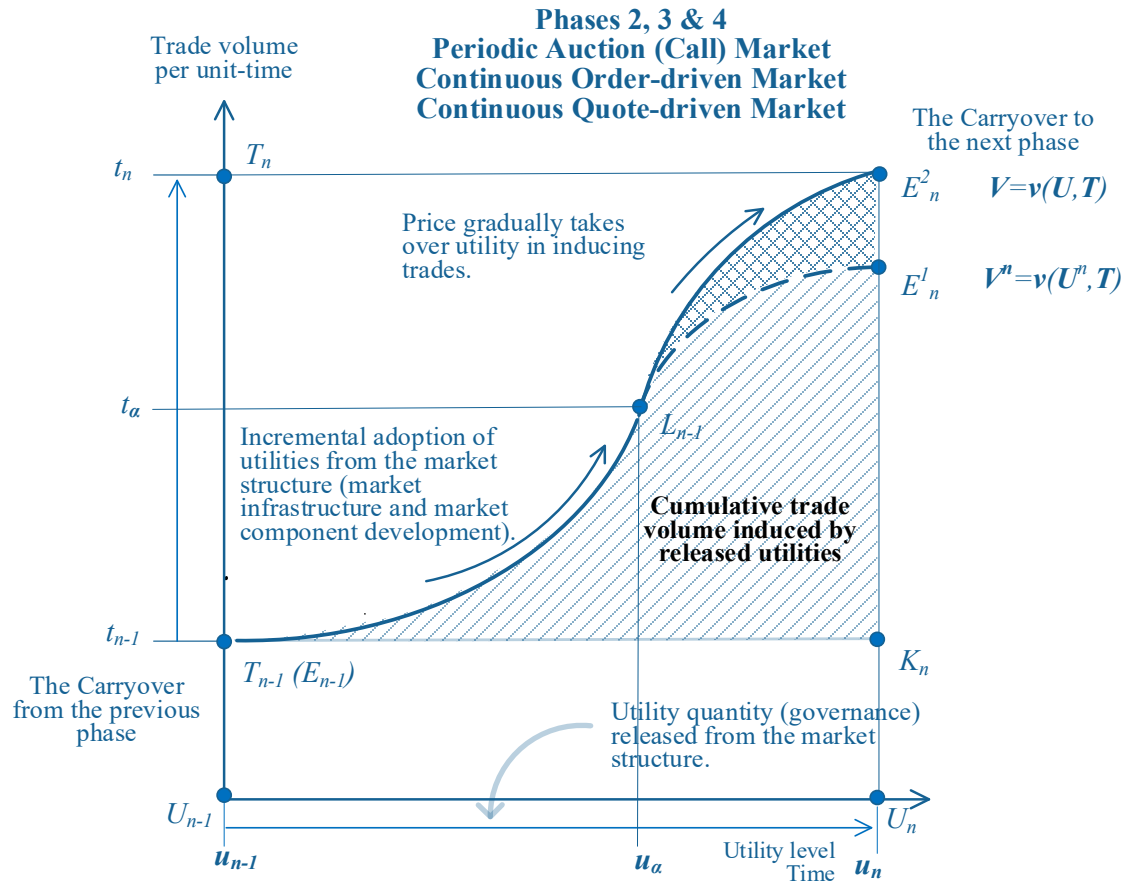
Source: The Author

Figure 5-4: Utility Quantity vs. Trade Volume (Phase 1)



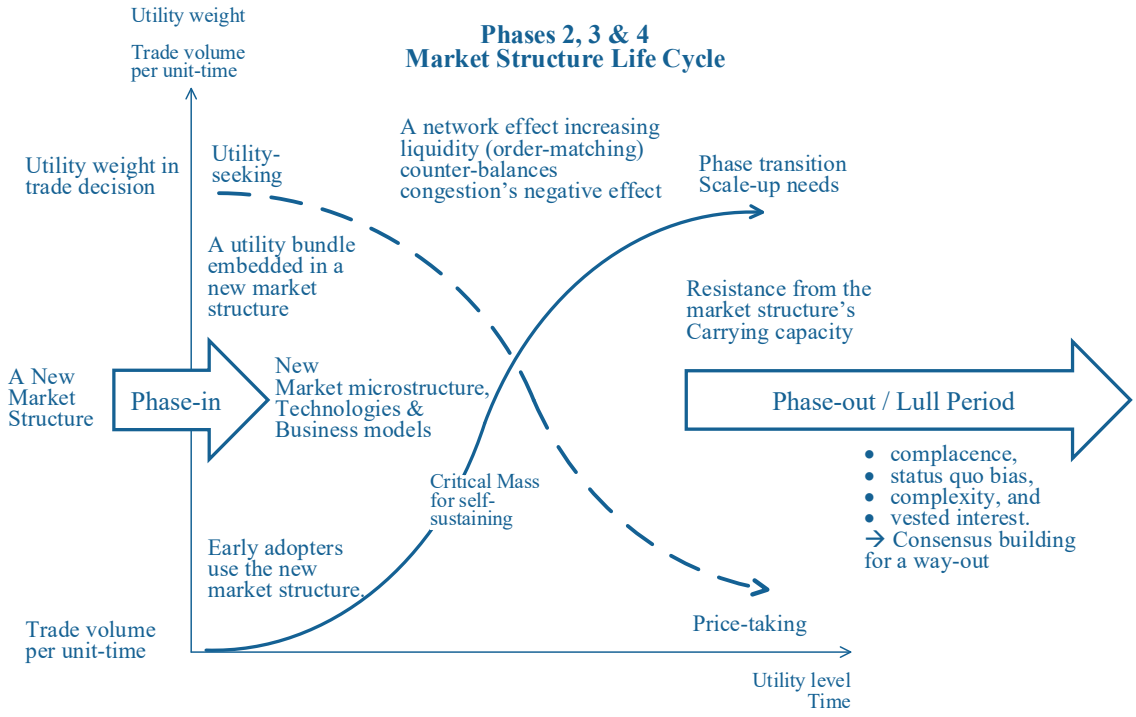
Source: The Author

Figure 5-5: Utility Quantity vs. Trade Volume (Phase 2, 3 & 4)



