

Economic Unit

HARMONISING BROAD MONETARY AGGREGATES

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HARMONISING BROAD MONETARY AGGREGATES

INTRODUCTION

Following a request from the Committee of Governors to develop the earlier work of the Raymond Group,¹ this preliminary note compares the broad money aggregates used in Community countries and examines the scope for improving the harmonisation of their definitions. More consistent aggregates would facilitate the assessment of the compatibility of national monetary policies, and assist in the future development of a Community-wide aggregate.

However, the harmonisation should not be undertaken mechanistically. Differences in national financial systems and in the behaviour of economic agents must be taken into account, whilst the link between national monetary aggregates and the final goals of monetary policy should be preserved. This constrains the extent to which statistical harmonisation is possible, or indeed is desirable, leading to the warning that "a formal harmonisation of the money stock definitions should not be attempted" (Committee of Governors, January 1990).

This note, which takes stock of work carried out in national central banks, contains five sections. Section 1 highlights changes which could improve the consistency of assets included in definitions of "broad money". Section 2 discusses the treatment of cross-border holdings and foreign currency assets which are rapidly gaining in importance. Section 3 focuses on statistical issues related to the definitions of the monetary issuing and holding sectors. Section 4 reviews the economic properties which should be maintained.² The main proposals are summarised in the conclusions.

1 Special Report on a Common Framework for the Monitoring of Monetary Policies: 27th April 1990.

2 A statistical framework for assessing these properties is sketched in the Technical Annex.

1. THE COMPONENTS OF BROAD MONETARY AGGREGATES

1.1. The definition of monetary assets

Theory attributes a basic role to money as the medium of exchange which is closely related to spending. This implies that all assets used as a means of payment should be included in any measure of money. Narrow aggregates, generally named M1 and including notes, coins and sight deposits, have consequently been constructed with this consideration in mind. However, other "liquid" assets may be close substitutes for the means of payment if they either have a short maturity or can be easily transformed into a means of payment with little cost (for example, a small interest penalty). Such assets have been included in broader measures of the money supply.

Unfortunately, it is not possible to define more precisely the distinction between monetary and non-monetary assets. The boundary is inevitably disputed territory, and has been drawn by different countries in different places. Financial innovation and deregulation have compounded the difficulties, blurring the distinction between financial assets and between financial intermediaries. The response by most central banks has been to experiment with different measures of the money stock and to analyse the information from several measures at the same time, even if one aggregate is generally assigned the predominant role (see Table 1A).

To derive practical criteria on whether or not assets are sufficiently liquid to be included in "money", operational judgements have to be made on the concepts of "a short maturity" and of "little cost". Both present difficulties.

When assessing the liquidity of an asset by its maturity, the relevant economic criterion is the residual maturity. However, this definition is often impractical statistically, because of the heavy burden on data collection it entails. Consequently, the initial term or period of notice is generally used by central banks to categorise assets but a choice of the maturity threshold has still to be made. Whilst all agree that a deposit of a few months should be counted as broad money, there is little consensus on whether a deposit of a few years should. One approach to this question has been to construct a measure of money by weighting assets according to a proxy for their liquidity (Divisia indices). The difference

TABLE 1A: NAMES OF THE CURRENT OR PLANNED AGGREGATES

COUNTRIES	CURRENT AGGREGATES (Cf Raymond Special Report, April 90)	PLANNED AGGREGATES (cf Annex IV of Mon. Pol. Sub-Committee Report No 1, Nov. 1990)
BELGIUM	M1, M2H (harmonised), M2 (national)	M1, M2H (harmonised), M2 (national)
DENMARK	M1, M2 (harmonised)	M1, M2 (harmonised), <u>new Krone M2</u> (domestic counterpart)
GERMANY	M1, M2, M3 , M3e (extended)	M1, M2, M3 , M3e (extended)
GREECE	M0, M1, M2, M3 , M4	M0, M1, M2, M3 , M4
SPAIN	M1, M2, M3, <u>ALP</u>	M1, M2, <u>new M3</u> , new ALP, " <u>old</u> " <u>ALP+CP</u> (only for 1991)
FRANCE	M1, <u>M2</u> , M3, L ("liquid assets")	new M1, new M2, <u>new M3</u> , (considering M3 extended), M4, P1, P2, P3
IRELAND	M1, M3 , "M3 and other liquid assets"	M1, M3 , "M3 and other liquid assets"
ITALY	M1, <u>M2</u> , M3, AFI ("financial assets")	M1, <u>new M2</u> , AL ("liquid assets"), AF ("financial assets")
LUXEMBOURG	M1, M2	M1, M2
NETHERLANDS	M1, <u>M2</u>	M1, <u>new M2 (domestic counterpart)</u> , <u>new M3</u>
PORTUGAL	M1, <u>L-</u>	M1, <u>L-</u>
UNITED KINGDOM	<u>M0</u> , M1, M2, M4 , M4c, M5	<u>M0</u> , M2, M4

N.B.: - in **bold** : main broad aggregate under review for harmonisation

- underlined : main aggregate used in setting monetary policy:

- All aggregates are nested, i.e. a sub-set of a larger one, except for:

- P1, P2, P3 in France (longer term financial assets)
- M2 and M4 in the UK (to be amended)

Consequently, sub-aggregates can be produced :

e.g. for Belgium, M2 national can be split into: M1, (M2H-M1) and (M2-M2H)

between the interest rate on the asset and that on a representative long-term bond may be taken as this proxy, on the assumption that interest payments compensate the holder for liquidity foregone. Thus, if the yield on a deposit of a few years maturity was equal to that on the long-term bond, it would be regarded as illiquid and assigned no weight in the measure of money. Nevertheless, this approach is hampered by several difficulties; for example when yield curves are downward sloping, this criterion would suggest perversely that long-term assets are more liquid than short-term ones. Distortions stemming from the tax treatment of different financial assets pose additional problems.

It is equally difficult to form a judgement on whether the cost of transforming an asset into a means of payment is sufficiently small to treat it as money. Data on penalties for early withdrawal are sometimes not available. They are also difficult to interpret: is, for example, a short-term deposit with a high penalty for early withdrawal more or less liquid than a longer-term deposit with a lower penalty? Finally, the penalty or risk of loss involved in the transformation may be uncertain in advance. This is the case for short-term securities where liquidity is not ensured by the issuer but by the market at the risk of a capital loss.

These arguments confirm that the harmonisation exercise should not be viewed as a simple process of agreeing on an ideal definition of money, which can be universally applied. A more eclectic approach is required. The natural starting point is a comparison of the components currently included in broadly-defined aggregates.

1.2. Comparing broad money stocks

The following comparison of the assets included in broad money is based on the information provided by the central banks for the Raymond Group Special Report, updated for the subsequent changes which have either been announced or are under active consideration in France, Italy, United Kingdom, Spain, Netherlands and Denmark.³ The review has not been checked with central banks and should be regarded as preliminary and

3 See Annex IV of Monetary Policy Sub-Committee Report No. 1, November 1990 for a description of these changes. Please note that the amendments in Italian and Spanish aggregates are preliminary and remain under consideration in the respective central banks.

