MONETARY POLICY OPERATIONS IN SINGAPORE

Monetary Authority of Singapore

April 2007

MAS

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Monetary Management Division
Monetary Authority of Singapore

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1 INTRODUCTION

1.1 The Monetary Authority of Singapore (MAS) is the central bank of Singapore and carries out a full range of central banking functions, including the issuance of currency following its merger with the Board of Commissioner of Currency, Singapore (BCCS) on 1 October 2002. Like any central bank, one core function of MAS is the conduct and implementation of monetary policy. This function is undertaken by the Monetary Management Division (MMD) of MAS, whose four primary responsibilities are:

i. Implementation of exchange rate policy;
ii. Conduct of money market operations for banking system liquidity management;
iii. Management / issuance of Singapore Government Securities (SGS) in support of government initiatives in bond market development; and
iv. Provision of banking and financial services to the government.

1.2 In recent years, various aspects of monetary policy operations have been of much public and policy interest, particularly the modus operandi of MAS' foreign exchange and money market operations. This monograph looks behind the MAS' veil and aims to illuminate some key aspects of its monetary policy operations. More specifically, the monograph assesses the monetary implications of MAS' operations and elucidates the effects of these operations on MAS' balance sheet.

1.3 The monograph is organised as follows. Section 2 first sets out a stylised central bank balance sheet, with numbers from a typical MAS balance sheet for illustration. It also provides an overview of MAS'

interactions with the other key players in the banking system, viz. the government represented by the Accountant-General's Department (AGD), the Central Provident Fund (CPF) Board, and banks in Singapore. Section 3 outlines the objective of each of MAS' key responsibilities in monetary policy operations and provides details on how these operations affect the key components of MAS' balance sheet. Section 4 provides some concluding remarks.

2 CENTRAL BANK'S BALANCE SHEET AND KEY PLAYERS IN THE BANKING SYSTEM

Central Bank's Balance Sheet and Its Main Components

2.1 Table 1 sets out a stylised balance sheet of a central bank, listing the main categories of assets and liabilities. The figures refer to the size of the corresponding items on a typical MAS balance sheet. The figures shown are unaudited and are intended purely for illustrative purposes only. The main balance sheet items will be briefly described as follows.

TABLE 1: TYPICAL BALANCE SHEET OF A CENTRAL BANK

Assets			Liabilities		
a.	Foreign Assets	186.6	d.	Currency in Circulation	15.5
b.	Domestic assets (Credit)		e.	Government's Deposits	101.3
	- Loans to banks	0.2	f.	Banks' Cash Balances	6.9
	- Government Securities	6.8	g.	Borrowing from Banks	1.2
c.	Other Assets	0.9	h.	Capital, Reserves, Provision and Other Liabilities	69.6
Total Assets (A)		**194.5**	**Total Liabilities (L)**		**194.5**

2.2 **FOREIGN ASSETS**: The foreign assets of MAS constitute Singapore's Official Foreign Reserves (OFR). The size of OFR is an important indicator of a country's financial standing and provides the central bank the capacity to intervene in the FX market in support of the domestic currency. This is particularly important for Singapore given that its monetary policy is centred on the management of the trade-weighted basket of the exchange rates of Singapore's major export competitors and sources of imports. Indeed, the size of Singapore's OFR has over the years provided significant confidence in, and underpinning to, the Singapore economy in general and strength of the Singapore Dollar (S$) in particular.

2.3 **DOMESTIC CREDIT**: In conducting money market operations for liquidity management in the banking system, MAS may lend to or borrow from banks in Singapore, both on a secured and unsecured basis. This will appear as an asset (domestic credit) or liability depending on whether lending exceeds borrowing or not. Table 1 shows that there was a net borrowing from banks of S$1.0 billion, comprising an outstanding borrowing of S$1.2 billion and an outstanding lending of S$0.2 billion. At the same time, MAS also holds an inventory of Singapore Government Securities (SGS) for use in its money market operations and for the MAS Repo Facility to facilitate market-making by Primary Dealers in the SGS market. MAS' acquisition of SGS, mostly at primary auctions, is classified as domestic credit extended to the government, as SGS are the debt liabilities of the government.

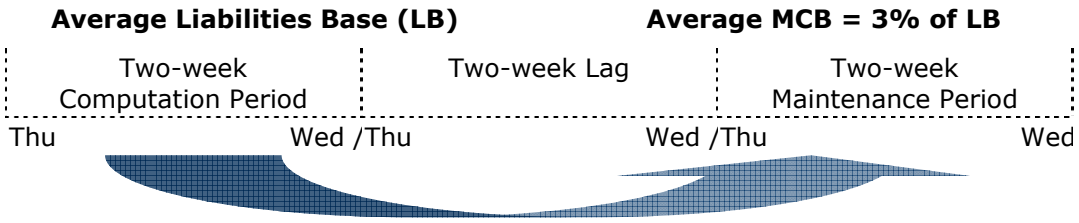
2.4 **CURRENCY IN CIRCULATION**: The issuance of currency is a function of most central banks around the world. Since its merger with BCCS on 1 October 2002, MAS has also assumed the responsibility of currency issuance in Singapore. Under the provisions of the Currency Act, each S$ currency note must be fully backed by foreign assets. The amount of currency in circulation is demand-determined, based on the needs of the public for transaction purposes. The size of MAS' currency liability therefore rises or falls in response to changes in currency demand by the public. Currency in circulation (CIC) comprises notes and coins held by public, banks' vault cash, and the currency holding of MAS. Currency in active circulation (CIAC) comprises only notes and coins held by the public, but excludes banks' vault cash and the currency holding of MAS.

2.5 **GOVERNMENT DEPOSITS**: Central banking has its roots in the provision of banking services to the government and, to-date, most central banks, including MAS, continue to undertake this function to varying extent. In view of the significant role of the government in the

economy, the transactions which it undertakes would have a sizeable influence on the flows of funds in the banking system. Given the fiscal rectitude of the government and its consistent budget surpluses over the years, there has been a net transfer of funds by the government from the banking system to MAS. As such, government deposits with MAS have always been positive and growing over the years. Adding to this pool of deposits are the net proceeds of SGS issuance, and surplus funds from the CPF as contributions of CPF members exceed withdrawals at present.

2.6 **BANKS' CASH BALANCES WITH MAS**: All banks in Singapore maintain cash balances in their current accounts with MAS for the purpose of meeting their reserve requirements and settlement of interbank transactions. Banks are required to maintain interest-free cash balances with MAS - called the Minimum Cash Balance (MCB) - equivalent to 3% of their liabilities base. While banks' MCB is allowed to fluctuate between 2% and 4% of their liabilities base on a day-to-day basis, they must ensure that the average MCB ratio for the two-week maintenance period is not less than 3% (Chart 1).