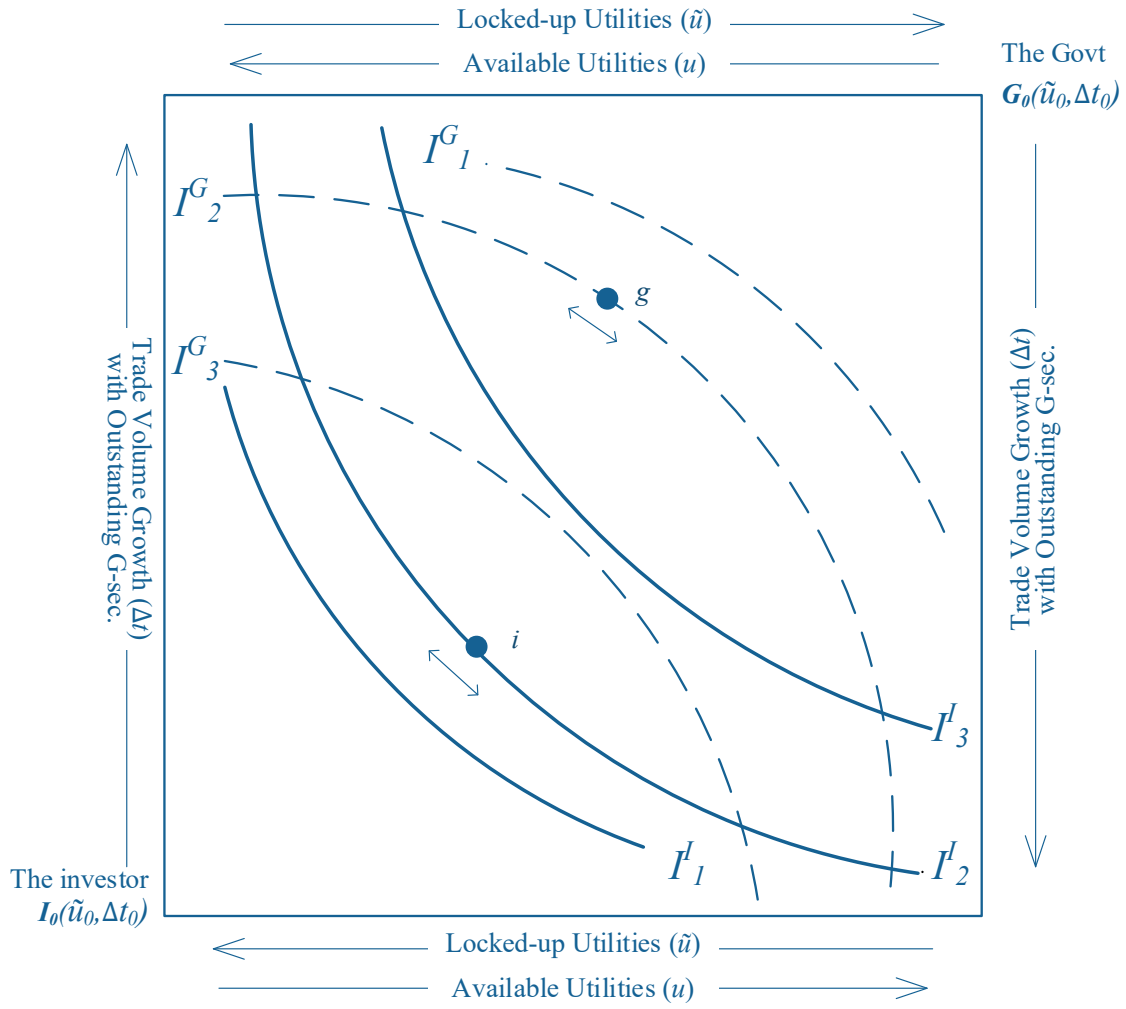
Source: The Author

Figure 5-6: Market Structure Life Cycle (Phase 2, 3 & 4)



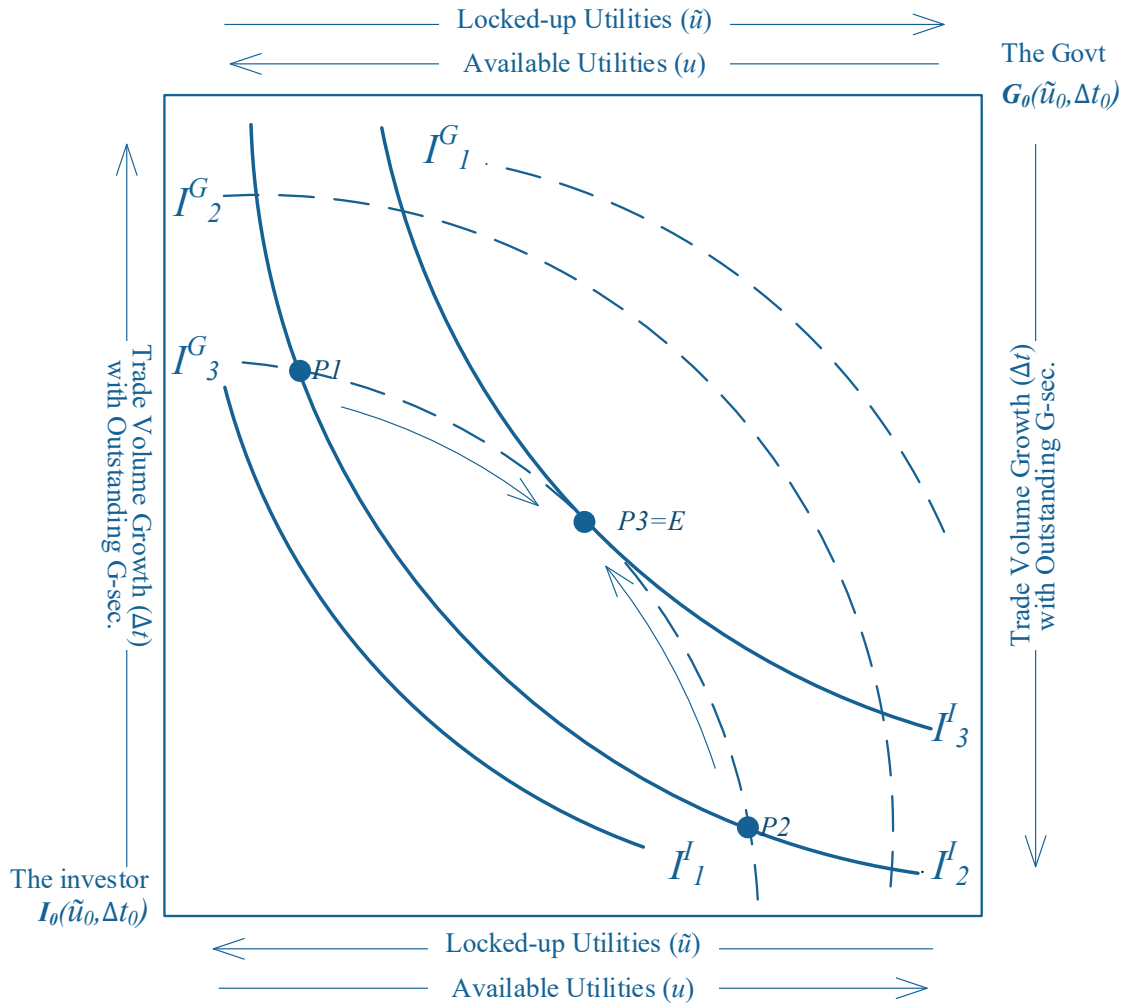
Source: The Author

Figure 5-7: Market Structure Life Cycle (Phase 2, 3 & 4)