TABLE 1B : THE ASSET COMPOSITION, SUB-AGGREGATE DIVISION AND BOUNDARY OF THE MAIN BROAD MONEY STOCKS
(see Table 1A for a list of the main (sub-)aggregates)

MAIN ASSETS (cf Section 1)	BELGIUM	DENMARK	GERMANY	GREECE	SPAIN	FRANCE	IRELAND	ITALY	LUXEMBOURG	NETH.	PORTUGAL	U.K
NOTES, COINS & SIGHT DRP.	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M1	M0 & M2-M0
DEPOSITS - SIGHT SAVING	M2H-M1	#	M2-M1	M2-M1	M2-M1	M2-M1	)	)	M2-M1	)	#	) M4-M0
- FIXED TIME	M2H-M1	M2-M1	M3-M1	part in	M3-M2	M3-M2	)	)	)	M2-M1	)	) If <5years
- AT NOTICE	if <1year	M2-M1	if <4years	M3-M2	--> <1year	M3-M2	)	)	M2-M1	)	L -M1	) (M2-M0 if residual)
	#	M2-M1	M3-M2	M2-M1	M2-M1	#	)	)	)	)	L -M1	) maturity
	+++++	+++++	+++++	+++++	+++++	+++++	)	)	#	)	L -M1	) <1month ⁵
NON-NEGOTIABLE CERTIFICATES (Saving certificates, ...)	M2H-M1	#	M3-M2	M3-M2	M3-M2	M3-M2	see "other assets"	M2-M1	#	M2-M1	#	M4-M2
	if <1year	since >1year	+++++	+++++	+++++	+++++	+++++	--> *	if <5years	if <5years	if <5years	if <5years
CERTIFICATES OF DEPOSITS (incl. short-term Bk bonds)	#	#	M3e-M3	M4-M3	M3-M2	M3-M2	*	M2-M1	#	M2-M1	L -M1	M4-M2
	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
REPURCHASE AGREEMENTS (between Bks & non Bks)	#	#	#	#	ALP-M3	M3-M2	#	M2-M1	#	#	#	#
	+++++	+++++	+++++	+++++	--> if <3months	+++++	+++++	--> *	+++++	+++++	+++++	+++++

MEMORANDUM ITEMS

Cf Section 2: FOREIGN CURR.	M2H-M1	*	M1	*	* --> M1	M3-M2	M1	M1	*	M2-M1	*	M4c --> *
CROSS BORDER HOLDINGS	part in	*	part in	*	*	*	*	*	see	*	*	*
	M2-M2H		"M3e"-M3		--> M3e-M3			--> M2-M1	BELGIUM			
Cf Section 3: Claims on UCITS	*	#	#	*	*	* --> "Short" in M3-M2	*	*	*	#	*	*
TREASURY BILLS & COMMERCIAL PAPER	*	part in	*	*	ALP-M3	M4-M3	*	M3-M2	*	M2-M1	L -M1	M5-M4
		M2-M1			--> *			--> AL-M2		if <2years		--> *
OTHER ASSETS	*	*	*	*	part in M2-M1	ALP-M3 --> *	P1	*	*	*	L -M1	*

* : excluded from any aggregate
 --> : announced/planned change # : asset not available in this country
 Sources : national submissions to the Raymond Special Report, updated for announced or planned changes
 +---- : main boundary of (current/planned) aggregate under review
 (in this note)

subject to further improvement. Tables 1B and 2 present the information in summary form.⁴

Two main conclusions can be drawn. On the one hand, the aggregates are defined in a broadly similar way in most countries,⁵ with the changes proposed in the last six months increasing the similarity in many cases. On the other hand, there are still areas where the differences between aggregates may be reduced.

Despite the basic similarity between the broad aggregates, different names are often used by Community Countries. This is a source of potential confusion. One simple step towards harmonisation would be to rename similar aggregates consistently, although the break with past tradition would have to be explained in the national context. At present similar aggregates are called M3 in many countries (Germany, France, Spain, Ireland, Greece and the Netherlands),⁶ M2 in others (Italy, Belgium, Denmark and Luxembourg) and M4 in the United Kingdom. Narrower aggregates could also be labelled consistently. Thereafter, the name of any new proposed aggregate could be checked to avoid the risk of confusion, as may be caused for example, by a comparison of the new French M4 aggregate and the dissimilar measures in the United Kingdom and Greece.

The main differences in the asset composition of the aggregates can be grouped under four headings:

- (a) For time deposits, thresholds on the initial term or on notice for withdrawal are imposed only in some countries, and even then

4 The tables are based on the categorisation of assets adopted in the Raymond Group Special Report. It is sometimes difficult to allocate assets across the categories because of differences in financial structures.

5 The main exception is Portugal where the L- aggregate is much broader than measures used in other countries. However, it might be possible to construct an indicator similar to those used elsewhere if only for internal purposes.

6 Spain currently focuses on ALP (and, in 1991 only, on ALP plus commercial paper), but the planned changes will narrow the difference between M3 and ALP. An M3 measure will be published in the Netherlands next year, although (the domestic counterpart of) M2 is considered more relevant for monitoring.

TABLE 2 : MAIN COMMON AND COUNTRY-SPECIFIC CLASSIFICATION OF ASSETS

MAIN COMMON ASSETS INCLUDED IN BROAD AGGREGATES UNDER REVIEW (**)	MAIN COUNTRY-SPECIFIC CASES:
COINS & NOTES & SIGHT DEPOSITS	
SIGHT SAVING ACCOUNTS	IRELAND: partly excluded (# in GERMANY, DENMARK & PORTUGAL)
FIXED TIME DEPOSITS	UK: excluded if term > 5 years (although 98% < 2 years) GERMANY: excluded if term > 4 years (" " 1 year) NETHERLANDS: " if term > 2 years BELGIUM: " if term > 1 year SPAIN: may exclude if term > 1 year
DEPOSITS AT NOTICE	GERMANY: excluded if notice > 1 year & not "statutory" IRELAND: partly excluded (# in FRANCE & B.L.E.U.)
NON-NEGOTIABLE CERTIFICATES	GERMANY & SPAIN: excluded from M3 (& ALP) UK: excluded if term > 5 years ITALY: exclusion planned for Postal certificates BELGIUM: excluded from M2 if term > 1 year (# in DENMARK, PORTUGAL & LUXEMBOURG)
CERTIFICATES OF DEPOSITS (incl. short-term bank bonds)	GERMANY: excluded from M3 (but in extended M3 if term < 2years) UK: excluded if term > 5 years (but more than 90% < 1 year) NETHERLANDS: excluded if term > 2 years IRELAND: excluded from M3 GREECE: excluded from M3 (but included in M4) (# in B.L.E.U., DENMARK)
MAIN ASSETS GENERALLY EXCLUDED FROM BROAD AGGREGATES UNDER REVIEW (**)	COUNTRY-SPECIFIC CASES
REPURCHASE AGREEMENTS (between banks and non banks)	FRANCE: included in M3-M2 (but likely to become negligible) ITALY: exclusion planned from M2 SPAIN: " " from (ALP-M3) if > 3 months
Claims on UCITS (see Section 3)	FRANCE: now included in M3-M2 if "short-term" BELGIUM: inclusion may be considered (not yet relevant for other countries)
TREASURY BILLS or COMMERCIAL PAPER (see Section 3)	FRANCE: in M4-M3 UK: M5-M4 (discontinuation planned) ITALY: in AL-M2 SPAIN: ALP-M3 (exclusion planned) NETHERLANDS & DENMARK: partly included in M2-M1 PORTUGAL: included in L-
Other short-term securities, " saving schemes or similar assets (see Section 3)	ITALY: in AL-M2 SPAIN: in ALP-M3 (exclusion planned) GREECE: partly included in M2 PORTUGAL: " " in L-

** : M3 for GERMANY, GREECE, SPAIN (domestic focus on ALP), FRANCE, IRELAND, the NETHERLANDS (domestic focus on M2);
M2 for BELGIUM, DENMARK, LUXEMBOURG & ITALY ;
M4 for the UK;
L- for PORTUGAL

: ASSET NOT AVAILABLE IN THIS COUNTRY

Sources: National submissions to the RAYMOND SPECIAL REPORT (updated for announced or planned changes).

the benchmarks vary. In Germany, for example, a time deposit is included in M3 if it has an initial maturity of less than four years or a (statutory) notice of withdrawal of less than one year. In the United Kingdom the threshold is an initial term of five years, in the Netherlands two years and in Belgium one year, whilst in Spain a threshold of one year is planned. In some other countries statistics may not be readily available.⁷

- (b) The grouping of non-negotiable certificates (such as fixed-term saving certificates) is heterogeneous. Consequently, any comparison in this area should be undertaken cautiously. Certificates are included in France, the United Kingdom and Greece, but are excluded in Germany, whilst Italy is proposing to drop postal saving certificates from M2. The different treatment may be partly explained by the different maturities of these instruments in different countries; for example, in Italy, recent research has shown that postal saving certificates are held for an average maturity of seven years.
- (c) Certificates of deposit which are negotiable include short-term bank bonds and are generally incorporated. The main exceptions are Germany, where they are recorded only in extended M3, Ireland and Greece. In Germany, their exclusion is based on the grounds that following changes in reserve requirements in the early 1980s, they became negligible (0.1% of GDP) as most holders shifted to Eurodeposits. In some countries maturity thresholds are applied: five years in the United Kingdom and two years in the Netherlands.
- (d) Repurchase agreements between banks and non-banks are at present incorporated in a broad aggregate in three countries (France, Italy and Spain). However, Spain is proposing to exclude agreements with a maturity of more than three months. In Italy, where no information on maturity is currently available, evidence suggests that repurchase agreements are closer substitutes for securities than for deposits, and hence could be dropped from the

⁷ Some information, however, may be derived from surveys or perhaps from reserve requirement forms as may be the case in France.

measure of money. In France, on the other hand, repurchase agreements are both short term (generally of a maturity less than a month) and considered to be close substitutes for deposits. However, most represent transactions between banks and UCITS (Undertaking for Collective Investments in Transferable Securities). They will be excluded following the integration of short-term UCITS into the money issuing sector.