CHART 1: COMPUTATION AND MAINTENANCE OF MCB



2.7 In addition to their demand for reserve balances, banks may also set aside additional cash balances in their accounts with MAS. The amount of additional cash balances depend on, among others, the following factors: (1) the institutional features of the payment system, which determine how efficiently interbank transactions are settled and whether on a gross or net basis; (2) the prevailing interest rate, which determines the opportunity cost of these non-interest bearing funds to the

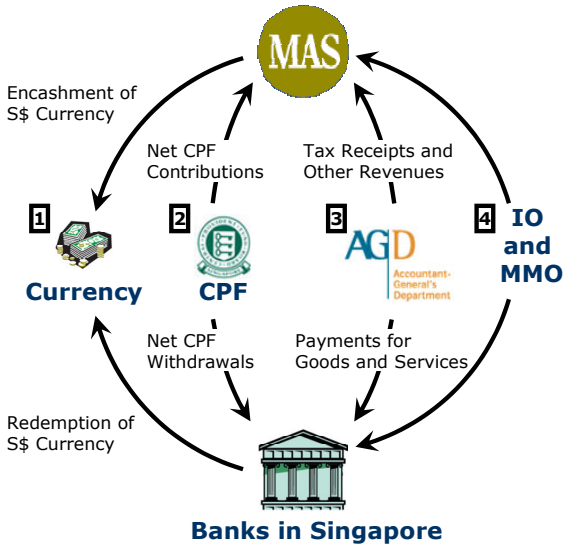
banks; (3) the cost to banks arising from failed transactions due to shortfall in balances, be it financial or reputational, including any censure by the central bank; and (4) the degree of uncertainty on payment flows. As such, unlike the demand for reserve balances which is based on banks' lagged two-week liabilities base and is hence pre-determined, the demand for additional cash balances is inherently less stable and less predictable. The total cash balances that banks maintain with MAS are used to clear and settle transactions among themselves, and with MAS and the government (i.e. AGD).

2.8 Together with currency in active circulation and banks' vault cash, banks' cash balances with MAS constitute what is known as the monetary base or reserve money of the banking system. Indeed, banks' cash balances with MAS form the largest component of the monetary base. Through intermediation by banks, the monetary base expands to become the money supply that facilitates transactions in the economy via a money multiplier process. The monetary base is an important policy variable in those economies with a quantity-based monetary policy that targets some form of monetary aggregates. Being a monopolistic supplier of the monetary base, the central bank can influence this quantity via its money market operations. However, for an economy that has set the interest rate as its monetary policy target, i.e. a price-based monetary policy regime, the monetary base becomes endogenous. Singapore's monetary policy targets neither the interest rate nor monetary aggregate, but is centred on the trade-weighted exchange rate. As such, the monetary base is also endogenous, and its level is based more on banks' demand for reserve and settlement balances.

Main Participants in the Domestic Banking System

2.9 Chart 2 provides a schematic illustration of the interactions among the key players and processes that affect fund flows and liquidity in the banking system in Singapore. These are discussed further below.

CHART 2: SCHEMATIC ILLUSTRATION OF TRANSACTIONS OF KEY PARTICIPANTS IN THE BANKING SYSTEM



2.10 **S$ CURRENCY ISSUANCE**: The Currency Department of the MAS is responsible for the issuance of S$ currency notes. MAS maintains a stock of S$ currency notes as a buffer to meet seasonal demand for currency by the public. When a bank needs S$ currency notes to meet increased demand by customers (e.g., during Chinese New Year and other festive periods), it goes through a process known as "encashment" of the S$ claims in its account with MAS. For example, when Bank A wants to encash its S$ claims on MAS, MAS will debit the bank's current account with it and, in return, pay Bank A an equivalent amount of S$ currency notes out of its currency holding. Although the amount of the bank's cash balance with MAS is reduced as a result, there is a corresponding increase in currency in active circulation, leading to no change in the overall monetary base (Chart 3).

2.11 In the opposite case in which a bank wants to reduce its holding of excess S$ currency notes, it will surrender these notes to MAS, which will in turn credit the bank's current account with MAS for the same amount. Every morning, the gross amounts of currency to be issued and returned that day, and hence its net effect on banks' MCB, are taken into account as an autonomous money market factor in MAS' money market operations.

CHART 3: SCHEMATIC ILLUSTRATION OF THE MECHANISM FOR FOREIGN ASSET BACKING OF S$ CURRENCY NOTES

1. Encashment by Bank A

MAS	
Assets	**Liabilities**
Currency holding ↓	Bank A's balance ↓

Currency Fund	
Assets	**Liabilities**
	CIC – MAS ↓ CIC – Bank A ↑

2. Replenishment by MAS

MAS	
Assets	**Liabilities**
Foreign assets ↓ Currency holding ↑	

Currency Fund	
Assets	**Liabilities**
Foreign assets ↑	CIC – MAS ↑

Bank A

1. Encashment by Bank A

Bank A	
Assets	**Liabilities**
Balance with MAS ↓ Vault cash ↑	

2.12 Under the Currency Act, each S$ currency note in circulation must be at least 100% backed by foreign assets. For this purpose, MAS maintains a Currency Fund to provide for the foreign asset backing of S$ currency notes. MAS keeps a stock of S$ currency notes in its currency holding. As the stock of S$ currency notes in its holding is depleted, MAS will replenish it to the desired level and, at the same time, transfer an equivalent amount of foreign currency at prevailing exchange rates to the Currency Fund. Conversely, if MAS' currency holding is above the desired level, the excess S$ currency notes will be taken out of circulation and an equivalent amount of foreign currency at prevailing exchange rates will be transferred out of the Currency Fund. It is via this process that S$ currency issue is 100% backed by foreign assets.

2.13 **CENTRAL PROVIDENT FUND (CPF) BOARD**: The CPF scheme is Singapore's mandatory and defined contribution pension fund scheme. The CPF Board administers the CPF scheme and collects CPF contributions from members and employers, and dispenses funds to members under the various approved CPF withdrawal schemes. Given the relatively youthful profile of CPF members at present, CPF contributions have tended to exceed CPF withdrawals. The CPF Board places the net proceeds as Advance Deposits with MAS for subsequent subscription to Special Issues of Singapore Government Securities. These Special Issues of SGS have original maturities of 20 years and are non-marketable. They are issued specifically to the CPF Board to meet its investment requirements under the CPF Act and pay an interest equivalent to the interest the CPF Board pays to CPF members. Given the size of its transactions, the CPF Board is a significant participant in the banking system involving fund transfers between its agent banks and the MAS. These CPF fund flows constitute another important autonomous money market factor which MAS has to consider in its money market operations. The CPF Board informs MAS in advance of its transactions or fund requirements so that they can be taken into account when MAS conducts its money market operations.

2.14 **ACCOUNTANT-GENERAL'S DEPARTMENT (AGD)**: Given the significant role of the government in the economy, government fund transfers constitute by far the largest autonomous factor in the domestic money market. The government derives its revenue from taxes, fees, levies, land sales and investment income, and spends on wages of public sector employees, and goods and services it purchases from the private sector. Given the fiscal rectitude of public finance in Singapore, the government budget has consistently been in surplus over the years. AGD is primarily responsible for managing the cash flows of the government. AGD maintains working balances in its accounts with the banks, and transfers funds to or from its account with the MAS as the need arises. As

with the CPF Board, AGD also provides MAS with information in advance on its fund flows to facilitate its money market operations.