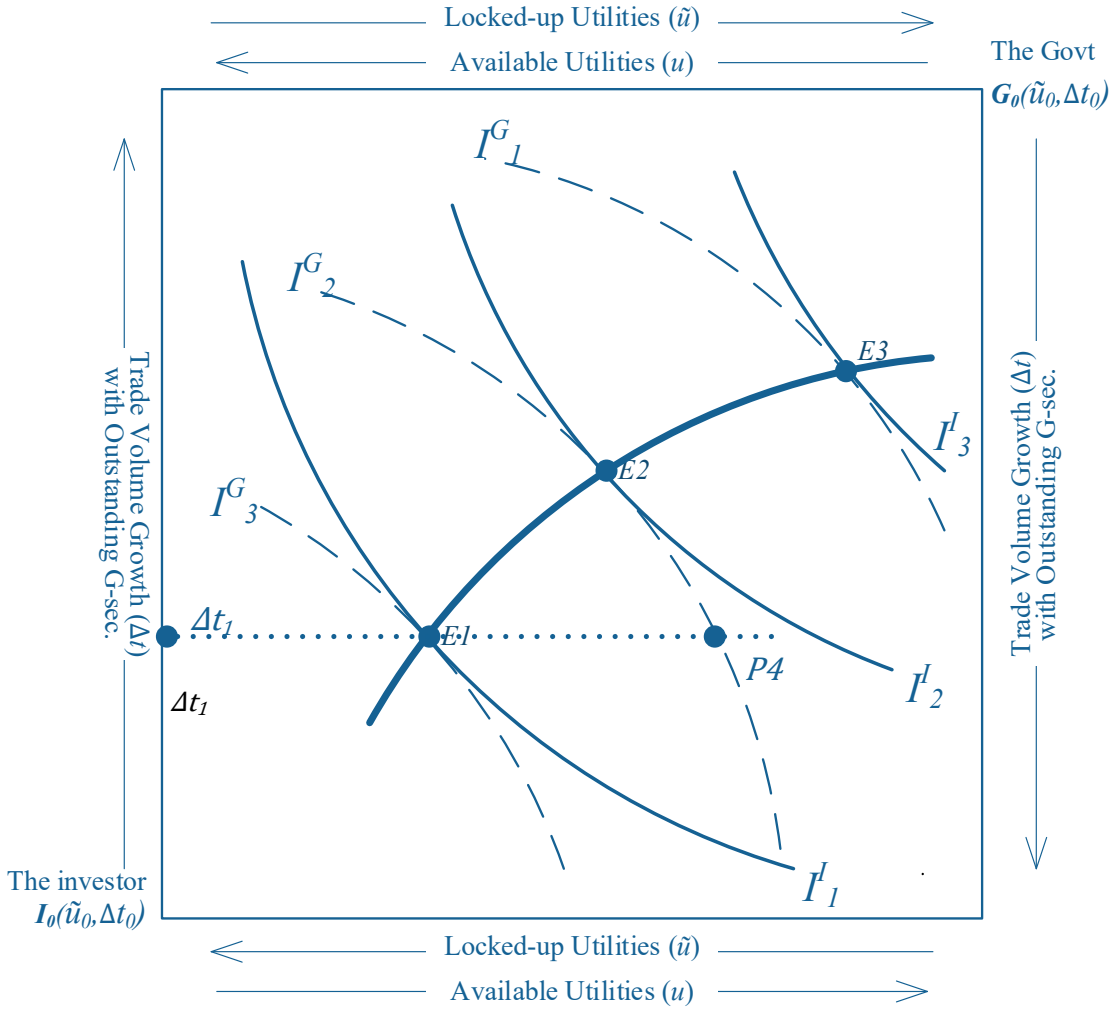
Source: The Author

Figure 5-8: Edgeworth Box (Moving to Equilibrium)



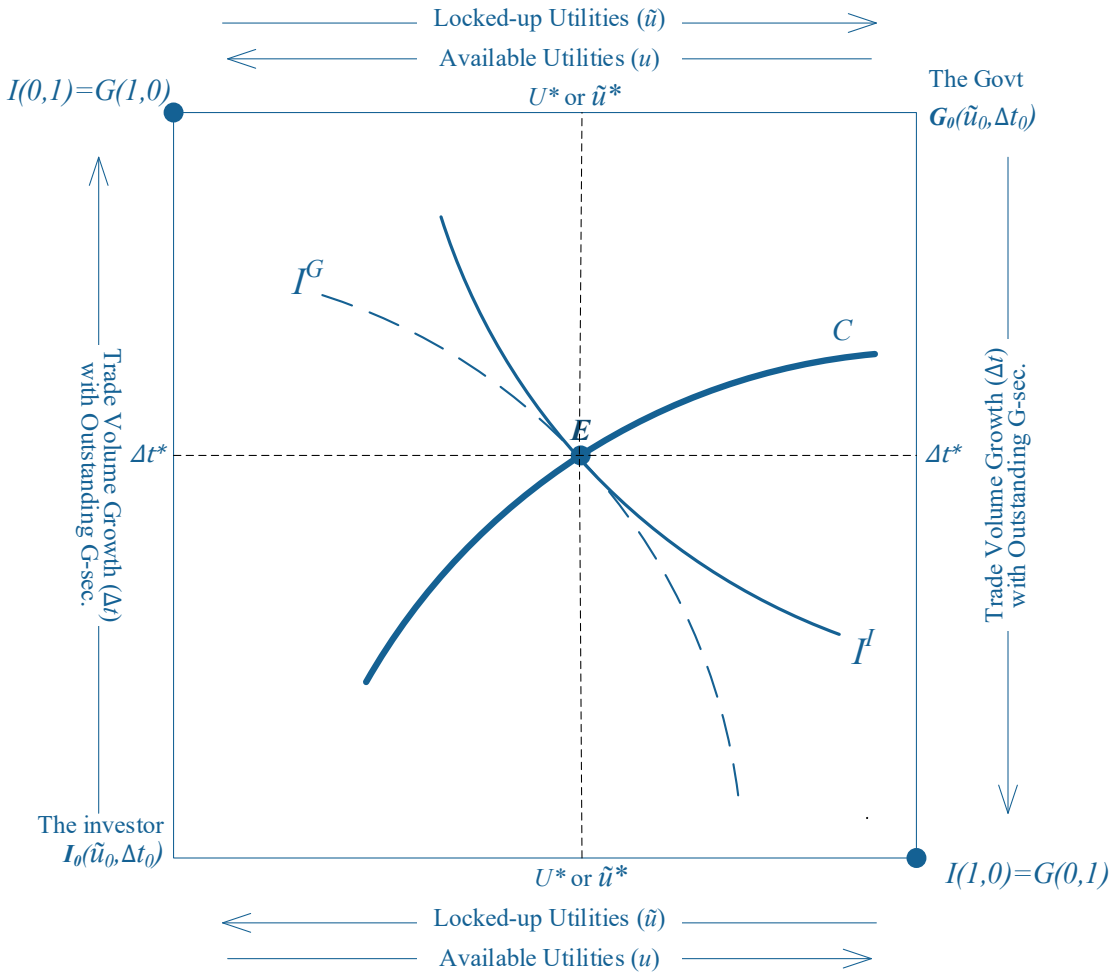
Source: The Author

Figure 5-9: Quasi-Edgeworth Box (Contract curve)



Source: The Author

Figure 5-10: Quasi-Edgeworth Box (Optimality)



Source: The Author

6 Discussion

This conclusion is for the entire dissertation in addition to the conclusions for Chapters 3, 4, and 5.

This research aimed to improve upon the conventional policy framework (CPF) for LIEs. Then, the aim was supported by the questions: why and how the CPF has not worked for GSM development in LIEs, and how the development community can improve upon it.

This dissertation illustrated the two paradigms of GSM development study: a static one and a dynamic one. The former pertains to the static properties of market development, while the latter relates to its dynamic properties. In the static paradigm, this dissertation accomplished the three tasks concerning policy frameworks: reviewing the CPF for its applicability to LIEs, proposing an alternative framework, and testing the alternative framework for applicability. In the dynamic paradigm, this dissertation uncovered the role of a market structure's utilities in market development management and related a GSM's positive externalities to the government's critical role and historically differing policy bases for early-phase and highly advanced GSMs. The dynamic paradigm dealt with dynamic interactions among the investor, the trader, and the government.

The review of the CPF concludes that improving upon the CPF requires a better understanding of a GSM's evolution and GSMs' diversity. The CPF implicitly conflated emerging GSMs in policy selection. Consequently, mismatches between adopted policies and LIE realities result in disappointing results. The blind reliance on a PD system is an example of those mismatches and inadvertently misled LIEs in GSM development. Many LIEs have PD systems in place, but the systems are barely functioning (Chapter 3). A better understanding of early-phase GSMs would have allowed the international development community to advise their governments to consider a realistic and economical market microstructure. GSM policymakers could have managed their expectation better.

For the second task concerning policy frameworks, this dissertation proposed endogenous market development through the "Two-Dimensional Policy Framework for Government Securities Market Development" (TDPF) (Chapter 4). I carefully sorted out widely known

CPF-policies and mapped them in the TDPF's two-dimensional matrix table. The columns represent four market development phases differentiated by exogenous factors (phase-differentiation), and the rows contain market components classified by endogenous factors (phase-coherency).