Provided that the relevant information is available, further work should be undertaken to reduce the differences described above, as set out in the conclusions.

2. FOREIGN CURRENCY, CROSS-BORDER HOLDINGS AND EC-WIDE AGGREGATES

2.1. Residence and currency denomination

Section 1 was based on the implicit assumption that the only liquid assets included in the definition of "money" are those denominated in the domestic currency, issued by domestic intermediaries, and held by residents. This simplification, which is, strictly speaking, valid only in the case of a closed economy, has two major drawbacks.

First, as barriers to capital movements have been reduced (and in most cases abolished) international financial integration is proceeding rapidly, with the consequence that liquid assets denominated in foreign currency and/or held abroad may be close substitutes to the means of payment, and hence linked to domestic spending. Consequently, excluding these assets from domestic monetary aggregates may lead to a deterioration in the relationship with final goals.

Second, utilising national aggregates defined on the "closed economy" basis in the construction of a money stock for the EC as a whole would lead to a potentially significant underestimation. It would imply the omission of monetary assets held by EC residents abroad (even within the Community) and those held domestically but denominated in foreign currencies (including EC currencies).

There are three possible criteria to define national monetary aggregates which could form the basis of a Community-wide aggregate:

- residence of the holder: aggregates include all liquid assets held by residents with both home and foreign banks,⁸ whatever the currency of denomination;
- location of the issuer: aggregates include all liquid assets held with domestic banks, by both residents and non-residents, whatever the currency of denomination;
- currency denomination: aggregates include all liquid assets denominated in domestic currency held by both residents and non-residents with both home and foreign banks.

To derive a consistent and comprehensive aggregate for the Community, one and only one of the three criteria should be applied to each and every country. Were this not to be the case, the resulting EC-wide definition would lead to omissions and duplications. For example, if Germany chose the criteria of currency denomination and France the residence of the holder, the French residents' holdings of DM (wherever held) would be included in both the German and the French aggregates and hence counted twice in the Community aggregate, whilst German residents' foreign currency holdings would be omitted. Finally, each criterion would lead to a different measure of the total Community money stock because of the treatment of operations with non-EC residents or in non-EC currencies.⁹

2.2. Implications for national aggregates

The choice of criterion will affect not only the size but also the properties of aggregates. The main advantages of each criterion are discussed briefly in turn.

On the assumption that residents' monetary holdings are more likely to be related to spending in their home country than are assets held by non-residents, the residence-of-holders criterion seems the preferable

8 "Banks" is used as a shorthand form for the money-issuing sector (see Section 3).

9 The criterion of currency denomination implies the inclusion in the Community money stock of non-EC residents' holdings in EC currencies (wherever held); the criterion of the issuer's residence the inclusion of non-EC residents' holdings with banks located in the Community (in any currency); the criterion of residence implies the inclusion of EC residents' holdings with non-EC banks (in any currency).

choice. This consideration is particularly relevant for countries with reserve currencies, in which there are large non-residents' deposits.

For countries with no capital controls, the only advantage of the criterion of the issuer's residence is that the statistical information is more readily available from domestic banks than it is from intermediaries located abroad. Nevertheless, this argument is becoming less compelling as cross-border intermediation develops and is recorded more accurately.

National aggregates drawn up on the basis of currency denomination could provide information relevant for exchange-rate determination. However, such information is only partial, since it cannot capture pressure on exchange rates stemming, for instance, from operations in non-monetary assets. It is also unlikely to be timely, and may add little to information supplied directly by exchange markets.

2.3. Current definitions and data availability

Current aggregates are generally based on domestic residents holdings of liquid assets in domestic and foreign currency with domestic intermediaries only. The consistent definition of aggregates on the basis of the residence of holder criterion, so as to yield eventually a comprehensive Community-wide money stock, implies that all monetary assets held by residents should be included, independently of the currency of denomination and of the location of the issuer. This is an ambitious requirement.

As shown in Tables 3a and 3b, all Community Countries in fact base their aggregates on the residence of holder criterion, except Greece because of statistical constraints. Furthermore, most countries include foreign currencies. The major exceptions are: Denmark, which is proposing to change the aggregate to exclude them on the grounds that the instruments of monetary policy primarily influence domestic currency; the United Kingdom, which, however, collects the relevant data; Greece, where foreign currency holdings are not considered to be connected with spending; and Luxembourg, for statistical reasons. Spain has not included foreign currency deposits in the past as they were small, but plans to include them in the near future.

The extension to include assets held with intermediaries located abroad is more challenging. Nevertheless, it is already viewed as very important by several central banks. For whilst the exclusion of liquid

TABLE 3a : CROSS-COUNTRY COMPARISON OF THE USE OF INTERNATIONAL CRITERIA (**)

CRITERIA:	COMMON ASPECTS:	COUNTRY-SPECIFIC CASES:
HOLDERS ¹	ONLY DOMESTIC RESIDENCE	GREECE: non residents included (for statistical reasons)
LOCATION	(except for notes & coins)	NETHERLANDS: " " " in M1 (& hence M2) " "
		BELGIUM: " " " in M2-M2H (holdings abroad) "
		N.B.: the distinction between residents and non-residents varies across countries (e.g. based on nationality, domicile, length of stay)
CURRENCY DENOMINATION	DOMESTIC & FOREIGN	U.K.: foreign currency excl. (except in M4c, no longer published)
		SPAIN: foreign currency excluded but planned inclusion
		DENMARK: foreign currency to be excluded (not "controllable")
		GREECE: " " excluded ("no link with spending")
		PORTUGAL: " " " "
		LUXEMBOURG: " " " (for statistical reasons)
ISSUERS ¹	DOMESTIC RESIDENCE	BELGIUM: cross-border holdings in M2-M2H
LOCATION		N.B.: GERMANY (ITALY & FRANCE): current (planned) measures extended to cross-border holdings

Sources: National submissions to the SPECIAL REPORT updated for announced or planned changes

(**): Main aggregates under review listed in the footnote of Table 2

TABLE 3b: COUNTRY-SPECIFIC USE OF INTERNATIONAL CRITERIA

COUNTRIES	AGGREGATES UNDER REVIEW	HOLDER'S LOCATION: DOMESTIC ONLY	CURRENCY DENOMINATION: DOMESTIC ONLY	ISSUERS' LOCATION: DOMESTIC ONLY	NUMBER OF CRITERIA APPLIED *
BELGIUM	M2 H	YES	NO	YES	2
	M2	YES	NO	NO(a)	1
DENMARK	current M2	YES	NO	YES	2
	new Krone M2	YES	YES	YES	3
GERMANY	M3	YES	NO	YES	2
	M3 extended	YES	NO	NO(a)	1
GREECE	M3	NO	YES	YES	2
SPAIN	current M3(or ALP)	YES	YES	YES	3
	planned " "	YES	NO	YES	2
FRANCE	new M3	YES	NO	YES	2
	considering extended M3	YES	NO	NO(a)	1
IRELAND	M3	YES	NO	YES	2
ITALY	current M2	YES	NO	YES	2
	planned M2	YES	NO	NO(a)	1
LUXEMBOURG	M2	YES	YES	YES	3
NETHERLANDS	new M3	YES(b)	NO	YES	2
PORTUGAL	L-	YES	NO	YES	2
UNITED KINGDOM	M4	YES	YES	YES	3

* To derive a comprehensive EC-wide aggregate, only one (and the same) criterion should be selected in each and every country.