2.15 **MONETARY AUTHORITY OF SINGAPORE (MAS)**: Being the central bank, MAS is at the heart of the domestic banking system and interacts with the key participants as outlined above. As monetary policy in Singapore is centred on the management of the trade-weighted exchange rate, MAS conducts money market operations to ensure sufficient liquidity in the banking system to meet banks' demand for reserve and settlement balances. The extent and size of the operations will depend on the net liquidity effect on the banking system of MAS' FX intervention operation and the various money market factors described above. From day to day, the magnitude and direction of each of these money market factors can vary significantly. MAS' FX intervention and money market operations, denoted as IO and MMO respectively in Chart 2 earlier, and their impact on MAS' balance sheet are discussed in greater detail in the next section.

3 MONETARY POLICY OPERATIONS, SGS ISSUANCE AND IMPACT ON MAS' BALANCE SHEET

3.1 This section discusses in detail MAS' key functions in monetary policy operations and the issuance of SGS, and how these operations impact the MAS' balance sheet.

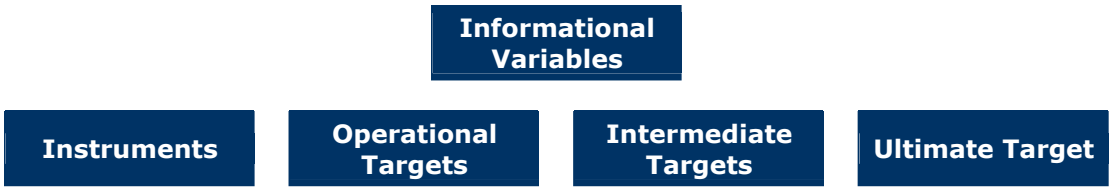
Implementation of Exchange Rate Policy

3.2 Since 1981, Singapore's monetary policy has been centred on the management of the exchange rate. The primary objective of monetary policy in Singapore is to promote price stability as a sound basis for sustainable economic growth. MAS manages the S$ against a trade-weighted basket of currencies of Singapore's major trading partners and competitors, and maintains it broadly within an undisclosed target band. The Economic Policy Department within MAS reviews monetary policy on a semi-annual basis and provides recommendations on the slope and width of the exchange rate policy band consistent with economic fundamentals and market conditions. As it affects the economy with some lags, monetary policy has to be pre-emptive and forward-looking, with a medium-term focus on low inflation and sustained economic growth.

3.3 The approach to monetary policy in most countries can be schematically illustrated in Chart 4. At one end of the spectrum is the ultimate target of policy, while at the other end is the instrument or instruments by which policy is implemented. Because of the long lags and very indirect connections between the instrument and ultimate goal, most central banks have found it useful to make use of other variables that stand in between. These can be classified as intermediate targets, operational targets, and informational variables or indicators.

3.4 In the Singapore context, the ultimate target of monetary policy can thus be defined as price stability or low inflation. The monetary policy instrument to achieve this purpose is the exchange rate when MAS intervenes in the FX market to bring the S$ trade-weighted index (S$ TWI), i.e. the operational or intermediate target, within the prescribed policy band. Useful informational variables for this purpose include interest rates and forward FX rates among others.

CHART 4: MONETARY POLICY FRAMEWORK



3.5 Hence, day-to-day, MAS monitors the movements in the S$TWI closely and ensures that it moves in an orderly fashion broadly within the policy band. However, when the S$TWI breaches the policy band on either side, or when there is undue volatility or speculation in the S$, MAS will step in to intervene in the FX market using spot or forward FX transactions. For tactical reasons, MAS may on occasions, intervene before the band is breached, or allow the S$TWI to breach the band before intervening. Intervention operations may take the form of a purchase of S$ against the US$ to stem the depreciation of the S$, or alternatively a sale of S$ against the US$ to moderate its appreciation. The frequency of these FX intervention operations is indeterminate, but MAS will refrain from intervention as far as possible and allow market forces to determine the level of the S$ exchange rate within the S$TWI policy band.

3.6 For its accountability, the Monetary Management Division (MMD) reports its FX intervention and money market operations at the fortnightly Monetary and Investment Policy Meeting (MIPM), which is equivalent to the Monetary Policy Committee of other central banks. At times of

heightened S$ volatility and FX market turbulence, MMD also provides regular updates on S$ developments to the monetary policy committee in between MIPM meetings. In addition, the Economic Policy Department conducts semi-annual review of MMD's FX intervention and money market operations, in conjunction with its formulation of the exchange rate policy for the following period.

3.7 The effects of FX intervention operations on MAS' balance sheet are schematically illustrated in Box 1. It is via MAS' direct FX intervention operations that Singapore's OFR are accumulated or depleted.

BOX 1: INTERVENTION OPERATIONS AND MAS' BALANCE SHEET

a. *Purchase of S$ against US$ with a Bank*

Assets	**Liabilities**
Foreign Assets ↓	Bank's Cash Balances with MAS ↓

b. *Sale of S$ against US$ with a Bank*

Assets	**Liabilities**
Foreign Assets ↑	Bank's Cash Balances with MAS ↑

Conduct of Money Market Operations

3.8 In the context of Singapore's open capital account, the choice of the exchange rate as the focus of monetary policy would necessarily imply that domestic interest rates and money supply are endogenous. This is the principle underlying the Theorem of the Impossible Trinity, also known as the Open-Economy Trilemma, which states that a country cannot simultaneously manage its exchange rate and maintain an open capital market while pursuing a monetary policy (interest rate or money supply) oriented toward domestic goals.

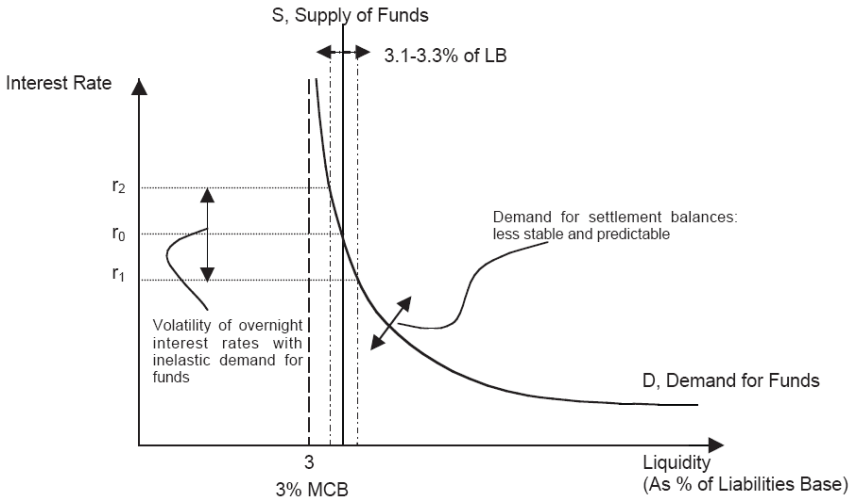
3.9 Concomitantly, MAS' money market operations are aimed at ensuring that there is sufficient liquidity in the banking system to meet banks' demand for reserve and settlement balances. Interest rate

volatility may arise in the overnight market as banks attempt to meet reserve requirements or settlement balance requirements by trying to fund account deficiencies or dispose of account surpluses. Generally, the amount of volatility depends on two factors: the size of the surplus or shortage in the banking system; and the institutional mechanisms for providing or removing liquidity from the system.