Testing the TDPF substantiated the applicability of endogenous market development. I tested the TDPF for its real-world applicability with the Indian GSM's policies in the past (Chapter 4). The results were favorable, subject to ongoing tests with other GSMs for improvement. The TDPF helps the GSM policymaker focus on the policies that are coherent with its macroeconomic and social environments and across its development phase's market components. The GSM policymaker can work on endogenous market development but hardly do so on exogenous market development. The policymaker is part of a development phase.

In the dynamic paradigm, I addressed the endogenous causality of trade volume growth (Chapter 4) and the ownership arrangements of early-phase GSMs (Chapter 5). The causality analysis of the Indian GSM's trade volumes uncovered the counterintuitively dominant role of utilities released from the market structure in early-phase markets, while the trading service price did not affect the trade volumes. This discovery led to the theorization of utilities in early-phase markets. The analysis of GSMs' ownership arrangements revealed the significance of a GSM's positive externalities and the rationales for government intervention and policy differentiation between early-phase and highly advanced GSMs.

Product consumption theories for imperfect markets would equip the GSM policymaker with the predictability of trade volume evolution and phase transition. The utilities for trading can be regarded as products, including technologies or services (Chapter 5). The Indian GSM case showed that the investor's[67] adoption of a new market structure was steady but gradual from 2005 to 20013 and faced resistance from the market structure's carrying capacity (Chapter 4). These patterns were consistent with consumers' new product adoption patterns. The pattern recognition would enhance the GSM policymaker's communicability for cross-sectoral collaboration among market stakeholders. The patterns may vary from market to market and

[67] In a bank-centric market, the bank-dealer often transacts as an investor for its bank's investment account and as a trader (an intermediary) for its trading account (Section 5.1).

need more empirical studies for precise pattern recognition.

The public/impure-public good setting also regulates a GSM's market structure designing process. Since utilities, rather than trading service prices, dictates a trade volume increase, the government, the utility supplier (the liquidity demander), conceptually faces off the investor, the utility demander (the liquidity supplier). Both parties can be seen as consumers bartering two goods (the marginal trade volume and the market utility quantity) in a quasi-Edgeworth Box. This graphical analysis suggests that achieving market development equilibriums requires cross-sectoral collaboration between the government and the investor (Chapter 5).

This public/impure-public good setting also indicates historically differing policy bases for early-phase and highly advanced GSMs and justifies policy differentiation (Chapter 5). It explains why advanced markets' market policies are not necessarily applicable to early-phase markets' development and operation. Advanced GSMs had established market and social infrastructure a long time before developing their GSMs to meet public interests. By contrast, early-phase GSMs, which recently launched market development initiatives, have to absorb market and social infrastructure's building costs while simultaneously pursuing public interests. Without the government's intervention, a GSM's explicit transaction costs would be prohibitively expensive and defeat the GSM's objectives.

Social optimality requires government intervention (Chapter 5). The market structure is a public good for the public and generates positive externalities essential for modern economic management and well-being. Nonetheless, the market structure is an impure public good (a club good) for the trader and the investor. Therefore, it is likely that the public would free-ride, and the trader and the investor would maximize their benefits inside their clubs. In that situation, the absence of government intervention would underprovide the positive externalities in an early-phase market, which is imperfect, and the GSM would fail to achieve social optimality. Thus, a GSM's public/impure-public good setting warrants the government intervention in GSM development and operation through regulation, subsidies, and direct or indirect provision. Consequently, the government is the primary provider of the utilities and the positive externalities.

Phase coherence bounds a government intervention. For instance, a PD system is not viable in an LIE environment, but government subsidies can make it viable for the trader. A policy

linkage between the primary and secondary markets can cross-subsidize market making in the secondary market from G-sec issuance in the primary market. That is the case with many advanced markets (Chapter 3). In an LIE GSM, however, other parts of the market are incompatible with a PD system, and an attempt to make a PD system alone viable causes unbearable stresses to other parts of the market.

7 Conclusion

This dissertation pointed out the CPF's blind reliance on the PD system, introduced a phase-differentiated and phase-coherent policy framework by organizing CPF policy measures into the two-dimensional (market development phases versus market components) framework, discovered and theorized the dominant role of utilities in trade volume growth in early-phase GSMs phases or their early stages, and related a GSM's positive externalities to the government's critical role and historically differing policy bases for early-phase and highly advanced GSMs.

This dissertation's contributions cover local policymakers, academics, and practitioners, including the international development community. The dissertation first reified the conflated and inextricable concept of GSMs into an addressable and analyzable concept primarily through the TDPF. This reification brought a GSM closer to local policymakers. Consequently, policy issues associated with GSMs became more addressable for LIE governments than before. Second, the dissertation opened a new research theme, GSM development in early-phase markets, for academics. The knowledge gaps regarding the theme include endogenous causality factors in scarcely resourceful economies, the properties and effects of utilities, and the interactions between exogenous and endogenous factors. Third, this dissertation provided practitioners, including the international development community, with a new perspective and a guideline for program formulation.

This research is subject to limitations. Though qualitative evidence is based on a twenty-year field assessment, quantitative evidence is limited to the Indian GSM case. In particular, the TDPF can be upgraded by getting tested with more GSMs. Inter- or multi-disciplinary theory application is new to the GSM development study, and further theoretical consistency tests solidify the theoretical base for GSM development. This research has excluded market microstructure. However, IT technologies possibly have significant impacts on GSM development policies.

Many issues remain open for future study on GSM development in LIEs. A study on the PD system's interactions between the primary and secondary markets would upgrade policy

comprehensiveness. Insights into interactions between a GSM's exogenous and endogenous factors would add more credibility to endogenous market development strategies. A GSM's utility adoption patterns may differ, depending on utility contents, like reliability, functionality, convenience, and utility facilitators/conduits, like technologies, laws and regulations, accounting rules or operational procedures, or overall institutional capacities.

References

Abbas, S. M., & Christensen, J. (2007). The Role of Domestic Debt Markets in Economic Growth: An Empirical Investigation for Low-Income Countries and Emerging Markets. *IMF Working Papers*, 07(127), 1. Retrieved from https://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Role-of-Domestic-Debt-Markets-in-Economic-Growth-An-Empirical-Investigation-for-Low-20973 or https://doi.org/10.5089/9781451866919.001.

Adelegan, O. J., & Radzewicz-Bak, B. (2009). What Determines Bond Market Development in Sub-Saharan Africa? IMF Working Papers, 09(213), 1. Retrieved from SSRN: http://ssrn.com/abstract=1486531 an or https://doi.org/10.5089/9781451873603.001

African Development Bank. (2007). African Fixed Income Guidebook, African Development Bank. Retrieved from: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/2007%20African%20Fixed%20Income%20Guidebook.PDF

African Development Bank. (2010). African fixed income and Derivatives Guidebook, African Development Bank. Retrieved from: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/AfDB-Guidebook-EN-web.pdf5T

Aguilar, C. (2006). The Development of Latin-American Bond Markets: The Case of Colombia. Research Project. Inter-American Development Bank, Washington, DC.