(a) Subject to data availability (foreign branches, BIS, etc.)

(b) Non-residents holdings of sight deposits included in M1 and hence M3

assets held abroad by residents has not yet undermined the relevance of currently-defined monetary aggregates in most countries, the recent rapid growth in cross-border holdings of German and French residents suggests that this conclusion may not hold in the future. Even if "domestic" aggregates continue to be the most useful in the near future, wider measures may provide helpful supplementary information.

At present, informational constraints are particularly severe; foreign banks' balance sheets are not available to domestic central banks, while data on the external positions of BIS reporting banks are produced only on a quarterly basis with a four-month delay. Faced with these statistical shortcomings, some central banks, concerned with the increasing relevance of cross-border holdings, have resorted to the partial solution of including residents' monetary claims on foreign branches of domestically-owned intermediaries only. This approach has been already adopted by the Bundesbank in the extended measure of M3 and by the Banque Nationale de Belgique in M2 ("national"), whilst the Banca d'Italia plans to adopt it in the new M2 measure. The necessary data on foreign branches' activities are available as a result of banking supervision on a consolidated basis.

This solution continues to exclude assets held by residents with foreign branches of foreign banks and consequently aggregating the national measures would still underestimate the area's money stock. In practice, the underestimation may prove minor in the short run, to the extent that the delocalisation phenomenon develops from customer relationships with domestically-owned banks and their foreign branches (rather than with international banks and their foreign branches). However, cross-border holdings with the latter intermediaries may well increase in the future, as the single market in financial services develops. This has already been experienced in the case of French residents' holdings abroad; in consequence the Banque de France is considering the utilisation of the quarterly BIS data, supplemented by monthly information from the balance of payments.

Further discussions between Community central banks on the appropriate treatment of foreign currency and cross-border holdings in monetary aggregates would be valuable to ensure a consistent approach.

Exchange of statistical data could also prove to be very useful, if it improved the timeliness and quality of information available locally.

3. STATISTICAL ISSUES IN SECTORAL DEFINITIONS

3.1. Partition between the issuing and holding sectors

Community countries have formed different judgements on the appropriate partition between the sectors issuing and holding monetary assets. This partition is necessary to avoid double counting, which would lead to distortions in the link between money and spending. In general terms, the distinction corresponds to financial intermediaries as against non-financial agents,¹⁰ although the latter may include long-term financial intermediaries such as insurance companies and pension funds. However, given the differences in financial structures between countries and in some cases in the availability of statistics, the boundary between the "money creating" and the "non-money creating" sectors varies as shown in Table 4.

The treatment of building societies provides a good example. In the United Kingdom, the lack of statistical information led to some building societies' deposits with banks being included in M2, despite societies forming part of the money creating sector in the definition of M4. Planned modifications based on improved data will, however, ensure that M2 is a sub-set in M4 in the future. In Spain, the situation is a little different. Building societies and other specialised financial institutions (finance and leasing companies) have not to date been incorporated in the money issuing sector, with the implication that their monetary holdings are counted as part of money stock. However, improved statistical data will permit the reclassification of these institutions. As a result, their holdings of liquid assets will no longer be counted as money, whilst their liquid liabilities to the non-financial sector will be included.

In addition, holders may discriminate between similar assets issued by different intermediaries in some countries, but not in others. For example, in Italy, certificates of deposits issued by banks are considered to be close substitutes for deposits, and hence are incorporated

10 This distinction generally accounts for the exclusion of commercial paper from money measures.

TABLE 4: MAIN COMMON AND COUNTRY-SPECIFIC ASPECTS OF SECTORAL DEFINITIONS (**)

	MAIN COMMON ASPECTS:	MAIN COUNTRY-SPECIFIC CASES:
ISSUING SECTOR	DOMESTIC RESIDENT FINANCIAL INTERMEDIARIES - except for "long-term" Financial Intermed. (Ins. Comp., Pension Fds,...) - plus some Non Resident Financial Intermed. for extended measures - plus Public sector (see below)	FRANCE: inclusion of "Short-term" UCITS ITALY: except for "special credit institutions" SPAIN: "building societies" & other specialised institutions to be included BELGIUM: UCITS treated as "transparent" IRELAND: M3 includes only Ctal Bk+"licenced banks"
Public sector (as issuer)	INCLUSION OF COINS and of some Postal liabilities (Treasury Bills generally excluded)	FRANCE: includes other small deposits with Treasury SPAIN: T.B. in ALP-M3 (exclusion planned) NETHERLANDS: T.B. in M2 NETHERLANDS: "local authorities" liabilities in M2 DENMARK: T.B. in M2
HOLDING SECTOR	All "NON-FINANCIAL" agents (consistent with issuer defintion) (hence Commercial paper excluded)	U.K: building societies deposits with banks in M2 and not in M4 (but planned nesting of M2 in M4)
Public sector (as holder)	Central Government's holdings EXCLUDED (generally) Public sector firms' holdings INCLUDED (generally) Other public bodies: NO GENERALISATION possible	UK: all public sector excluded SPAIN: some public sector firms to be included BELGIUM: all public sector excluded IRELAND: inclusion of all public sector holdings (except Central Government's ones)

Sources: National submissions to the SPECIAL REPORT updated for announced or planned changes

(**) : main broad aggregates under review listed in footnote of Table 2

in "money", whereas those of "Special credit institutions" seem to be closer substitutes for securities. In contrast, in France all certificates of deposit are included in money. Cross-country comparisons may be helpful to check the relevance of such distinctions.

Finally, permanent changes in the financial environment may require extensions to the "money-creating" sector to include new financial institutions; this is the case in France for "short-term UCITS" (money market mutual funds). Liabilities of short-term UCITS are close substitutes for bank deposits. UCITS have been considered as "transparent" in Belgium and France up to the present, that is, their liquid assets have been allocated to different aggregates as if they were directly held by non-financial agents. Consequently, whenever UCITS changed their portfolio behaviour, aggregates were affected, even if non-financial agents' holdings of UCITS did not vary. From 1991, statistical improvements in France will enable short-term UCITS to be included in the "money-creating" sector, so that all their liabilities will be included in the new M3. As such institutions can be established in all EC countries since October 1989, a consistent treatment could prove necessary in the future.

3.2. Treatment of the public and private sectors

Opinions differ on the appropriate treatment of the liquid liabilities and assets of the public sector. In very general terms, the public sector is treated as a money issuer mainly (but not exclusively in some Community countries) for coins, while its holdings of liquid assets are often (but not systematically) excluded from monetary aggregates. The latter choice is based primarily on the absence of a close link between public sector spending and its liquid holdings.

Additional research would be valuable to examine whether or not a more consistent cross-country standard could be applied. On the liabilities side, this could focus both on the issuer (whether central or local government or postal authorities) and on the type of claims. For example, Treasury bills are generally excluded from measures of broad money, although the Netherlands and Denmark incorporate them. Exclusion in Spain is at the planning stage.

On the asset side, analysis by the category of public sector holder would also appear fruitful. Central government holdings of monetary assets are generally excluded. In contrast, monetary assets of state-owned

firms are generally included in measures of money on the grounds that their holdings may be linked to their spending. Spain, where the classification is being reconsidered, the United Kingdom and Belgium currently provide the exceptions. No generalisation is possible for the treatment of assets held by other public bodies.

Analysis of the sectoral monetary holdings of households and non-financial firms could supply interesting information, given their different behavioural motivation for holding money. These generally lead to differences in the adjustment of actual to desired money balances, in the sensitivity to changes in interest rates, in the relation with planned spending, and in the degree of relevance of international factors (as in the case of currency substitution). This sectoral distinction may, therefore, contribute to a better interpretation of the signals contained in the monetary aggregates. Besides its conjunctural relevance, it may also convey information about the evolution of the financial system. Empirical research in this area could provide interesting insights.