3.10 The size of daily surplus or shortage in the banking system, and hence the size of MAS' money market operations, depend to a large extent on MAS' ability to estimate banks' demand for cash balances with the MAS. The level of reserve requirements may influence volatility in so far as it affects MAS' ability to estimate the banks' demand for cash balances. As discussed in Section 2, banks in Singapore are required to maintain reserve requirement or MCB with MAS equal to 3% of their liabilities base. At 3%, the reserve requirement is binding in the sense that the amount of cash balances that banks are required to set aside at the end of the day is on average sufficient to meet their typical intraday liquidity requirements. Given the lagged maintenance period, both MAS and the banks themselves can estimate with certainty the banks' requirement for central bank balances. In addition to the demand for reserve balances, banks would also set aside additional fund as buffer to facilitate settlement of interbank transactions. Based on historical experience, an additional liquidity buffer in excess of banks' reserve requirements of 0.1-0.3% points, or 3.1-3.3% of their liabilities base at current MCB requirement of 3%, has been found to be adequate to alleviate any frictional liquidity in the banking system. Within this range, overnight interbank interest rate would remain fairly stable, although its volatility may also depend on the skewness in distribution of funds in the banking system and on any existence of market power exerted by some banks. Chart 5 shows a graphical illustration of MAS' supply of and banks' demand for funds in the banking system.

3.11 The second factor affecting interest rate volatility is the set of mechanisms that a central bank adopts for resolving daily deficiencies or surpluses in banks' cash balances. Generally, these mechanisms affect overnight interest rate volatility by altering the interest sensitivity of the demand for or supply of central bank balances. Thus, the averaging provisions for MCB requirements of between 2% and 4% of banks' liabilities base have helped to reduce daily liquidity pressures and lowered interest rate volatility. The averaging provisions for MCB requirements have the effect of making the demand for cash balances more interest sensitive and hence less vertical, i.e. more downward-sloping. In addition, the fact that the 3% MCB requirement is binding and that banks' MCB ratio is allowed to fall to 0% of their liabilities base during the day have helped alleviate intraday liquidity pressures.

CHART 5: SUPPLY OF AND DEMAND FOR FUNDS

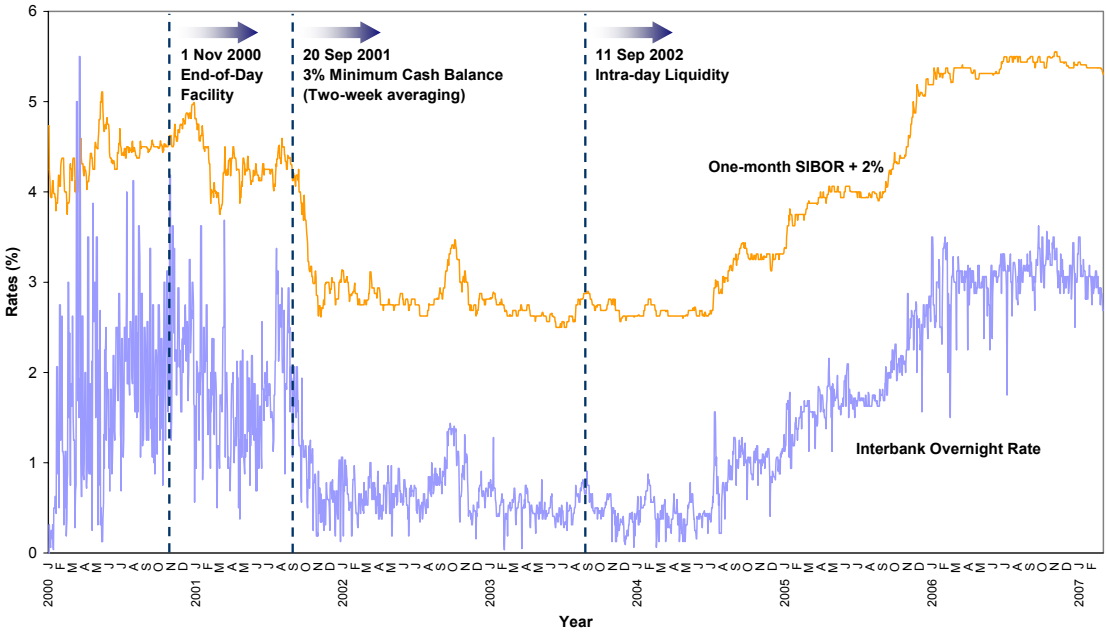


3.12 Interest rate volatility also depends on how a central bank provides liquidity through money market operations and through discount or lending facilities. In this respect, apart from MAS' daily money market operations, MAS provides an End-of-Day Liquidity Facility, an Intra-day Liquidity Facility and a Standing Facility.

3.13 MAS' End-of-Day Liquidity Facility is a late-day refinancing facility, which allows banks to cover their net debit positions that may arise from end-of-day cheque-clearing positions. On a bank's request, MAS may provide lending via overnight sale and repurchase agreements (repos) of SGS at an interest rate of 2% above the 1-month S$ Singapore Interbank Offered Rate (SIBOR) fixed at 11.00 am of the same day by the Association of Banks in Singapore (ABS). This facility is made available to all banks in Singapore, subject to limits. Such a refinancing facility offered by the central bank has the effect of making the supply curve less steep or more interest rate-sensitive, thereby leading to less interest rate volatility. Indeed, as shown in Chart 6, the overnight interest rate has not exceeded the interest rate charged for the use of MAS End-of-Day Liquidity Facility (orange line in chart) during and at the end of the day since the facility was implemented in November 2000. The volatility of overnight interest rate has also been significantly reduced since the averaging provisions for MCB requirements came into effect in September 2001, although this could also be partly due to the easy money market conditions in the aftermath of the 11 September terrorist attack on New York.

3.14 In September 2003, an Intra-Day Liquidity Facility was introduced to ensure adequate liquidity for settlement purposes. This facility allows MAS' appointed Primary Dealers to borrow intra-day funds from MAS via intra-day repos at a rate determined daily by MAS. A haircut of 5% is also applied.