Aguilar, C., Cárdenas, M., Meléndez, M., Salazar, N., & Casas, C. (2006). The Development of Latin-American Bond Markets: The Case of Colombia. Fundacion Para La Educacion Superiory Y El Desarrollo, Bogota, Colombia. Retrieved from https://www.repository.fedesarrollo.org.co/handle/11445/1513

Akamatsu, N., & Puongsophol, K. (2017). Good Practices in Developing Bond Market: with a focus on government bond market. Association of Southeast Asian Nations Plus Three. Retrieved from https://asianbondsonline.adb.org/documents/abmi_good_practices_developing_bond_market_draft.pdf

Alexander, C. (2001). *Market models: A guide to financial data analysis*. Chichester, UK: Wiley. ISBN 9780471899754 Retrieved from https://www.amazon.co.uk/Market-Models-Guide-Financial-Analysis-ebook/dp/B003VIWZFQ/ref=tmm_kin_swatch_0?_encoding=UTF8&qid=&sr=

Amante, A., Araujo, M., & Jeanneau, S. (2007). The Search for Liquidity in the Brazilian Domestic Government Bond Market. *BIS Quarterly Review* (June): 69–82. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.370.5057&rep=rep1&type=pdf

Amihud, Y., & Mendelson, H. (1980). Dealership markets: Market-making with inventory. *Journal of Financial Economics* 8, 31–53. Retrieved from https://www.sciencedirect.com/science/article/pii/0304405X80900203, or https://doi.org/10.1016/0304-405X(80)90020-3

Andrews, R. (2010). Exploring the Impact of Community and Organizational Social Capital on Government Performance. Political Research Quarterly, 64(4), 938-949. doi:10.1177/1065912910381649

Arif, M. (2007). Developing Bond Market in Pakistan. *SBP Research Bulletin*, Volume 3, Number 1. State Bank of Pakistan, Karachi, Pakistan. Retrieved from http://www.sbp.org.pk/research/bulletin/2007/vol3/Bond-Market-Pakistan.pdf

Arnone, M., & Ugolini, P. (2005). *Primary Dealers in Government Securities.* Washington, DC: International Monetary Fund. Retrieved from https://www.imf.org/external/pubs/nft/2005/pdgs/pdgs.pdf

Arvai, Z., & Heenan, G. (2008). A Framework for Developing Secondary Markets for Government Securities. *IMF Working Paper* 08/174, 1–55. Retrieved from SSRN: http://ssrn.com/abstract=126650735

Bagehot, W. (Jack Tayler) (1971) The Only Game in Town. *Financial Analysts Journal*, 27:2, 12-14, Retrieved from https://www.tandfonline.com/doi/pdf/10.2469/faj.v27.n2.12?needAccess=true or HTTPS://DOI.ORG/ 10.2469/faj.v27.n2.12.

Bank of Tanzania (2001). *Economic and Operations Annual Reports, June 2001*. Retrieved from https://www.bot.go.tz/publications/EconomicAndOperationsAnnualReports/June_2001/EOR_1998-99(I).htm.

Bank of Tanzania. (2015). *Guidelines for Participation in Primary and Secondary Markets for Treasury Bonds.* Retrieved from https://www.bot.go.tz/financialmarkets/TBonds/TBonds-EN.pdf

Berensmann, K., Dafe, F., & Volz, U. (2015). Developing local currency bond markets for long-term development financing in Sub-Saharan Africa. *Oxford Review of Economic Policy*, 31(3-4), 350-378. Retrieved from https://academic.oup.com/oxrep/article-abstract/31/3-4/350/1800465?redirectedFrom=fulltext, or https://doi.org/10.1093/oxrep/grv032

BIS, 2002. The Development of Bond Markets in Emerging Economies. BIS Papers No. 11, Monetary and Economics Department, Bank for International Settlements, Basil, Switzerland. Retrieved from www.bis.org/publ/bppdf/bispap11d.pdf

Blair, J. P., & Carroll, M. C. (2008). social capital. Economic Development Journal, 7(3), 42–49. Retrieved from https://www.iedconline.org/web-pages/resources-publications/economic-development-journal-summer-2008/

Blommestein, H., & Horman, G. (2007). Public Debt Management and Bond Markets in Africa. Organisation of Economic Co-operation and Development, Paris. Retrieved from http://www.publicdebtnet.org/export/sites/PDM/public/CORE-

TOPIC/Government_Debt_Management_and_Bond_Markets_in_Africa_final_5_June_2007_7_.pdf

Brockman, P., & Chung, D. Y. (1999). Bid-ask spread components in an order-driven environment. *The Journal of Financial Research*, 22(2), 227-246. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1475-6803.1999.tb00724.x#accessDenialLayout

Bruno Biaisa,B, Glosten, L., & Spatt, C. (2005). Market microstructure: A survey of microfoundations, empirical results, and policy implications. *Journal of Financial Markets,* 8, 217–264. https//doi:10.1016/j.finmar.2004.11.001

Buchanan, J. (1965). An Economic Theory of Clubs. *Economica*, 32(125), new series, 1-14. https://doi:10.2307/2552442

Buchanan, J. M. (1968). *The Demand and Supply of Public Goods*. In: *The Collected Works of James M. Buchanan, Vol. 5*. Electrical version (1999) Indianapolis, IN: Liberty Fund, Inc. Retrieved from http://oll.libertyfund.org/title/1067

Castellanos, J. (1998). Developing Government Bond Markets. IADB. Retrieved from https://core.ac.uk/display/6675669

Castellanos, S. G., & Martínez, L. (2006). The Development and Challenges Faced by the Mexican Bond Market. Latin-American and Caribbean Research Network Project on The Development of Latin American Bond Markets, Inter-American Development Bank, Washington, DC.

CCIL (2019a, November). *Rakshitra*. The Clearing Corporation of India, Limited. Available at https://www.ccilindia.com/Research/CCILPublications/Lists/CCILPubRakshitra/Attachments/307/Rakshitra%20November%202019.pdf

CCIL (2019b). *Factbook 2019 Annexure*. The Clearing Corporation of India, Limited. The current issue available at https://www.ccilindia.com/Research/CCILPublications/Lists/lstfactbook/Attachments/35/Complete_FACTBOOK.pdf

Chaumont, G. (2018). Sovereign Debt, Default Risk, and the Liquidity of Government Bonds. Retrieved from https://economics.sas.upenn.edu/system/files/2019-01/ChaumontJMP.pdf

Chaumont, G. (2018). Sovereign Debt, Default Risk, and the Liquidity of Government Bonds. Retrieved from https://economics.sas.upenn.edu/system/files/2019-01/ChaumontJMP.pdf

Chordia, T., Sarkar, A., & Subrahmanyam, A. (2005). An Empirical Analysis of Stock and Bond Market Liquidity. *The Review of Financial Studies* Vol. 18, No. 1 ª 2005 The Society for Financial Studies. Retrieved from https://academic.oup.com/rfs/article-abstract/18/1/85/1592285 or https://doi.org/10.1093/rfs/hhi010

Christensen, C. M. (1997a). Patterns in the evolution of product competition. *European Management Journal*, 15(2), 117-127. https://doi:10.1016/s0263-2373(96)00081-3

Christensen, C. M. (1997b). *The innovator's dilemma: when new technologies cause great firms to fail*. Boston, MA: Harvard Business School Press. ISBN 978-0-87584-585-2.

Christensen, C. M. (2006). The Ongoing Process of Building a Theory of Disruption. *Journal of Product Innovation Management*, 23, 39–55. https://doi:10.1111/j.1540-5885.2005.00180.x

Claessens, S., Klingebiel, D., & Schmukler, S. L. (2007). Government bonds in domestic and foreign currency: The role of institutional and macroeconomic factors. *Review of International Economics*, 15(2), 370-413. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-9396.2007.00682.x or https://doi.org/10.1111/j.1467-9396.2007.00682.x

Coase, R. H. (1960). The Problem of Social Cost. *Journal of Law and Economics*, 3 (October), 1-44. In R. H. Coase. (1988) The Firm, the Market, and the Law. Chicago, IL: The University of Chicago Press. [Kindle version]

Coase, R. H. (1988). The Nature of the Firm: Influence. *Journal of Law, Economics, and Organization*, 4 (Spring), 33-47. In R. H. Coase. (1988) The Firm, the Market, and the Law. Chicago, IL: The University of Chicago Press. [Kindle version]

Coase, R. H. (1991). The Institutional Structure of Production. In: C. Ménard and M. M. Shirley (eds.), *Handbook of New Institutional Economics*, 31–39. 2005. The Netherlands: Springer.

