

Seasonal adjustment of monthly money statistics

Introduction

This article explains the method used for seasonal adjustment of the monthly money series, M_1 and M_3 . [1]

Developments this year have made it very evident that revisions to the seasonal adjustments applied to the monetary aggregates can make a considerable difference to the apparent course of the latter month by month. Thus the new seasonal adjustments announced in May produced a seasonally-adjusted growth of sterling M_3 that was considerably more rapid in recent months (and particularly in February) than the adjustments previously in use had done.

The introduction of new seasonal adjustments did not mean that the previous estimates had been calculated incorrectly. The information needed for seasonal adjustment is almost always incomplete, so that the best estimates of seasonal influences tend to change over time. The adjustments are based on information about the past behaviour of the series, and they are naturally liable to revision in the light of more refined data.

There are greater difficulties in measuring the seasonal influences affecting the money series than those for many other series: the past may not be a reliable guide to present seasonal patterns, largely because of abrupt changes in the pattern of public sector operations. As is explained more fully below, the Bank endeavours to take account of these changes, and to anticipate, on the basis of the latest available actual information and forecasts, the probable pattern in the current financial year. Not only has the public sector borrowing requirement for a financial year proved hard to forecast, but it has been even more difficult to forecast its pattern, month by month. Later information on the outturn for the financial year accounted for a large part of the revisions which were announced in May; the remainder reflected modifications to take account of better information about government expenditure by banking months (rather than calendar months), as soon as this became available.

The nature of the problem

The purpose of seasonal adjustment is normally to remove from a statistical series those fluctuations which broadly recur each year at the same time. [2] It is traditionally carried out by looking at the deviations of a series from its trend over several years and deriving from them average deviations appropriate to the different months of the year. These averages provide adjustments which can be added to or subtracted from the original series to produce a seasonally-adjusted series. Such methods are perfectly adequate for a series such as beer consumption, where seasonal variation is caused by weather or social customs, and therefore changes, if at all, only slowly from year to year.

Seasonal adjustment of the monthly money statistics needs to go further than this. In the first place, the month-to-month changes in bank deposits and lending are very much influenced by the monthly flows of government revenue and expenditure. If the pattern of government receipts and payments were more

or less unchanged from year to year, the normal method of seasonal adjustment described above would probably suffice. Not infrequently, however, administrative changes occur, such as the introduction of a new tax or of new arrangements for disbursing government expenditure, which can alter the pattern of these flows abruptly. These may cause sudden large changes in the regular monthly pattern of bank deposits and advances, which traditional methods of seasonal adjustment, depending on averaging the past, will not pick up for two or three years. A method has to be found of linking the seasonal adjustment of the banking statistics, and hence of the money stock, with the seasonal adjustment of the central government borrowing requirement, principally in order to deal with these sudden changes in the established pattern. In the first year or two after a sudden change, the distribution of its impact on the various banking series has to be estimated. This implies that revisions to recent seasonal adjustments will be larger than usual later on, when the change has worked its way through the moving averages of the standard method. It should be emphasised that it is not the purpose of seasonal adjustment to correct for *all* fluctuations in government receipts and payments, but only for those of a regular recurrent nature. Erratic items will always remain in the monthly banking series, including the money stock, even after seasonal adjustment.

The second point is rather different. Seasonal adjustment as described above takes no account of the differing dates in the month on which banking months end — the third Wednesday (except in December, when it is the second Wednesday). Mainly because of the influence of government transactions, these dates are of great significance. If revenue and expenditure flowed evenly through the month, the varying length of banking month would affect both about equally, and their influences on the banking system would largely cancel out. But, in fact, this is not the case: certain taxes are due to be paid, monthly or quarterly, around the make-up date; and large payments are made from the Consolidated Fund to local authorities on fixed dates in respect of housing subsidies and the Rate Support Grant, the totals varying considerably from one month of the year to another. So the money and banking figures are adjusted by an estimated correction for recurrent patterns associated with the varying reporting dates, as well as for the more 'normal' seasonal factors which cancel out within the year. (If the banking figures were collected on end-month rather than mid-month reporting dates, no correction would be needed for the date in the month; there would, however, be other problems because banking activity is exceptionally high at that time and also because the day of the week on which months end varies.)

These distinctive characteristics of seasonal adjustment as applied to the money and banking figures — that the 'seasonal' pattern can change abruptly from one year to the next, and that the adjustment is affected by the date at the beginning and end of the month concerned — lead to some unusual features. First, the adjustments to be applied to individual months in any year often differ substantially from those for the same month in the

[1] Table 11 in the statistical annex.

[2] The same principles apply to other recurrent patterns associated with the calendar, e.g. variation depending on the dates in the month to which the figures relate.

year before. Secondly, the seasonal adjustments do not necessarily precisely cancel out over a period of twelve months.