4. MAINTAINING ECONOMIC PROPERTIES

The previous sections have identified the differences in national aggregates which map out the potential field for harmonisation. However, as noted in the Introduction, it is important to analyse the economic characteristics of any new aggregate. Indeed, the possible amendments suggested would be recommended for implementation only if any deterioration in the desirable economic properties were relatively minor. The performance of current aggregates provides a benchmark for comparison, although it should be borne in mind that the properties are likely to change over time as the process of financial integration within the Community continues apace.

4.1. Desired Properties

The following key economic properties are often identified as desirable for a monetary aggregate:

- (i) Stability: aggregates should have a stable long-run relationship with the final goals, even though the relationship may be affected by shocks in the short-run.

- (ii) Being a leading indicator: aggregates should supply advance information on current nominal demand and future developments of prices.
- (iii) Controllability: aggregates can be effectively influenced by the instruments of monetary policy. This implies that changes in the instruments induce a reasonably predictable variation in the monetary aggregate.

Aggregates rarely, if ever, fully exhibit these three characteristics at the same time. Decision makers are therefore faced with trade-offs when choosing an aggregate as a central reference for monetary policy.

One well-known trade-off is between controllability and stability. For example, the monetary base may be the aggregate which can be controlled most strictly, but which often possesses the most unstable multiplier and the weakest link with final objectives. In addition, if the authorities try to exploit the perceived stability of money demand to induce modifications in their behaviour, agents may respond by switching into assets which are near substitutes, or new financial instruments may be developed. This will undermine the stability of the previous relationships.

Another example of a trade-off is given by the contrast between an aggregate which is simple and readily available, such as the monetary base, and aggregates whose comprehensiveness and accuracy can only be obtained by losing timeliness, as is often the case for broad money stocks. However, as broad aggregates include a wider spectrum of liquid assets, they may in some cases be less affected by financial innovation, to the extent that the portfolio movements induced by innovation are between assets which are incorporated. Consequently, they usually exhibit less volatility which would otherwise impair their value as leading indicators (see graphs in Annex).

4.2. Assessing properties

The increasing importance of international linkages in the environment of free capital mobility and exchange rate stability characterising Stage One of EMU is severely weakening the degree of controllability of the single country's money stock, although for the EC area as a whole some controllability may be regained through the co-ordination of monetary

policies. To the extent that it is difficult to assess the capacity to influence aggregates (and their counterparts),¹¹ more emphasis may hence be given to the other two properties when evaluating the characteristics of national aggregates.

Given the focus on long-run stability, the estimation and testing of money-demand equations play a prominent role in the assessment of the economic properties by quantitative methods. The evaluation of the leading-indicator property may rely more on purely statistical techniques, which help measure the predictive power and the degree of volatility of aggregates, although the lack of theoretical underpinnings for such approaches is a disadvantage, as results may sometimes be difficult to interpret.

Some of the methods which could be used to examine these properties are reviewed briefly in the Annex. This is put forward as a suggestion for a common technical framework which could help reduce the unavoidable element of discretion in empirical analysis.

5. CONCLUSION: SUMMARY AND PROPOSALS

5.1. Summary

This preliminary note surveyed the scope and the limits to the harmonisation of national broad monetary aggregates, taking stock of the work underway in central banks.

The potential harmonisation of aggregate may be approached from two angles. One method would be to attempt to identify assets in different countries with similar economic features and to group them together into national aggregates. Conceptually at least, these aggregates would exhibit similar economic characteristics, and would in that sense be harmonised. In practice, however, this ideal goal would rarely be attained. Results would be ambiguous and controversial, whilst rapid financial innovation would gradually undermine their robustness. The alternative approach, adopted in this note, was to start with the current statistical definitions and to exploit the opportunities for improving their similarity. This is less ambitious, but is recommended as the more practical and pragmatic option.

11 See the note by the Economic Unit on "The role of money-supply counterparts in the co-ordination of monetary policy" (December 1990).

In Section 1, on the basis of such criteria as the degree of maturity, the components of currently defined (or planned) broad aggregates were compared, and possible steps towards harmonisation were identified. These include improving the cross-country consistency of the treatment of time deposits, non-negotiable certificates and repurchase agreements.

In Section 2, the implications of rapidly increasing cross-border holdings and foreign currency assets were discussed. The desire to move towards a comprehensive Community-wide aggregate imposes constraints on national definitions. Three alternative criteria which could be used in this task were explored. The favoured approach was to resort to the criterion of holders residence as this is likely to lead to aggregates most closely linked to domestic spending. In consequence, national aggregates should ideally contain all liquid assets held by domestic residents, including those in foreign currency and those held abroad. Current aggregates were measured against this criterion, and the statistical problems involved in moving to the preferred definition were outlined.

In Section 3, differences in the boundary between the issuing and holding sectors were studied and some discrepancies between countries in the treatment of the public sector were identified.

Finally, Section 4 reviewed the desirable economic properties of monetary aggregates which should be maintained in the harmonisation process. Quantitative methods which could be applied in the empirical analysis are presented in an Annex, with the purpose of suggesting a common technical framework.

5.2. Proposals

Although national definitions of broad aggregates display some basic similarities, the differences between aggregates identified in this paper should be examined more closely.

In several cases the differences may be small in empirical terms, suggesting that progress can be made towards harmonised aggregates with only a minimal impact on the economic properties. The other side of the coin, of course, is that the corresponding "improvements" are more cosmetic than substantive (though probably important for presenting a more uniform approach to the public). Adopting a more consistent notation across countries clearly falls into this category. Whenever changes significantly affect aggregates, the economic properties of the newly defined measures

should be analysed. Should their informational content be too poor to suggest the replacement of current aggregates as primary targets or indicators of domestic monetary policy, they could nonetheless be introduced as supplementary harmonised measures.

Data availability is an important prerequisite for making progress quickly and at a relatively small cost, given that any changes in data collection would impose costs both on central banks and on financial intermediaries. Subject to the caveat that the required data are available (both for the future and the past), the following concrete proposals are made for the next stage of the harmonisation process. Initially, in order to keep the task manageable, attention would be concentrated on the broad aggregates of the five largest economies.

a) Time deposits

Examine the possibility of adopting a common initial maturity threshold. If, for the sake of argument, this were set at 2 years, it would involve the exclusion of deposits with the following initial maturities from national aggregates:

- German M3: between 2 and 4 years;
- U.K. M4: between 2 and 5 years;
- French M3: over 2 years;
- Italian M2: over 2 years;
- Spanish M3: over 2 years (instead of over 1 year as presently planned)

There is evidence that deposits over 2 years original maturity in Germany and the U.K. are negligible, and hence the changes should make little difference to the properties of the aggregates. This may also be the case in other countries. If, however, the relevant data on maturity structure were not available, there would be three alternative choices:

1. Assume that long-term deposits are small and hence that the aggregates are in practice sufficiently harmonised;
2. Collect the relevant information (perhaps in survey form), if the cost is deemed to be justified;
3. Abandon the current or planned thresholds in Germany, the U.K. and Spain and adopt the practice of the two other countries, i.e. include all time deposits in the aggregate.

b) Non-negotiable certificates

Non-negotiable certificates, such as savings certificates, are a heterogeneous grouping, reflecting different financial structures. The first task is to examine more closely the characteristics of assets included in this category to ascertain whether a more uniform treatment is possible. A study of the maturity and liquidity characteristics would reveal whether or not a maturity threshold could be introduced. One possible conclusion could be that aggregates are already sufficiently harmonised in this area. If not, there would be two options:

1. Harmonising by exclusion; i.e. removing certificates from French M3 and U.K. M4.
2. Harmonising by inclusion; i.e. incorporating certificates in the German and Spanish aggregates (and not implementing the planned exclusion in Italy).

c) Repurchase agreements

If harmonisation is considered as necessary, the two options would be:

1. Excluding agreements from the French and Spanish aggregates (this should have a minor influence on the new French aggregate);
2. Maintaining repurchase agreements in the Italian aggregate and agreements of over 3 month maturity in Spain.