Copeland, T. E., & Galai, D. (1983). Information Effects on the Bid-ask Spread. *The Journal of Finance*, 38(5), 1457. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1983.tb03834.x or https://doi.org/10.1111/j.1540-6261.1983.tb03834.x

Cornes, R., & Sandler, T. (1996). *The Theory of Externalities, Public Goods, and Club Goods* (2nd ed.). Cambridge: Cambridge University Press. https://doi:10.1017/CBO9781139174312

Dattels, P. (1995). The Microstructure of Government Securities Markets. IMF Working Paper, WT/95/117. International Monetary Fund. Washington, DC. Retrieved from https://www.elibrary.imf.org/doc/IMF001/07169-9781451853988/07169-9781451853988/Other_formats/Source_PDF/07169-9781455282715.pdf

Dattels, P. (1995). The Microstructure of Government Securities Markets. *IMF Working Paper*, WT/95/117. International Monetary Fund. Washington, DC. Available at https://www.elibrary.imf.org/doc/IMF001/07169-9781451853988/07169-9781451853988/Other_formats/Source_PDF/07169-9781455282715.pdf

De Brun, J. E., Gandelman, N., Kamil, H., & Porzecanski, A. C. (2008). The Fixed-Income Market in Uruguay. *Bond Markets in Latin America*. Retrieved from SSRN: http://ssrn.com/abstract=929166 and https://doi.org/10.7551/mitpress/7710.003.0010

De La Torre, A., & Schmukler, S. L. (2007). *Emerging Capital Markets and Globalization: The Latin American Experience*, World Bank, Washington, DC., and Stanford University Press, Palo Alto, California. Retrieved from https://publications.iadb.org/en/publication/emerging-capital-markets-and-globalization-latin-american-experience

Debreu, G., & Scarf, H. (1963). A Limit Theorem on the Core of an Economy. *International Economic Review*, 4(3), 235-246. https://doi:10.2307/2525306

Demsetz, H. (1968). The Cost of Transacting. *The Quarterly Journal of Economics*, Volume 82, Issue 1, February 1 1968, Pages 33–53. Retrieved from https://academic.oup.com/qje/issue/82/1 or https://doi.org/10.2307/1882244

Deuskar, P., & Johnson, T. C. (2016). Central Banks And Dynamics Of Bond Market Liquidity. *CFRAL Working Paper*. Centre for Advanced Financial Research and Learning. Mumbai. Retrieved from http://www.cafral.org.in/sfControl/content/Speech/46201664559PM-Deuskar_Johnson_Paper.pdf

Dufour, A., & Engle, R. (2000). Time and the Price Impact of a Trade. *The Journal of Finance, 55*(6), 2467-2498. Retrieved from https://www.onlinelibrary.wiley.com/doi/abs/10.1111/0022-1082.00297 or https://doi.org/10.1111/0022-1082.00297

Easley, D., & O'hara, M. (1987). Price, trade size, and information in securities markets. *Journal of Financial Economics*, 19(1), 69-90. Retrieved from https://www.sciencedirect.com/science/article/pii/0304405X87900298?via%3Dihub or https://doi.org/10.1016/0304-405x(87)90029-8

Easley, D., Kiefer, N. M., O Hara, M., & Paperman, J. B. (1996). Liquidity, information, and infrequently traded stocks. *The Journal of Finance,* 51(4), 1405-1436. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1996.tb04074.x or https://doi.org/10.2307/2329399

Endo, T. (2020). The primary dealer system in lower-income economies. *Emerging Markets Review*, 45, December, 100715. https://doi:10.1016/j.ememar.2020.100715

Endo, T. (2021a). Endogenous Market Development for Government Securities in Lower-Income Economies. (Unpublished). Graduate School of International Development, Nagoya University

Endo, T. (2021b). Utilities and Development Dynamics in Early-Phase Government Securities Markets. Working manuscript (Not submitted for publication). Graduate School of International Development, Nagoya University

Faias, M., & Luque, J. (2017). Endogenous formation of security exchanges. *Economic Theory*, 64, 331–355. https://doi.org/10.1007/s00199-016-0989-9

Fleming, M., Sareen, S., & Saggar, S. (2015). Structural Changes In The Indian Government Bond Market. *CFRAL Working Paper*. Centre for Advanced Financial Research and Learning. Mumbai. Retrieved from http://www.cafral.org.in/sfControl/content/Speech/46201623614PM-Fleming_Sareen_Paper_Dec_2015.pdf

Fleming, M., Sareen, S., & Saggar, S. (2016). Trading Activity In The Indian Government Bond Market. *CFRAL Working Paper*. Centre for Advanced Financial Research and Learning. Mumbai. Retrieved from http://www.cafral.org.in/sfControl/content/Speech/71201624534PMFleming_Sareen_Saggar_Paper_Abstract_June_2016.pdf

Foucault, T., Pagano, M., & Röell, A. (2014). *Market liquidity: Theory, evidence, and policy*. Oxford: Oxford University Press. Kindle Edition. ISBN: 9780199936243. Retrieved from https://www.amazon.com.au/Market-Liquidity-Theory-Evidence-Policy-ebook/dp/B00CS1WCFA

Garman, M. B. (1976). Market microstructure. *Journal of Financial Economics*, 3(3), 257-275. Retrieved from https://www.sciencedirect.com/science/article/pii/0304405X76900064?via%3Dihub or https://doi.org/10.1016/0304-405x(76)90006-4

Glosten, L. R., & Harris, L. E. (1988). Estimating the components of the bid/ask spread. *Journal of Financial Economics*, 21(1), 123-142. Retrieved from https://www.sciencedirect.com/science/article/pii/0304405X88900347?via%3Dihub or https://doi.org/10.1016/0304-405x(88)90034-7

Glosten, L. R., & Milgrom, P. R. (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics,* 14(1), 71-100. Retrieved from https://www.sciencedirect.com/science/article/pii/0304405X85900443?via%3Dihub or https://doi.org/10.1016/0304-405x(85)90044-3

Gregoriou, A. (2008). The asymmetry of the price impact of block trades and the bid-ask spread. *Journal of Economic Studies, 35*(2), 191-199. Retrieved from https://www.emeraldinsight.com/doi/abs/10.1108/01443580810870164 or https://doi.org/10.1108/01443580810870164

Grossman, S., & Miller, M. (1988). Liquidity and Market Structure. *The Journal of Finance*, XLIII(3), 618-633. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1540-6261.1988.tb04594.x or https://doi.org/10.1111/j.1540-6261.1988.tb04594.x

Gurowitz, E. (2012) Positioning Products and Services Accurately. Retrieved February 8, 2021, from http://gurowitz.com/2012/12/positioning-products-and-services-accurately/

Hanson, J. A. (2007). The Growth in Government Domestic Debt: Changing Burdens and Risks. *World Bank Policy Research Working Paper* 4348. World Bank, Washington, DC. Retrieved from http://elibrary.worldbank.org/docserver/4348.pdf.

Harris, L. (2003). *Trading and Exchanges: market microstructures for practitioners*. New York: Oxford University Press.

Hasbrouck, J, Sofianos, G & Sobsebee, D. (1993). New York Stock Exchange Systems and Trading Procedures. *NYSE Working Paper* 93-01. Retrieved from http://people.stern.nyu.edu/jhasbrou/Research/Working%20Papers/NYSE.pdf.

Hasbrouck, J. (2007). *Empirical market microstructure: The institutions, economics and econometrics of securities trading*. Oxford: Oxford University Press. ISBN-13: 978-0-19-530164-9 and ISBN: 0-19-530164-1. Retrieved from https://www.amazon.com/Empirical-Market-Microstructure-Institutions-Econometrics/dp/0195301641.