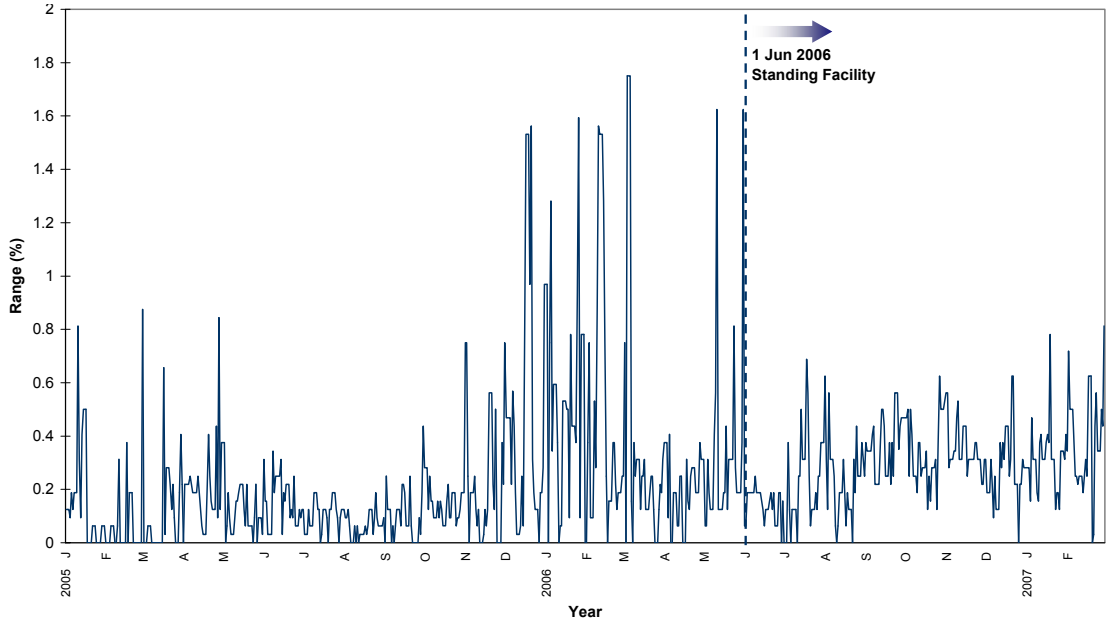
CHART 6: SINGAPORE OVERNIGHT INTERBANK OFFERED RATES



3.15 The MAS' Standing Facility is a borrowing / lending facility provided to MAS' appointed Primary Dealers and is akin to facilities provided by other central banks such as the Bank of England, the European Central Bank and the Reserve Bank of Australia. This facility was introduced in June 2006 in view of increasing volatility in rates and complements MAS' money market operations. The daily money market operations provides for broad liquidity management of the banking system. The Standing Facility allows Primary Dealers to initiate borrowing or deposit transactions with MAS based on their needs and by so doing, fine-tune the liquidity of the banking system. The Standing Facility is made available twice a day during 10.45-10.55am and 6.15-6.25pm. MAS will lend cash collateralised with SGS at a fixed rate and take deposits at a lower fixed rate. A reference rate is first determined every morning during the money market operations by taking the weighted average rate of successful bids by Primary Dealers for $500m of overnight deposits. The facility's lending rate will then be 0.5% above the reference rate and the deposit rate will be 0.5% below the reference rate.

3.16 The MAS Standing Facility is not a mechanism for interest rate targeting and is purely for the purpose of containing intra-day interest rate volatility. Thus, this is not inconsistent with the structure of our monetary policy of exchange rate targeting and open capital markets.

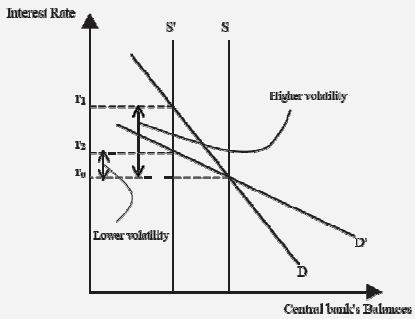
CHART 7: INTRA-DAY VOLATILITY OF INTERBANK OVERNIGHT RATES



3.17 In a move to level the playing field between banks and non-banks, there has been a global trend over the last few years to lower reserve requirements on banks to zero or a non-binding level. In Singapore, the MCB ratio was reduced from 6% to 3% of banks' liabilities base on 2 July 1998. In countries where the reserve requirements have been reduced to a non-binding level or even zero, banks' demand for central bank balances is more for purpose of settlement rather than reserve requirements, and hence is less predictable and less interest sensitive. This may lead to greater interest rate volatility and may require alternative mechanisms for provision of liquidity by central banks to mitigate the increase in interest rate volatility. Box 2 provides stylised illustrations of some possible measures used by central banks to manage interest rate volatility.

3.18 Day-to-day, MAS conducts its main money market operations in the morning at about 9.45am after assessing and estimating the key money market factors for the day. Throughout the day, MAS monitors the monetary conditions of the banking system and, if necessary, carries out further money market operations in the afternoon at about 2.30pm. The amount of liquidity to inject or withdraw from the banking system each day will depend on the net liquidity impact of: (1) MAS' FX intervention operations, if any, and the maturity of its past money market operations; (2) changes in banks' liabilities base and, hence, their demand for reserve balances; (3) net changes in currency demand; (4) net SGS issuance; (5) CPF Board's fund transfers; and (6) AGD's fund transfers. MAS conducts money market operations exclusively with SGS Primary Dealers in recognition of their role as specialist intermediaries in the SGS and S$ money markets. The instruments used for money market operations are (1) SGS repos / reverse repos; (2) FX swaps and reverse swaps; and (3) direct borrowing / lending.

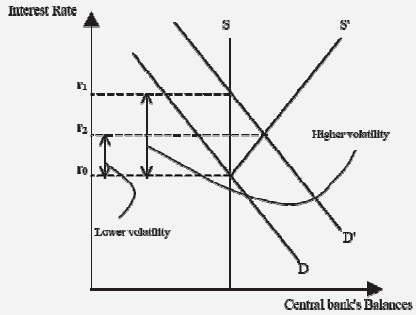
BOX 2: CENTRAL BANK MEASURES TO MANAGE INTEREST RATE VOLATILITY



Changing Interest Sensitivity of Demand

E.g. by enhancing the efficiency of settlement system and allowing averaging provisions for reserve requirements.

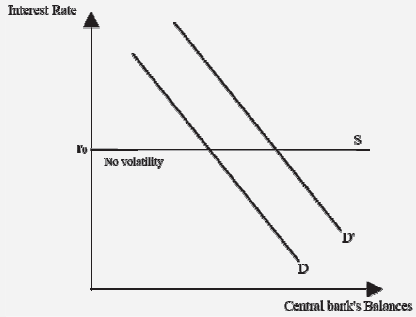
With more interest-sensitive demand for central bank balances, the volatility of short-term interest rates would be lower for any unexpected deviation in central bank's forecast and supply of funds.