d) International Criteria

Adopting the recommendation that wider aggregates are constructed consistently, on the basis of definition of domestic residents' holdings of all liquid assets, wherever held, would involve the following steps:

1. Include monetary assets held by residents and denominated in foreign currency in the U.K. M4 ; this inclusion is already planned in the case of Spain.
2. Examine whether monetary aggregates could be "extended" to include residents' deposits with foreign branches of domestically owned banks in the U.K. and Spain. In France, these statistics apparently do not distinguish residents from non-residents.
3. Analyse whether the aggregates should be extended to incorporate domestic residents' deposits with foreign banks' branches located abroad, by using BIS statistics and, perhaps, balance-of-payments

data. The new aggregates could be helpful to proxy Community-wide measures, and in the national context, they may be used in conjunction with existing aggregates.

e) Treatment of the issuing and holding sectors

Taking into account the changes planned in Spain, there are no striking differences in the institutional division drawn between the issuing and the holding sector in the five countries, except for the treatment of the public sector. Here, two steps towards harmonisation could be considered:

1. Excluding Treasury bills from the Spanish aggregates (as is planned) and the numerically small deposits with the French Treasury. This would harmonise the treatment of the central government as an issuer;
2. Including public owned firms deposits with the monetary sector in the U.K. (as is planned in Spain), which would bring the treatment into line with the other three countries.

No generalised treatment of other public sector holdings is possible and, for the time being, it would seem reasonable to continue to use national definitions.

5.3. Follow-up

To take the harmonisation exercise forward, discussions with national experts are needed to judge both the practicability and the advisability of the above proposals. Data availability will have to be explored in greater depth, whilst information on the economic and statistical properties of the aggregates (in use or under consideration) will also have to be collected.

Although the Economic Unit could undertake a large part of the applied work, it would be crucial to be in close contact with central banks and to have their support with regard to technical matters. For this reason, consideration should be given to the establishment of an informal working group which would provide a forum for discussing various aspects of the endeavour to harmonise aggregates and for co-ordinating the work carried out in Basle and within the central banks. This approach would certainly help speed up the work and ensure that important national considerations are taken into account at an early stage of the exercise.

Such a technical working group (perhaps consisting of one representative from each central bank and some members of the Economic Unit) could produce an interim report on the five largest countries in the spring of 1991.

TECHNICAL ANNEX

SOME METHODS TO ASSESS THE ECONOMIC PROPERTIES OF MONETARY AGGREGATES

Statistical and econometric techniques are required to analyse the economic properties of the modified aggregates. The choice of techniques, their practical implementation and the interpretation of their results, all present major and unavoidable elements of discretionary judgement. A possible common framework for systematic comparisons across countries is proposed in this annex to limit this arbitrariness.

Some of these methods, especially those to assess the property of monetary aggregates as leading indicators, rely mainly on statistical considerations, while others, illustrated by a discussion on the stability of money-demand equations, require more stringent theoretical hypotheses.

1. Statistical approaches

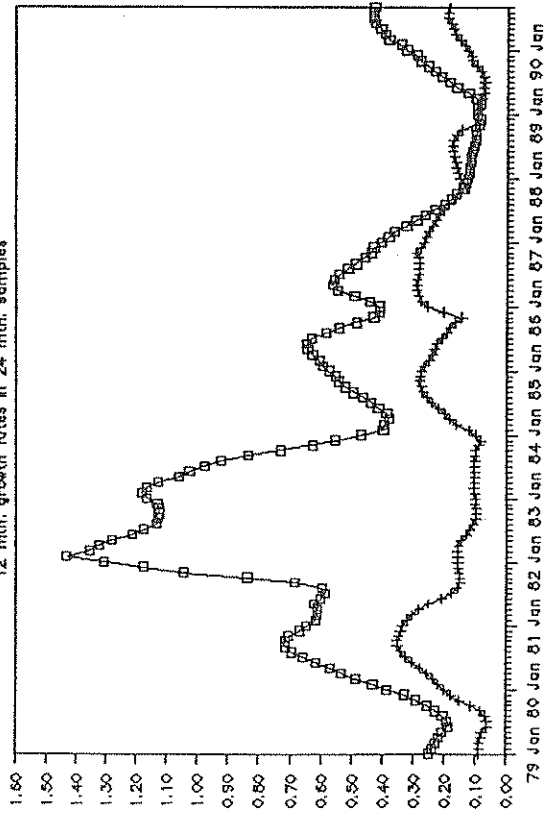
(a) As a preliminary step, the degree of volatility of aggregates can be appraised by using moving indexes of variation (ratio of standard error over mean for a rolling sample). Although very simple, this descriptive statistic can be useful in supplying a preliminary indication of the extent to which the aggregate can be analysed easily. Graphs are attached, showing the volatility of money growth and velocity for selected narrow and broad aggregates in Germany, France, Italy and Spain. cursory inspection confirms that broad aggregates are generally less volatile than narrow ones, except for short periods of time (e.g. around 1987 for the Spanish M3). This qualitative result seems to hold even if the size of the rolling sample is changed. Deeper interpretation would naturally require more thorough analysis.

(b) Analysing the degree of association between changes in the aggregates and in the goals is a more complex matter. Straightforward statistical measures (contemporaneous and lagged correlation) can be misleading as they may capture a common link with a third variable (spurious correlation) rather than a direct relationship based on economic grounds. Rendering the variables stationary¹ (by "detrending" or differentiating them) is a statistical device that can reduce this risk.