Hauser, S., Levy, A., & Yaari, U. (2001). Trading Frequency and the Efficiency of Price Discovery in a Non-Dealer Market. *European Journal of Finance*, Volume 7 Issue 3, pp. 187-197. Retrieved from https://www.tandfonline.com/doi/abs/10.1080/13518470122687

Herring, R & N Chatusripitak. (2000). The case of the missing market: the bond market and why it matters for financial development. ADB Institute working paper, no 11, July 2000. Retrieved from http://repository.upenn.edu/fnce_papers/42

Hildenbrand, W. H. (1974). *Core and Equilibria of a Large Economy*. Princeton: Princeton University Press.

Ho, T., & Stoll, H. (1981). Optimal dealer pricing under transaction and return uncertainty. *Journal of Financial Economics* 9, 47–73. Retrieved from https://www.sciencedirect.com/science/article/pii/0304405X81900209?via%3Dihub or https://doi.org/10.1016/0304-405X(81)90020-9

Horton, G. (n.d.) Refining the Windermere Hierarchy. Retrieved February 8, 2021, from http://www.zephram.de/blog/innovationsstrategie/refining-the-windermere-hierarchy/

Huang, R. D., & Stoll, H. R. (1997). The components of the bid-ask spread: A general approach, *Review of Financial Studies* 10, 995–1034. Retrieved from https://academic.oup.com/rfs/article-abstract/10/4/995/1605656?redirectedFrom=fulltext or https://doi.org/10.1093/rfs/10.4.995

Iden, G., & Arnone, M. (2003). Primary Dealers in Government Securities: Policy Issues and Selected Countries Experience. *IMF Working Papers*, 03(45), 1. Retrieved from https://www.elibrary.imf.org/view/IMF001/05415-9781451846492/05415-9781451846492/05415-9781451846492.xml?redirect=true&redirect=true or https://doi.org/10.5089/9781451846492.001

IMF & World Bank. (2016). Development of local currency bond markets overview of recent developments and key themes prepared for the G20 IFAWG, International Monetary Fund, Washington, DC, Retrieved from http://www.imf.org/external/np/g20/pdf/2016/121416.pdf

IMF, World Bank, EBRD, & OECD. (2013). Developing Local Currency Bond Markets: A New Diagnostic Framework. Retrieved from http://www.oecd.org/daf/fin/public-debt/Local-Currency-Bond-Markets-Diagnostic-Framework-2013.pdf or

https://www.imf.org/en/Publications/Policy-Papers/Issues/2016/12/31/Local-Currency-Bond-Markets-A-Diagnostic-Framework-PP4811

IMF & World Bank. (2021). Guidance Note For Developing Government Local Currency Bond Markets. *Analytical Notes No. 2021/001*. Washington, DC: International Monetary Fund, and World Bank. Available at https://www.imf.org/en/Publications/analytical-notes/Issues/2021/03/17/Guidance-Note-For-Developing-Government-Local-Currency-Bond-Markets-50256

Jiang, G., & McCauley, R. N. (2004). Asian Local Currency Bond Markets. *BIS Quarterly Review, June 2004: International Banking and Financial Market Developments* (June): 67–79. Bank for International Settlements, Basel, Switzerland. Retrieved from https://www.bis.org/publ/qtrpdf/r_qt0406f.htm

Knack, S. (1999). Social Capital and the Quality of Government: Evidence from the United States. Policy Research Working Papers. November 1999. The World Bank. Retrieved from DOI:10.1596/1813-9450-2504Corpus ID: 15863231

Kripfganz, S., & Schneider, D.C. (2018). ardl: Estimating autoregressive distributed lag and equilibrium correction models. Proceedings of the 2018 London Stata Conference. Retrieved from http://repec.org/usug2018/uk18_Kripfganz.pdf.

Kumhof, M., & Tanner, E. (2005). Government Debt: A Key Role in Financial Intermediation. *IMF Working Paper* 05/57. Retrieved from https://www.imf.org/external/pubs/ft/wp/2005/wp0557.pdf

Le Grazie, R. & Fernandez, J. M. (2006). Secondary Government Bond Marke. LAC DEBT GROUP, Inter-American Development Bank, Washington, DC. Retrieved from https://publications.iadb.org/en/secondary-government-bond-market

Leal, R. P. C., & Carvalhal-da-Silva, A. L. (2006). The Development of the Brazilian Bond Market. Inter-American Development Bank, Washington, DC. http://www.iadb.org/res/laresnetwork/projects/pr253finaldraft.pdf.

Madhavan, A. (1992). Trading Mechanisms in Securities Markets. *The Journal of Finance*, 47(2), 607-641. https://doi:10.2307/2329117

Madhavan, A., & Smidt, S. (1993). An analysis of changes in specialist inventories and quotations. *Journal of Finance* 48, 1595–1628. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1540-6261.1993.tb05122.x or https://doi.org/10.1111/j.1540-6261.1993.tb05122.x

Mohan, R. (2004) Decade of Reforms in Government Securities Market in India and the Road Ahead. Keynote Address by Dr. Rakesh Mohan, the then Deputy Governor, Reserve Bank of India at the Annual Conference of FIMMDA jointly organised by Fixed Income Money Market Dealers Association of India (FIMMDA) and Primary Dealers Association of India (PDAI) on March 20, 2004 at Dubai. Retrieved from http://rakeshmohan.com/docs/RBIBulletinNov2004-2.pdf

Mohan, R. (2006) Recent Trends in the Indian Debt Market and Current Initiatives. Retrieved from http://www.rakeshmohan.com/docs/RBIBulletinApril2006-1.pdf and https://rbidocs.rbi.org.in/rdocs/Speeches/DOCs/69400.doc.

Mohan, R., & Ray, P. (2009). Development of the Indian Debt Market. The Stanford Center for International Development Working Paper 410, December. Retrieved from https://siepr.stanford.edu/sites/default/files/publications/410wp.pdf

Mohan, R., & Ray, P. (2017). Indian Financial Sector: Structure, Trends and Turns. *IMF Working Papers* WP/17/7. Retrieved from https://www.imf.org/~/media/Files/Publications/WP/wp1707.ashx

Moitra, S. K. (1983). *Structure and Management of The Gilt-Edged Securities Markets in India.* Corporate Investment Research and Consultancy Bureau. New Delhi

Moore, G. A. (2014). *Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers* (3rd ed.). New York, NY: Harper Business [Kindle version]

Nath, G. (2013). Liquidity issues in Indian sovereign bond market. MPRA Paper 51633, University Library of Munich, Germany. Retrieved from https://mpra.ub.uni-muenchen.de/51633/

Panizza, Ugo. (2008). Domestic and External Public Debt in Developing Countries. *United Nations Conference on Trade and Development Discussion Paper* No. 188. Retrieved from SSRN: http://ssrn.com/abstract=1147669.