Changing Interest Sensitivity of Supply (1)

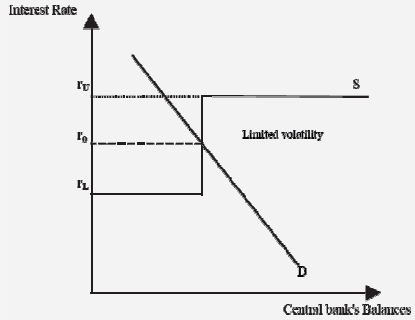
E.g. by allowing banks to obtain additional funds from the central bank as market interest rates rise, the supply curve will be flatter, rather than vertical.

With a flatter supply curve for funds, the volatility o f
short-term interest rates would be lower for any unexpected shift in the demand for central bank balances.



Changing Interest Sensitivity of Supply (2)

At the end of the spectrum, if the central bank stands ready to supply and absorb unlimited amount of funds at a fixed interest rate, r 0 , there will be no interest rate volatility.



Provision of Refinancing & Deposit Facilities

The provision of central bank's refinancing facility to supply funds at above market rate r_U and deposit facility to absorb funds at below market rate r_L would serve to limit interest rate volatility.

Alternatively, by conducting money market operations as frequently as necessary during the day, the central bank can also maintain short-term interest rates within a narrow range.

3.19 The impact of these money market operations on MAS' balance sheet in the situation when MAS is injecting liquidity into the banking system is shown in Box 3. The opposite transactions, and hence balance sheet entries, take place when MAS is withdrawing liquidity from the system. As there is a maturing leg for each of these money market operations, their effect on liquidity in the banking system lasts only for the duration of the transactions. Likewise, the impact of MAS' FX swap operations on OFR is also for the duration of the transaction.

3.20 Table 2 shows how MAS' money market operations over the three-year period have largely been neutral to counteract the net impact of its FX intervention operations and changes in autonomous money market factors on liquidity in the domestic banking system. However, there may be occasions when MAS departs from its usual stance in money market operations and instead supplies much less or much more liquidity than is required to meet banks' demand for reserve and settlement balances. For example, on the morning of 12 September 2001 following the terrorist attack on New York City the night before, MAS injected S$2.5 billion into the banking system to bring the MCB ratio above the statutory minimum of 3% to 4.5% to calm market participants and ensure smooth functioning of all S$ markets. It was only after some calm had been restored to the market that MAS withdrew some of the liquidity in the late afternoon. The banking system was left flush that day and the few days thereafter.

BOX 3: MONEY MARKET OPERATIONS AND MAS' BALANCE SHEET

MMO to Inject Liquidity

a. Via SGS Repo

i. Loans to banks via repo on value date

Assets	Liabilities
Domestic Assets: Loans under Repo ↑	Bank's Balance with MAS ↑

ii. Repayment by banks on maturity date

Assets	Liabilities
Domestic Assets: Loans under Repo ↓	Bank's Balance with MAS ↓

b. Via FX Swap

i. Sale of S$ against US$ on value date

Assets	Liabilities
Foreign Assets ↑	Bank's Balance with MAS ↑

ii. Purchase of S$ against US$ on maturity date

Assets	Liabilities
Foreign Assets ↓	Bank's Balance with MAS ↓

c. Via Direct Lending

i. Direct lending to banks on value date

Assets	Liabilities
Domestic Assets: Loans to Banks ↑	Bank's Balance with MAS ↑

ii. Repayment by banks on maturity date

Assets	Liabilities
Domestic Assets: Loans to Banks ↓	Bank's Balance with MAS ↓

TABLE 2: NET IMPACT OF MONEY MARKET FACTORS AND MONETARY POLICY OPERATIONS ON THE DOMESTIC BANKING SYSTEM

	S$ million per Financial Year			
	02/03	**03/04**	**04/05**	**05/06**
Money Market Factors				
Public sector operations (AGD, CPF)	- 8,730	- 15,593	- 16,687	- 17,505
Currency in circulation	256	48	- 281	- 93
SGS issuance, redemption, interest	- 1,423	674	- 2,314	- 829
Sub-total	**- 9,897**	**- 14,871**	**- 19,282**	**- 18,427**
MAS Foreign Exchange and Money Market Operations				
FX operations, including FX swaps	9,375	35,695	12,269	23,558
SGS repos and reverse repos	- 376	- 1,146	2,738	157
Direct borrowing and lending	500	- 19,787	4,909	- 4,767
Sub-total	**9,499**	**14,762**	**19,916**	**18,948**
Net Cash Injected (+) or Withdrawn (-)	**- 398**	**- 109**	**634**	**521**
Less: Change in banks' required MCB	188	188	484	482
Net Liquidity Impact: Expansionary (+) or Contractionary (-)	**- 586**	**- 297**	**150**	**39**
Memo item: Change in banks' liabilities base	6,264	6,263	16,145	16,064

3.21 The reverse occurred in mid-September 1985 when there was a massive speculative attack on the S$, and MAS intervened in the FX market to buy S$ against US$ but did not offset the liquidity drain of the intervention with money market operations. In other words, the FX intervention operation was left unsterilised to squeeze the speculators and make it costly for them to cover their short S$ positions. (See Box 4 on definition of sterilisation of FX intervention.) Concomitantly, the banking system was short of liquidity, with the MCB ratio closing at 5.4%, which was below the then statutory minimum of 6%, and overnight interest rate surging to close at 100% per annum that day and hovering at 20-30% per annum for the following few days.

BOX 4: STERILISATION OF FX INTERVENTION OPERATIONS

In the literature, sterilised intervention is defined as a FX transaction by a central bank that is accompanied by an offsetting sale or purchase of domestic assets that leaves the domestic monetary base unchanged. For example, in the event of a speculative attack on its domestic currency, a central bank will sell US$ against the domestic currency (transaction (1)) and at the same time buy domestic bonds (transaction (2)) to offset the liquidity impact of its FX intervention. The effect of these two transactions on the central bank's balance sheet is shown below.

Central Bank Balance Sheet

Assets			Liabilities	
Foreign Assets	↓	(1)	Banks' Current A/C	↑ (2) ↓ (1)
Domestic Assets	↑	(2)		

On the liability side, the two transactions offset each other fully and do not affect the monetary base. On the asset side, however, one asset (domestic) is substituted for another (foreign), and the effect of such an intervention on the exchange rate depends on whether the private sector in the aggregate is indifferent to the corresponding changes in its financial portfolio. This is known as the portfolio-balance model of exchange rate determination. In essence, if the private sector regards the domestic and foreign assets as perfect substitutes, the sterilised intervention operation will have no portfolio-balance effect on the exchange rate. On the other hand, if the assets are not regarded as perfect substitutes, market pressures will generate an adjustment in their relative expected yields, entailing a change in the spot exchange rate relative to interest rates and the expected future spot rate, in order to induce the private sector to alter its financial portfolio in accordance with the intervention operation. In addition to any effect it may have through the portfolio-balance channel, sterilised intervention may have an influence on the exchange rate through the expectations or signalling channel. There is a large body of literature discussing the effectiveness of sterilised FX interventions and tests of the portfolio-balance model and signalling channel.