Conventional statistical practice is, of course, that the seasonal adjustments to a series add to zero over a year. For the national accounts and flow of funds, including the quarterly series of M_1 and M_3 , the period chosen is the calendar year. The same convention is adopted for the monthly money and banking series. [1] But for monthly sterling M_3 it might be thought more useful to base the adjustments on the 'financial year' (or, more precisely, the year ending in mid-April), the period for which monetary targets have been set. [2] In general, there is no statistical reason to favour one period or the other, but there are a number of other considerations which are relevant to the choice between the two possible approaches.

The first is a behavioural point and relates to the payment of mainstream corporation tax which is concentrated in the March quarter. If companies tend to set aside money in advance to pay the tax, the M_3 series would reflect behaviour more correctly if the adjustments spread the tax over the preceding months, i.e., if they were based on the financial year; conversely, if companies rebuild their depleted stock of money after paying tax, calendar year adjustments would be more correct. Although practice, no doubt, varies among companies, and, indeed, for the same companies in different years, it seems likely that a majority of companies set their mainstream tax payments aside in advance, and on this basis, therefore, financial year seasonals would be preferable.

But other considerations point the other way. Forecasting of corporation tax receipts has sometimes proved to be very difficult: if seasonal adjustments are centred on financial years and the outturn in the March quarter is substantially different from the forecast, any revision to the adjustments for the months of January–March will entail a sequence of offsetting revisions to the figures for the previous May to December; indeed, a revision to the forecast earlier in the year will have the same effect. By contrast, if, as now, adjustments are based on calendar years, a revised forecast coming, typically, towards the end of the financial year affects only the future and not the past path of monetary growth. The problem of revisions has not hitherto been so important but this year the original corporation tax forecast was £750 million too low, and the full extent of this underestimate did not become clear until very late in the financial year. The concentration of mainstream corporation tax in a particular quarter, which makes it especially hard to discern the underlying rate of monetary growth, remains a problem, whichever set of seasonal adjustments is used. But, in view of the particular problems with corporation tax that have been experienced this year, arrangements are being made to shorten the time lag between initial revision and analysis of tax receipts, and the consequential recalculation of the seasonal adjustments.

A related point is that the target period for monetary aggregates may not invariably be mid-April to mid-April; thus the proposal for a rolling target mentioned in the Chancellor's Budget statement on 11th April would be consistent with a target which might, on occasion, run for the year ending mid-October.

The arguments are, however, finely balanced and an eventual change to centring on financial years is by no means ruled out. It must be pointed out that, even if this were done for the adjustments which are strictly seasonal, it would not apply to the adjustments for half-yearly interest or for make-up date variation. The former sum to zero over half-years ending in July and January (since the debiting/crediting takes place in these banking months). The latter sum approximately to zero only over a period beginning and ending on the same date. Thus, whatever year is chosen, the total adjustments will not cancel out exactly.

Because of the connexions between the financial transactions of banks and the central government, the seasonal adjustment of money and banking figures is carried out with the data for each month arranged in the form of a two-way table or matrix (see Table A), in which their seasonal patterns are analysed. The matrix tables, with figures in millions of pounds, may give an air of spurious precision. In practice, each figure should be regarded as an approximation which is subject to revision, sometimes substantial, in the light of better or later information.

The next three sections of this article describe the assembly of this matrix and how the adjustments are constructed. The final sections concern the quality of the results, the derivation of adjustments for levels of M_1 and M_3 , and the new arrangements for publishing estimated seasonal adjustments in advance.

The matrix of seasonal adjustments

The limited financial information available by banking months is mostly provided by the central government and the banking system, plus some important isolated transactions. There is no breakdown of the private sector [3] and no information about local authorities' borrowing from non-bank domestic sources.

Nevertheless, the matrix framework provides some constraints which have to be preserved, if seasonally-adjusted figures are to be meaningful. First, the forms on which banks report their assets and liabilities are balance sheets: this means that the seasonal adjustment of the corresponding flows must be kept in line. Secondly, banks' holdings of government debt — largely Treasury bills — are the principal residual source of finance for the central government: this provides a link between the seasonal pattern of the central government and that of the banking system. Information on certain of the overseas and private sectors' assets and liabilities is reported by the banks; but the only other constraint on the system is the link between the overseas trade balance and the net external positions of the banks and central government. However, this is a very weak link, because visible trade is recorded by calendar months, and because there are so many other types of external financial transaction which are not recorded by banking months.