1 That is having a constant mean and a finite variance.

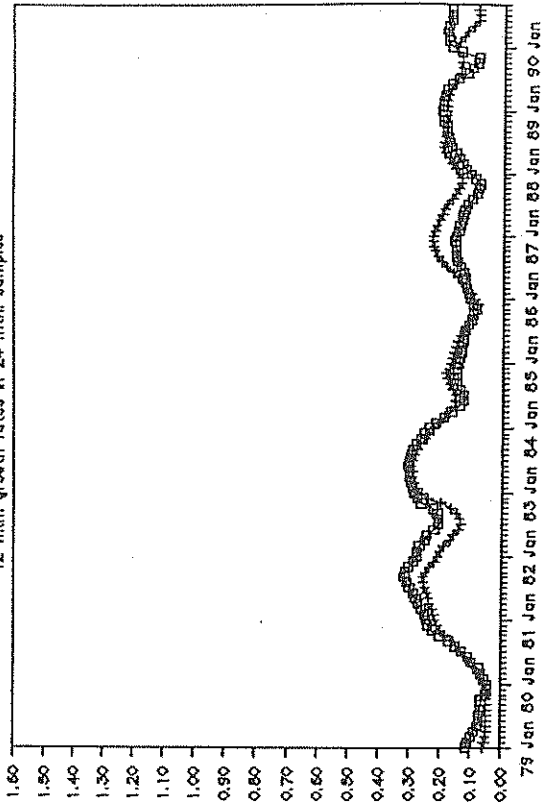
Volatility: GERMANY

12 mth. growth rates in 24 mth. samples



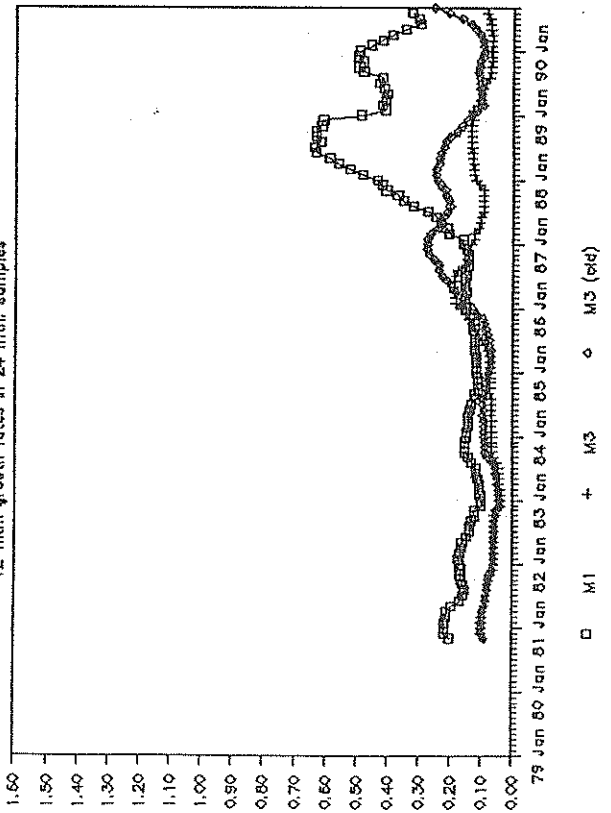
Volatility: ITALY

12 mth. growth rates in 24 mth. samples



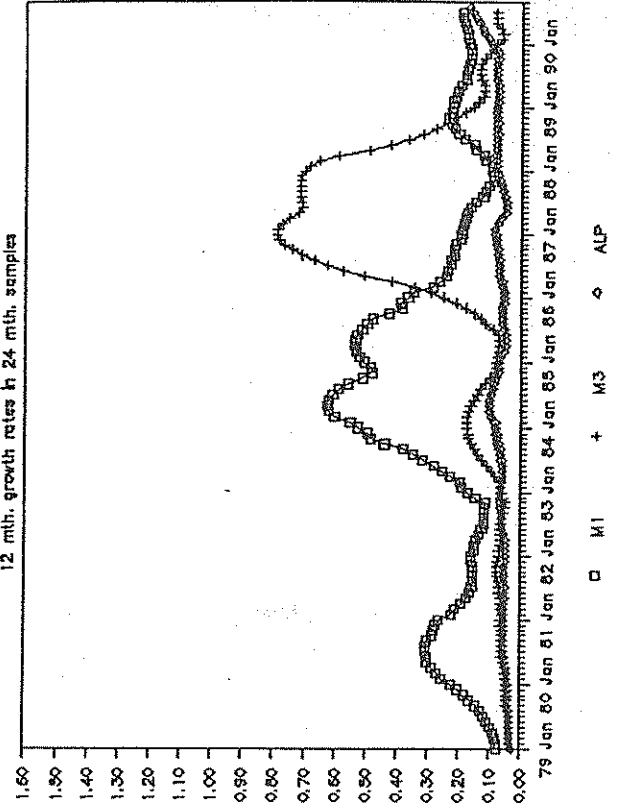
Volatility: FRANCE

12 mth. growth rates in 24 mth. samples

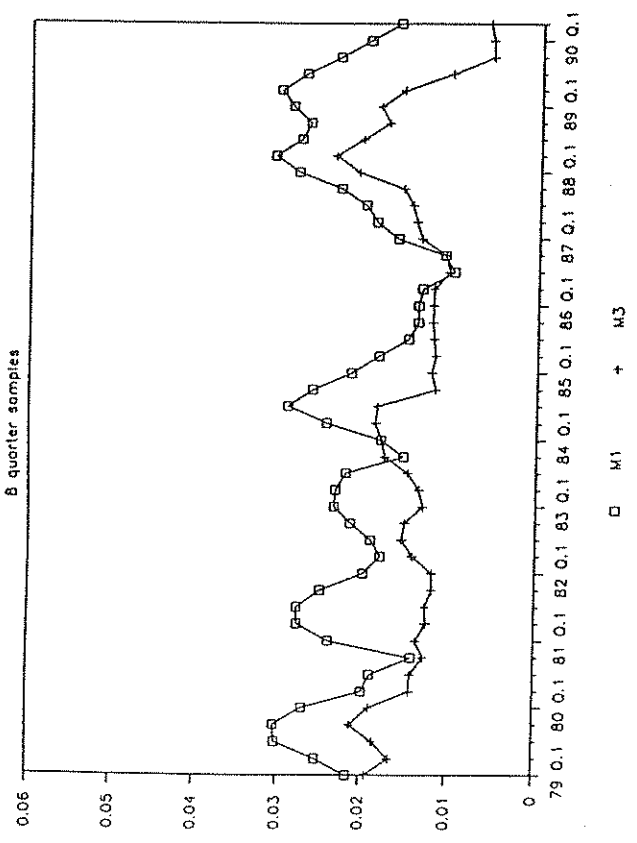


Volatility: SPAIN

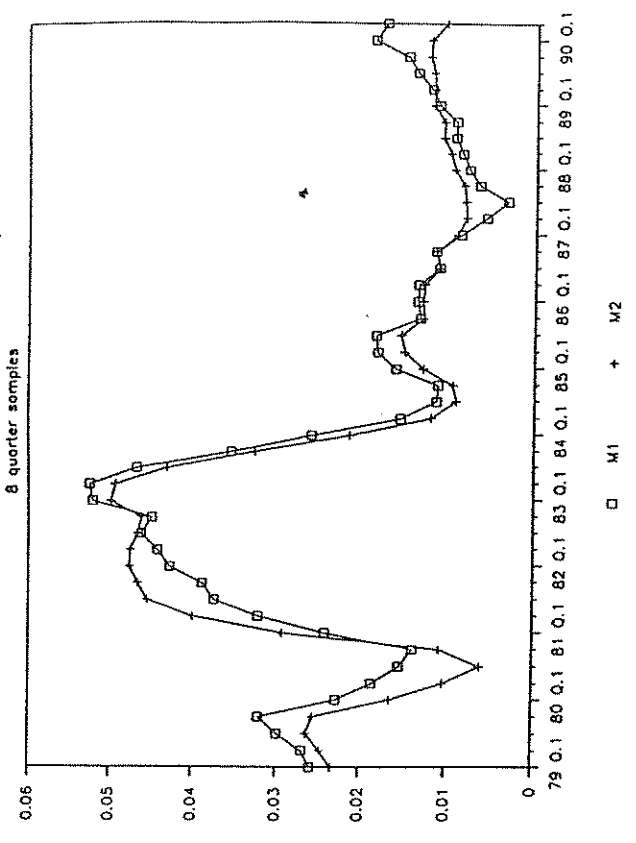
12 mth. growth rates in 24 mth. samples



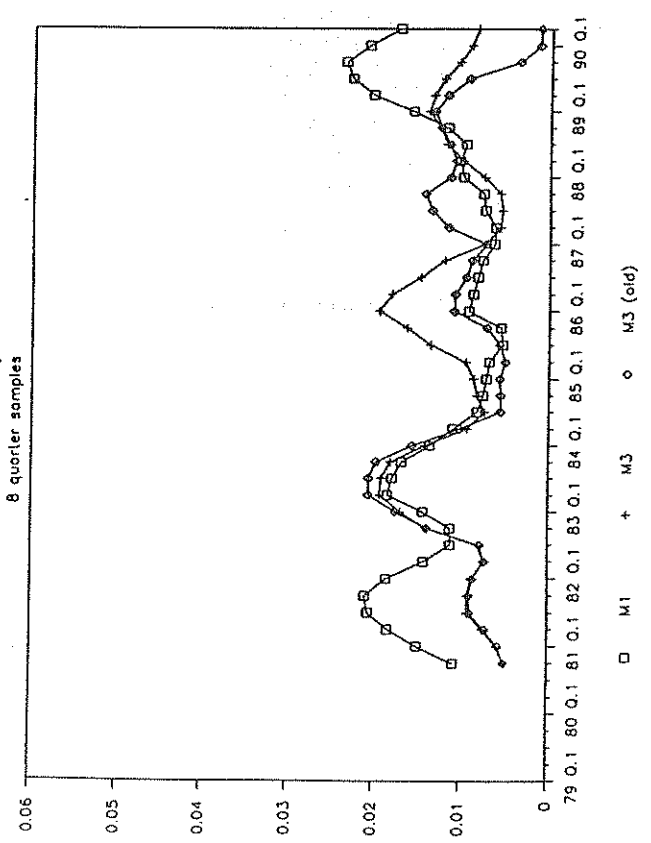
Volatility of velocity: GERMANY



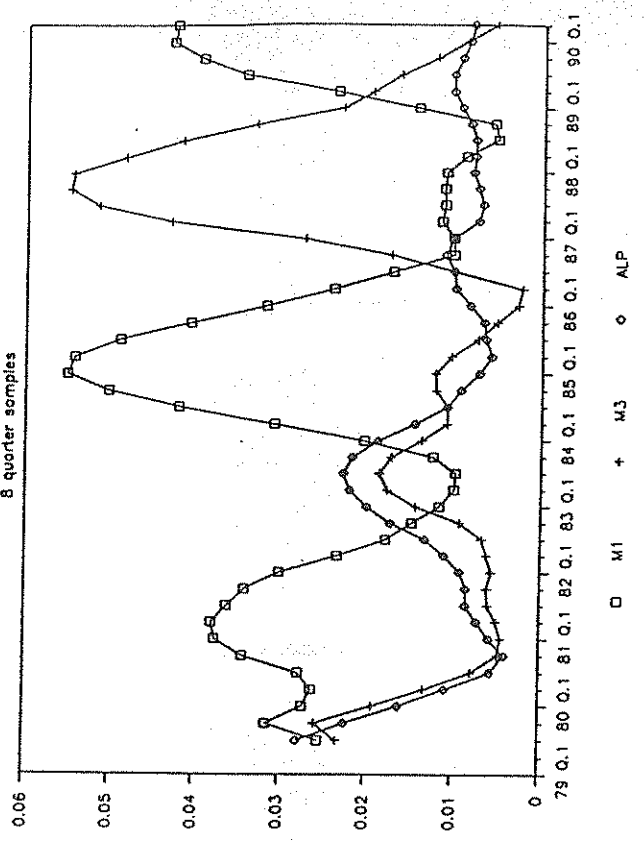
Volatility of velocity: Italy



Volatility of velocity: FRANCE



Volatility of velocity: SPAIN



(c) When focusing on the capacity of an aggregate to supply information on the future developments of the goals, various techniques can be applied to the stationarised series. They all share the common feature of utilising regression analysis to examine the significance of aggregates as determinants of the final goals. The simplest technique, yielding the so-called informational content statistic, was put forward in the Federal Reserve Board at the end of the '70s and is based on the assumption that only one lagged value of the monetary aggregate is relevant to forecast the goal. If this assumption is relaxed by allowing several lagged values of both the aggregate and the goal, another index, namely the final forecasting error, becomes the relevant one.

(d) Vector Autoregression is a further extension to allow the possibility that the monetary aggregate may itself be influenced by the lagged values of the goals. The relevant statistical tests will be those assessing the predictive power of both sets of variables on the other (Granger-causality tests), thereby supplying indications on whether there are important feed-backs between aggregates and final variables. Although a consistent definition of causality is necessarily based on strong a priori assumptions, the "atheoretical" notion of Granger-causality can provide a useful benchmark.

2. Theoretically-based approaches

(a) The stability of the substitution relationship among assets is more important than the degree of substitutability itself. If such a relationship can be identified, the degree of substitutability merely affects the size of the multiplier. On the contrary, unstable relationships do create problems, as the link between monetary policy and the final goals is consequently unpredictable. This has led to the suggestion that the most appropriate measure of the money stock is the one that exhibits the most stable demand.

The estimation of money demand, indeed, has been one of the most topical areas of applied research. Up until a few years ago, most equations did not take adequate account of the non-stationary nature of the main variables. In consequence, most estimates proved relatively unstable as a result of the wave of real and financial shocks in the 1980s. One alternative approach has been to utilise differenced forms for these variables, although this reduced the information obtainable from money-demand equations to their short-run dynamics. In order to address

such problems, "Error-Correction-Models" (ECM) and "Co-integration" analysis have been developed. These techniques are practised in most central banks, although, as far as is known, they have not been applied everywhere systematically. This approach helps clarify the stability issue, as it allows the appraisal of both:

- (i) the adjustment process for departures of actual money balances from equilibrium and
- (ii) the determination of changes in the equilibrium caused by variations in the explanatory variables.

Here, equilibrium refers to some long-run relationship holding between money, price, activity, interest rate, etc, notwithstanding short-term shocks. Such a stable relationship can be obtained (and the ECM is statistically well-founded, so that it can be tested with the usual econometric tools) whenever all these variables are "co-integrated", i.e. first all are stationary, once differenced (individually or in linear combination), and second, they can be related to produce a stationary residual process. The estimate of the residual process corresponds to the error correction term which ensures that the long-term relationship is maintained.