Over the years, MAS' FX intervention operations have been typically of the "lean against the wind" type, particularly in moderating the appreciation of the S$. By virtue of its money market operating procedures to provide sufficient liquidity to meet banks' demand for reserve balances, sterilisation of MAS' FX intervention operations occurs automatically, although not in the strict definition of sterilised intervention provided above. For example, MAS' FX intervention involving a sale of S$ against the US$ would result in an increase in OFR and a corresponding injection of S$ into the banking system. Sterilisation of the FX intervention as defined above may require MAS to sell SGS outright to exactly offset the liquidity impact of the intervention operations. However, as discussed in the main text, in conducting its money market operations, MAS takes into account the net liquidity impact of such FX intervention operations in conjunction with the various autonomous and other money market factors. Depending on the magnitude and direction of these factors, MAS may be required to withdraw liquidity, or even inject additional liquidity into the banking system in the same direction as the effect of the FX intervention. In addition, instead of outright sale / purchase of SGS, short-term money market instruments with fixed tenors are used, and these include SGS repos / reverse repos, FX swaps/reverse swaps, and direct lending/borrowing. To the extent that the liquidity in the banking system is restored to a level sufficient to meet banks' demand for reserve balances at around the MCB ratio of 3%, MAS' FX intervention operations can be said to have been sterilised in a broader sense. Notwithstanding this broad generalization, there were a few occasions in the past when MAS left its FX intervention "unsterilised" in an attempt to thwart speculative attacks on the S$.

Management/Issuance of SGS

3.22 As the fiscal agent of the government, MAS manages the issuance of SGS on its behalf. The issuance of SGS was in the first instance intended to provide a liquid investment alternative with little or no risk of default for banks' minimum liquid asset requirements. In 1998, when the government embarked on a strategy to develop Singapore as an international debt hub, MAS also took on an expanded developmental role. Central to Singapore's strategy to become an international debt centre is the development of an efficient SGS market. Being a core S$ financial market, a liquid and efficient SGS market with ample liquidity will benefit all S$ financial markets as a whole. While the issuance of SGS is not used for financing government deficits, given Singapore's consistent budget surpluses over the years, there are good reasons for MAS and the government to take an active interest in matters affecting the liquidity and efficiency of the SGS market.

3.23 First, a highly liquid SGS market contributes to the efficiency and stability of the financial system by providing pricing benchmarks and hedging instruments for other traded financial assets such as corporate bonds and asset-backed securities. These financial assets are assuming increasing importance as part of the trend in financial disintermediation towards direct financing (via the financial markets), and away from indirect financing (via bank credit). An efficient and liquid bond market would thus help to lower the costs of borrowing by domestic corporates, government-linked companies and statutory boards, besides contributing to growth of the financial services sector and, hence, the overall economy.

3.24 Second, outright and sale and repurchase (repo) transactions in government securities are important instruments of monetary operations. If market liquidity in SGS is lacking, MAS may not be able to conduct its money market operations effectively and efficiently, and would have to

rely on a narrower set of instruments such as FX swaps and uncollateralised lending / borrowing. Third, a liquid and efficient SGS yield curve would contain information, such as term structure of interest rates and implied inflation expectations, that is relevant for hedging and trading activities of market participants, as well as for macroeconomic modelling, forecasting and conducting monetary policy. Finally, in countries with fiscal deficits, a liquid and well-functioning government securities market would help lower the funding costs for the government by reducing the liquidity premium demanded by market participants.

3.25 In this regard, besides acting as the SGS issuing authority on behalf of the government, MAS also formulates and implements a number of policies to improve the microstructure of the SGS market. The Appendix shows a list of the more recent initiatives MAS has implemented since 2000 to develop the SGS market. The impact of SGS issuance and redemption, and payment of SGS coupon interest on the MAS' and government's balance sheets is illustrated in Box 5.

BOX 5: SGS ISSUANCE / REDEMPTION AND MAS' BALANCE SHEET

MAS' Balance Sheet		AGD's Balance Sheet	
Assets	**Liabilities**	**Assets**	**Liabilities**
(a) Issuance of SGS			
	Government deposits with MAS ↑	Government deposits with MAS ↑	SGS Outstanding ↑
	Banks' Balances with MAS ↓		
(b) Subscription of SGS by MAS			
Domestic Assets: SGS ↑	Government Deposits with MAS ↑	Government Deposits with MAS ↑	SGS Outstanding ↑
(c) Payment of SGS Coupon Interest			
	Government Deposits with MAS ↓	Government Deposits with MAS ↓	
	Banks' Balances with MAS ↑	(Interest payment is reflected as an expense item in the government's income / expense account)	
(d) Redemption of SGS			
	Government Deposits with MAS ↓		
	Banks' Balances with MAS ↑	Government Deposits with MAS ↓	SGS Outstanding ↓

4 CONCLUSION

4.1 In summary, this monograph has provided an overview of MAS' key functions in the area of monetary policy operations, and the related markets and key participants. As discussed, the various aspects of monetary policy operations involved are fairly intricate and closely inter-linked, with important systemic implications for the banking system and the economy. These functions are also carried out with the broader macroeconomic objectives in mind, including sustained medium-term non-inflationary economic growth, financial and monetary stability, and development of financial services sector. Often, non-quantitative considerations matter as much as quantitative considerations, rendering the conduct of these functions as much art as science. It is hoped that the monograph has helped enlighten market participants and the public on the various considerations and factors underlying MAS' monetary policy operations.

APPENDIX: Some Highlights of SGS Market Developments

1. In May 2000, MAS embarked on a focused issuance programme to ensure a sizeable free float of bonds above MLA holdings to meet the needs of both existing and new players. Today, typical issue sizes for new benchmark bonds range between S$2.0-2.5 billion.

2. On 1 June 2000, MAS introduced a daily repo facility to aid Primary Dealers in their market making activities. Under volatile market conditions, Primary Dealers may not always be able to cover their short positions. With the facility, Primary Dealers can have recourse to the pool of SGS MAS makes available. This is part of MAS' overall strategy to enhance the liquidity of the SGS market.

3. MAS signed and executed the PSA-ISMA Master Repurchase Agreement with all Primary Dealers. The provision of standard legal documentation that meets international standards facilitates the entry of more foreign players into the repo market.

4. MAS worked together with the Primary Dealers to institute guidelines for the treatment of failed SGS outright trades. These guidelines are outlined in the updated version of the SGS Rules and Market Practices, which can be found on the SGS website.

5. In mid-November 2000, MAS conducted a SGS purchase operation, in which MAS bought illiquid off-run issues from the market. The operation was aimed at concentrating liquidity in the larger benchmark issues.

6. In planning its issuance programme, MAS sought to re-open off-run issues as far as possible to reduce the number of illiquid off-run issues and concentrate liquidity in the benchmarks. In 2001, four SGS issues were re-openings of existing off-run issues.