An attempt is made to deal with the problem of administrative changes, and their effects on the seasonal pattern, in the same way as in the case of the calendar quarterly series. [4] That is, the seasonal adjustments of the series in the cells of the monthly financial matrix are made consistent by a balancing process. The matrix (see Table A) consists of five sectors (central government, other public sector, overseas, private and banking) and ten financial instruments (central

[1] More precisely, in this case the period is the year ending in mid-December.

[2] If the pattern is changing, it is impossible for the adjustments to add to zero over two different types of year.

[3] In this article, 'private sector' always refers to the private sector excluding banks.

[4] Described in more detail in *United Kingdom flow of funds accounts: 1963–1976*, which is being published this month.

Table A

Balanced seasonal adjustments^(a)

1977: £ millions

	January					February					March				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Central government lending	0	0				-49	49				-13	13			
Central government external transactions	-9		9			0		0			0		0		
Banks' net external transactions			366		-366			0		0			-34		34
Notes and coin	313			-265	-48	45			17	-62	-29			41	-12
Sight deposits ^(b)		177		-375	198		-96		-327	423		-8		181	-173
Time deposits ^(b)				-817	817				-30	30				-53	53
National savings	4			-4		-8			8		-53			53	
Bank lending ^(b)		6		-90	84		44		-73	29		52		185	-237
Treasury bills ^(b)	684			0	-684	409			0	-409	-288			0	288
Local authority debt		0			0		10			-10		-47			47
Total identified financial transactions	992	183	375	-1,551	1	397	7	0	-405	1	-383	10	-34	407	0
	April					May					June				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Central government lending	-16	16				32	-32				58	-58			
Central government external transactions	1		-1			1		-1			1		-1		
Banks' net external transactions			11		-11			-86		86			-28		28
Notes and coin	-42			18	24	10			18	-28	-29			35	-6
Sight deposits ^(b)		62		401	-463		69		-259	190		-56		32	24
Time deposits ^(b)				-134	134				7	7	28			107	-107
National savings	-24			24		3			3					-28	
Bank lending ^(b)		-30		-148	178		48		4	-52		41		163	-204
Treasury bills ^(b)	-28			0	28	171			0	-171	-296			0	296
Local authority debt		-109			109		33			-33		31			-31
Total identified financial transactions	-109	-61	10	161	-1	217	118	-87	-247	-1	-238	-42	-29	309	0
	July					August					September				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Central government lending	31	-31				47	-47				-43	43			
Central government external transactions	1		-1			1		-1			1		-1		
Banks' net external transactions			30		-30			43		-43			26		-26
Notes and coin	-213			188	25	120			-127	7	168			-107	-61
Sight deposits ^(b)		74		-10	-64		-60		32	28		-63		48	15
Time deposits ^(b)				25	-25				46	-46				252	-252
National savings	20			-20		-8			8		-23			23	
Bank lending ^(b)		-80		-442	552		7		204	-197		4		299	-303
Treasury bills ^(b)	387			0	-387	-258			0	258	-633			0	633
Local authority debt		42			-42		6			-6		6			-6
Total identified financial transactions	226	5	29	-259	-1	-98	-108	42	163	1	-530	-10	25	515	0
	October					November					December				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Central government lending	-45	45				29	-29				-31	31			
Central government external transactions	1		-1			1		-1			1		-1		
Banks' net external transactions			51		-51			-23		23			-356		356
Notes and coin	45			-43	-2	-14			5	9	-374			220	154
Sight deposits ^(b)		-28		44	-16		55		22	-77		-126		211	-85
Time deposits ^(b)				49	-49				70	-70				492	-492
National savings	0			0		8			-8		53			-53	
Bank lending ^(b)		-120		-247	367		11		-38	27		31		183	-214
Treasury bills ^(b)	337			0	-337	-156			0	156	-329			0	329
Local authority debt		-89			89		69			-69		48			-48
Total identified financial transactions	338	-192	50	-197	1	-132	106	-24	51	1	-680	-16	-357	1,053	0

(a) To be subtracted from unadjusted flows.

(b) Changes in domestic holdings, sterling only.

government lending, central government and banks' net external positions, notes and coin, bank deposits — sight and time — bank lending, central government debt — non-marketable and marketable — and local authorities' bank borrowing). Public sector bank deposits are shown under 'other public sector' because no breakdown between the deposits of central government, local authorities and public corporations is available for banking months. 'Identified financial transactions' of central government is the central government net balance of revenue over expenditure (excluding identifiable lending).