Patil, R.H.(2001). Broadbasing and Deepening the Bond Market in India. Center for Financial Institutions Working Papers 01-32, Wharton School Center for Financial Institutions, University of Pennsylvania. Retrieved from http://d1c25a6gwz7q5e.cloudfront.net/papers/1171.pdf

Rajaram, S., & Ghose, P. (2015). Two Decades of Primary Dealer Operations in India. *Rakhshitra*. May 2015, Clearing Corporation of India, Ltd. Retrieved from https://www.ccilIndia.com/Documents/Rakshitra/2015/May/Article.pdf

RBI. (2007). Government Securities Markets, *Report on Currency and Finance 2005-06*. Reserve Bank of India. Available at https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/77570.pdf

RBI. (2013). Negotiated Dealing System (NDS). Retrieved from https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/NDSOM290410.pdf

RBI. (2015) Master Direction – Operational Guidelines for Primary Dealer. Retrieved from https://rbidocs.rbi.org.in/rdocs/notification/PDFs/34MPBA3C2D6A9B114194A38ACD8C4E90BE50.PDF

RBI. (2019). Government Securities Market in India – A Primer. Retrieved from https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/PRI85CEC73A987F41AC89068EE7607A8BEC.PDF

Reddy, Y.V. (2002). Issues and Challenges in the Development of the Debt Market in India. *The Development of Bond Markets in Emerging Economies*, BIS Papers No. 11, June: 117-126. Retrieved from https://www.bis.org/publ/bppdf/bispap11j.pdf

Roger, E. M. (2003). *Diffusion of Innovations*. (5th ed.). New York, NY: Free Press. [Kindle version]

Rubin, R.H. (2005) Legal Systems as Frameworks for Market Exchanges. In C. Ménard and M. M. Shirley (eds.), *Handbook of New Institutional Economics*, 205–228. The Netherlands: Springer

Schinasi, G. J. & Smith, R. T. (1998). Fixed-Income Markets in the United States, Europe, and Japan: Some Lessons for Emerging Markets. IMF Working Paper, WP/98/173. International Monetary Fund. International Monetary Fund. Washington, DC. Retrieved from https://www.imf.org/~/media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/_wp98173.ashx

Shankar, R., & Bose, S. (2008). Auctions of Government Securities in India –An Analysis. *Reserve Bank of India Occasional Paper*, 29(3), Available at https://pdfs.semanticscholar.org/2a15/4a8fac6c6df6f2eae65c312ec35caadef3ba.pdf

Shumway, R. H., & Stoffer, D. S. (2016). Time series analysis and its applications: With R examples (6th ed.). New York: Springer.

Silva, A. (2008). Bond Market Development: Monetary and Financial System Stability Issues. Central Bank of Sri Lanka. http://www.unescap.org/pdd/projects/bondmkt/5_bond_SL_stability.pdf

Smaoui, H., Grandes, M. & Akindele, A. (2017). The Determinants of Bond Market Development: Further Evidence from Emerging and Developed Countries. *Emerging Markets Review*, Elsevier, 32(C), 148-167. Available at https://www.sciencedirect.com/science/article/pii/S1566014116301005?via%3Dihub or https://doi.org/10.1016/j.ememar.2017.06.003

Sophastienphong, K., Mu, Y., & Saporito, C. (2008). *South Asian bond markets: Developing long-term finance for growth*. Washington, D.C.: World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/6584

Stoll, H. R. (1978). The Supply of Dealer Services in Securities Markets. *The Journal of Finance*, 33(4), 1133-1151. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1978.tb02053.x or https://doi.org/10.2307/2326945

Stoll, H. R. (1989) Inferring the components of the bid‐ask spread: Theory and empirical tests. *Journal of Finance* 44, 115–34. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1989.tb02407.x or https://doi.org/10.1111/j.1540-6261.1989.tb02407.x

Stoll, H. R. (2003). Market Microstructure. *Handbook of the Economics of Finance Corporate Finance*. 553-604. Retrieved from https://www.sciencedirect.com/science/article/pii/S1574010203010136?via%3Dihub or https://doi.org/10.1016/s1574-0102(03)01013-6

Sundararajan, V., Dattels, P., & Blommenstein, H. J. (1997). *Coordinating Public Debt and Monetary Management*, International Monetary Fund. Retrieved from https://www.elibrary.imf.org/doc/IMF071/01370-9781557755551/01370-9781557755551/Other_formats/Source_PDF/01370-9781455273911.pdf.

Sy, Amadou. (2007). Local Currency Debt Markets in the I st African Economic and Monetary Union. *IMF Working Paper* 07/256. International Monetary Fund, Washington, DC. Available at https://www.imf.org/external/pubs/ft/wp/2007/wp07256.pdf

Szilagyi, P. G., Batten, J. A., & Fetherston, T. A. (2003). Disintermediation and the development of bond markets in emerging Europe. International Journal of the Economics of Business, 10(1), 69-84. Retrieved from https://doi.org/10.1080/1357151032000043339

Telser, L. (1994). The Usefulness of Core Theory in Economics. *The Journal of Economic Perspectives*, 8(2), 151-164. Retrieved from http://www.jstor.org/stable/2138541

Turner, P. (2002). Bond markets in emerging economies: an overview of policy issues in The development of bond markets in emerging economies. *BIS Papers* No 11, Basel, Switzerland: Bank for International Settlements, Monetary and Economic Dept. Retrieved from https://www.bis.org/publ/bppdf/bispap11.htm

Ventzislav, I & Lutz, K. (2005). A Practitioner's Guide to Lag Order Selection For VAR Impulse Response Analysis, Studies in Nonlinear Dynamics & Econometrics, De Gruyter, vol. 9(1), pages 1-36, March. DOI: https://doi.org/10.2202/1558-3708.1219

Warnock, F. E., & Burger, J. D. (2006). Local Currency Bond Markets. Retrieved from SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=930072 or http://dx.doi.org/10.2139/ssrn.930072

Williamson, O. E. (1979). Transaction-Cost Economics: The Governance of Contractual Relations. The Journal of Law & Economics, 22(2), 233-261. Retrieved May 25, 2021, from http://www.jstor.org/stable/725118

Williamson, O. E. (1981). The Economics of Organization: The Transaction Cost Approach. *American Journal of Sociology*, 87(3), 548-577. Retrieved from http://www.jstor.org/stable/2778934

Williamson, O. E. (1989). Transaction Cost Economics. In R. Schmalensee & R. Willig (eds.), *Handbook of Industrial Organization*, Vol. 1. New York: North Holland, pp. 136–184. https://wwwsciencedirect-com/handbook/handbook-of-industrial-organization/vol/1

Williamson, O. E. (1995) Hierarchies, Markets and Power in the Economy: An Economic Perspective. *Industrial and Corporate Change*, 4(1), 21−49.

https://doi.org/10.1093/icc/4.1.21

Williamson, O. E. (1998) Transaction Cost Economics: How It Works; Where It is Headed. *De Economist,* 146, 23–58. https://doi-org/10.1023/A:1003263908567

Williamson, O. E. (2005). Transaction Cost Economics. In C. Ménard and M. M. Shirley (eds.), *Handbook of New Institutional Economics*, 41−65. The Netherlands: Springer

Williamson, O. E. (2010). Transaction Cost Economics: The Natural Progression. *American Economic Review*, 100 (3), 673-90.

World Bank & IMF. (2001a). *Developing Government Bond Markets: A Handbook*. Washington, DC: World Bank and IMF. Retrieved from https://openknowledge.worldbank.org/handle/10986/13865

World Bank & IMF. (2001b). *Guidelines for Public Debt Management.* Washington, DC: World Bank and IMF. Retrieved from https://www.imf.org/external/pubs/ft/pdm/eng/guide/pdf/080403.pdf

World Bank & IMF. (2014). *Revised guidelines for public debt management (English)*. Washington, DC: World Bank Group. Retrieved from http://documents.worldbank.org/curated/en/539361468170971115/Revised-guidelines-for-public-debt-management

World Bank. (2007a). *Managing Public Debt from Diagnostics to Reform Implementation*. Washington, DC: World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/6658

World Bank. (2007b). Developing the Domestic Government Debt Market: From Diagnostics to Reform Implementation. Washington, DC: World Bank. Retrieved from http://www.publicdebtnet.org/export/sites/pdm/pdm/BEST-PRACTICES/International-Best-Practices/Documents/0821368745.pdf

World Bank. (2010). *Primary Dealer Systems*. DRAFT Background Note, Gemlock Advisory Services, World Bank, Washington DC. Retrieved from http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/pdBackgroundNotefinal.pdf