This approach seems illuminating for long-run intermediate monetary targeting as it helps to identify whether or not variations in actual money balances arise from changes in the long-run equilibrium (target), which may need corrective action, or from temporary departures from equilibrium, which will be absorbed automatically through the adjustment process.

(b) Some words of caution are, of course, needed. First, although this technique can help obtain stable long-run relationships in spite of the shocks experienced in the last years, they may be neither easy to derive from econometric analysis nor robust enough for many monetary aggregates. Secondly, these models are reduced forms, that is they are a compact way of summarising the links between variables, which are in fact derived from several economic relationships. As a result, it is difficult, if not impossible, to infer the precise features of the underlying behaviour.

The same warnings apply to the P* approach, which has been considered in some central banks (e.g. the Fed and the Bundesbank). This

approach attempts to define a measure of potential inflation due to excessive money creation on the basis of the "quantitative identity of exchange", where actual values are replaced by "equilibrium" values for output (e.g. potential) and velocity (e.g. a time trend in the U.S or the long run velocity derived from a stable money-demand equation with a constant average interest rate, in Germany).

Reduced forms cannot provide as much information as structural models, which may be built either to examine portfolio choices on the basis of the flow-of-funds approach or for the whole economy with real and financial sectors integrated explicitly. On the other hand, structural models are more difficult to estimate and less convenient to use, as several central banks have experienced. Finally, an interesting, though complex, blend of the approaches may be produced by combining a reduced form for financial asset demand together with a structural model for the real sector. Utilising this method, the informational content of monetary aggregates may be analysed through stochastic simulations.²

2 Work broadly along these lines was carried out at the Bank of Italy.

Formulae for some of the methods

(a) Moving coefficient of variation

At time t , the coefficient is defined as:

$$c_t = \left[\left(\frac{\sum_{i=1}^m (x_{t-i} - \bar{x}_{t-i})^2}{m} \right)^{\frac{1}{2}} / \sum_{i=1}^m x_{t-i} \right] * (m/m-1)$$

where x_t is the realisation of the variable at time t

m defines the number of periods over which each statistic is calculated.

(b) Informational content

This statistic, whose rationale is given in Tinsley et al. (Journal of Econometrics, 1980), is defined as $(1/2)(1/(1-R^2))$ where R^2 is the coefficient of determination of the regression:

$$Y_t = a + bx_{t-m} + \epsilon_t$$

where:

Y_t is the goal value at time t

x_{t-m} is the monetary aggregate value lagged m periods

ϵ_t is a disturbance displaying the usual properties

(c) Final forecasting error

This index proposed is calculated as the ratio¹ between the RSS of the following regression:

$$Y_t = a + B(L) Y_t + C(L) x_t + \epsilon_t$$

where $B(L)$, $C(L)$ are polynomials of the lag operator L and the other variables maintain their definition given above

and the RSS of the same regression under the hypothesis that $C=0$

(d) Vector Autoregression

This approach, proposed by Sims (Econometrica 1980) as an alternative to the traditional macroeconometrics, consists in the estimation of the system:

$$Y_t = a_1 + B(L) Y_t + C(L)x_t + \epsilon_{1t}$$

$$X_t = a_2 + D(L) Y_t + E(L)x_t + \epsilon_{2t}$$

In this framework, causality in the sense specified by the Granger (Econometrica, 1969) (i.e. "anteriority") can be assessed by running tests on the significance of the lagged variables. If $C(L) \neq 0$ and $D(L) = 0$ then x_t "causes" Y_t ; If $C(L) = 0$ and $D(L) \neq 0$ then Y_t "causes" x_t ; if $C(L) = D(L) = 0$ the two variables are independent, while if $C(L) \neq 0$ and $D(L) \neq 0$ there is feedback.

1 To be precise the ratio has to be multiplied by $[(T+m+n+1) * (T-m-1) / ((T+m+1) * (T-m-n-1))]$ where T is the sample size, m is the order of B and n is the order of C .