7. MAS admitted two additional banks to the list of Primary Dealers. On 22 February 2001 and 28 May 2001, Credit Suisse First Boston and Deutsche Bank AG respectively joined the ranks of Primary Dealers.

8. In April 2001, Singapore became the 22nd country to be included in the JP Morgan GBI Broad. Since December 2000, the JP Morgan Singapore Bond Index has existed as a stand-alone index. Singapore accounted for about 0.3% in the multi-country broad index.

9. A dedicated SGS webpage on the MAS website was launched on 15 May 2001. It provided a one-stop location where comprehensive information and data on the SGS market could be found. Also, for the first time, MAS' holdings of SGS were published. The SGS webpage sought to enhance transparency and create greater awareness of the SGS market.

10. Following consultation with various market players, the SGX-DT launched the 5-year Singapore Government bond futures. The contract began trading on 29 June 2001, with a notional value of S$100,000 and 3% coupon. At any point, contracts for the two nearest quarterly months (March, June, September and December) will be listed on the Exchange. The futures contract added one more instrument for traders to hedge their investments in the SGS market.

11. The inaugural 15-Year SGS Bond was launched on 3 September 2001, extending the benchmark yield curve to 15 years.

12. In order to meet the increased demand for Treasury bills as banks' liabilities base grew, as well as to create a more liquid and efficient SGS market across the maturity spectrum, the authorised borrowing limit of Treasury bills increased from S$15 billion to S$20 billion in October 2001.

13. In January 2002, MAS introduced the internet-based SGS eApps facility, which seeks to increase the efficiency of interaction between MAS and Primary Dealers. The first application available on eApps was the electronic tendering system. This system allows for greater ease in the submission of bids and enhances the efficiency of the auction process by shortening the auction window. Additional modules would be introduced at a later stage.

14. In an effort to make SGS more accessible to the investing public and thereby broadening the investor base, the minimum denomination for SGS Treasury bills in both primary auctions and secondary market trading was lowered from S$10,000 to S$1,000 in January 2002. This move also standardised the minimum denomination for SGS Treasury bills and bonds.

15. In April 2002, MAS launched a dedicated SGS website with its unique URL at www.sgs.gov.sg. The website, with enhanced functionalities, aims to provide the investing public, international investors and Primary Dealers with comprehensive information on the SGS market. The SGS issuance calendar, market statistics, legislation governing the SGS market, FAQs for investors and information on SGS dealers are some of the information provided.

16. ABN AMRO joined as a SGS primary dealer on 10 April 2002. With the inclusion of ABN AMRO, the number of Primary Dealers in the SGS market increased to eleven, comprising 3 local banks and 8 foreign banks.

17. MAS, together with the Primary Dealers, produced a SGS Repo Code of Best Practice in July 2002. The purpose of the Code is to set out best practices, which enhanced the integrity and professionalism of the SGS market.

18. In April 2002, MAS introduced a semi-annual peer evaluation for the Primary Dealers to promote and enhance the efficiency, competitiveness and professionalism of the SGS market. It allows Primary Dealers to appraise their peers in the following areas: the speed at which prices are quoted, the readiness to make markets, and the ability to provide competitive pricing.

19. In September 2002, MAS increased Primary Dealers' allocation limits at both SGS bonds and Treasury bill auctions from 20% to 30%. The auction allocation limits of non-Primary Dealers remained at 15%.

20. In September 2002, MAS began to allow the submission of non-competitive bids at Treasury bill auctions, instead of just at bond auctions as was the case previously. This enabled small investors, with informational disadvantage, to participate at primary auctions.

21. On 9 September 2002, MAS published A Guide to Primary Dealer Operations, which details the various roles, responsibilities, obligations and privileges of Primary Dealership in the SGS market. It also lists the guidelines for Primary Dealers' participation in MAS' money market operations. The Guide is available on the SGS website.

22. MAS added a new section on the SGS website – SGS Market Commentaries. This section gives SGS investors convenient access to a range of SGS market commentaries and analyses contributed by participating SGS Primary Dealers. Besides featuring daily, weekly and monthly SGS market reports, special-theme reports are also available to give readers up-to-date and relevant research on SGS market developments.

23. Since 16 September 2002, MAS has been releasing the results of SGS auctions within one hour after the cut-off time for submission of bids. This means that auction results are announced at 1.00pm, instead of 4.30pm, on the day of the auction. The shorter auction cycle between the close of auction submission and the

release of auction results reduces the risks market participants may be exposed to, which arise from uncertainties in auction outcomes and price movements.

24. MAS published A Guide to Singapore Government Securities (SGS). The Guide is intended for anyone who is interested to know more about the main features of the SGS market.

25. MAS' Circular on "Tax Incentives to Encourage Growth of the Debt Market" was announced in February 2003. This extended several of the tax benefits package first announced in 1998 including the tax exemption on income derived by Primary Dealers from trading of SGS, withholding tax exemption on interest earned from Qualifying Debt Securities (QDS) for non-residents and concessionary tax rates for residents on interest earned from QDS.

26. In April 2003, MAS converted from a multiple price auction format for SGS bond auctions to a uniform price auction format, similar to the format used by the US Treasury. This format reduces the risk of "winner's curse" (successful bidding at too high of a price) and achieves broader distribution of securities by spurring greater participation from relatively less informed bidders. Treasury bill auctions continued on the multiple price auction format until December 2006.

27. MAS Repo Facility guideline was refined in September 2003 to increase the amount of SGS offered by making available the portion of SGS holdings not used in the daily MMO. The settlement time for the general repo leg was also extended.

28. In May 2004, the SGS eApps facility was enhanced to allow the automation of the closing SGS price submission process by Primary Dealers. This has promoted greater efficiency in the collection and processing of the prices.

29. In August 2004, the authorised borrowing limit for Treasury bills increased from S$20 billion to S$30 billion to meet the growing demand for short-term SGS and develop the SGS market further.

30. Singapore was included in the Citigroup World Government Bond Index beginning January 2005. This makes Singapore the only other Asian country apart from Japan to be included in this index and the 22nd government bond market to be included.

31. The first phase on an electronic trading platform for SGS, the "SGS E-bond" was rolled-out in July 2005. The SGS E-bond platform was jointly developed by MAS and Bloomberg with the objective of improving price transparency and accessibility to different class of investors as well as increase awareness among foreign investors. This Request-For-Quote (RFQ) module is a first in the region and sets the foundation for a single regional bond market in the future.

32. In May 2006, the second phase of the SGS E-bond went live. This phase improves on the original E-bond RFQ module. Price providers can leave their bids and offers on E-bond, thus allowing greater price transparency.

33. In November 2006, MAS migrated the Repo Facility from the Reuters Dealing System to the eApps platform, thereby integrating both the Repo Facility and SGS auction application under the same platform.

34. In December 2006, MAS moved Treasury bills auctions to the uniform price auction format in line with SGS bonds.

35. MAS launched the inaugural 20-year SGS bond in March 2007, extending the benchmark yield curve to 20 years.