For each cell of the matrix, preliminary seasonal adjustments are obtained — using either moving average or deterministic methods. A moving average method, based on averaging the pattern of past years, is appropriate for series having a random or irregular element; a deterministic method is more suitable for series such as interest payments on government stocks where the pattern changes in steps (as stocks are issued or redeemed), but which has no random element. Particular attention is given to estimating the seasonal pattern of the central government's net balance, which is derived from the patterns of the components of its revenue and expenditure (see below). A weight, representing the reliability of estimate, is attached to each cell and balancing adjustments are made: the weighted sum of squares of these adjustments is minimised, subject to the balanced seasonals summing to zero in each row and to the seasonal for the sector total in each column. The seasonal adjustments for total identified financial transactions of the central government are regarded as well-defined and do not take part in the balancing. This ensures that identified changes in the pattern of government flows affect the banking series in a suitable way. The results for 1977 (the last year used in the current estimates) are given in Table A. Because the series are seasonally adjusted by calendar years, the adjustments in each cell sum to zero only over these years.

The second problem identified above — the effect of make-up date variations on central government flows — is dealt with by further adjustments made after the balancing has taken place.

Sources and methods for individual cells of the matrix

The central government net balance

The seasonal adjustments for the central government are built up from its components.

Revenue is divided into the following categories:

- 1 mainstream corporation tax;
- 2 advance corporation tax;
- 3 income tax paid under pay as you earn (PAYE);
- 4 income tax paid by unincorporated businesses (Schedule D etc.);
- 5 other income tax;
- 6 other Inland Revenue collections;
- 7 Inland Revenue unallocated;
- 8 value added tax (VAT);
- 9 car tax;
- 10 other Customs and Excise receipts;
- 11 North Sea oil royalties and petroleum revenue tax;
- 12 broadcast licence receipts;
- 13 other Consolidated Fund receipts;
- 14 interest receipts from local authorities; and
- 15 other National Loans Fund interest receipts (mainly from public corporations).

Items 1 to 6 are taken from the Inland Revenue collectors' records up to the Friday before the make-up date. Item 7 represents the difference between Consolidated Fund receipts from the Inland Revenue in the banking month and local tax collections in the Friday/Friday period. Item 10 includes a similar unallocated series for the Customs and Excise. Notes about the individual taxes appear in the appendix.

In government expenditure, the following categories are distinguished for seasonal adjustment:

- 1 housing subsidy payments to local authorities;
- 2 Rate Support Grant;
- 3 other supply expenditure (adjusted for changes in departmental balances);
- 4 interest on inter-government loans;
- 5 interest on government stocks; and
- 6 other interest payments.

Notes about the adjustment of these series appear in the appendix.

Government lending

This item appears separately in the matrix. In principle, it comprises net lending to:

- 1 local authorities (drawings from the National Loans Fund by the Public Works Loan Board, adjusted for changes in their unspent balances with the Paymaster General);
- 2 public corporations (including public dividend capital which is recorded under supply expenditure); and
- 3 private and overseas sectors.

The second of these is very irregular and no definite seasonal pattern has been found. There are no banking month statistics for the third component, which is included indistinguishably in supply expenditure.

Central government net external position

This is a very irregular series, with no indication of seasonality, apart from the annual servicing of the post-war North American loans. The pattern of the latter is included in the matrix.

Overseas sector

The seasonality of total identified financial transactions is assumed to be equal to that of the balance of payments current account; the latter is divided into imports, exports and invisibles. For imports and exports, the calendar month adjustments issued by the Department of Trade are used; although this is fairly appropriate for exports (which have a recording delay of about two weeks), it is not for imports. Banking month figures for invisibles are only available for a few major transactions (e.g. interest on the North American loans paid on 31st December each year).

Banking sector

Net external transactions of the banking sector have been tested for seasonality, but none has been detected, perhaps because it is rather irregular. However, the seasonal pattern of the balance of payments current account should be mainly reflected here or in the central government's external transactions. In balancing the matrix, the resulting seasonals are shown under 'banks' net external' but, because of the uncertainties, they are applied to the total ('external and foreign currency finance' in Table 11.3 in the statistical annex).

Banks' holdings of Treasury bills are combined with their reported holdings of government securities (at book values), as

a measure of the Government's residual need for finance, and the resulting series of flows is seasonally adjusted as a single series.

Deposits of, and lending to, UK residents (excluding the foreign currency element) are seasonally adjusted as levels, after the series have been smoothed to allow for statistical breaks, e.g. by adding a constant amount, or a constant proportion to the pre-break figures. The most important breaks occur in May 1975, when new banking returns were introduced, and the size of the breaks had to be estimated statistically. [1]

Notes and coin

Weekly figures (on Wednesdays) are available for notes in circulation, divided between banks' holdings [2] and those of the private sector. These are adjusted for seasonality and temporary increases due to movable public holidays. The former is what appears in Table A (without balancing).

Central government marketable debt

Total transactions in Treasury bills are combined (for the purpose of seasonal adjustment) with banks' transactions in government stocks (see banking sector). Non-bank transactions in government stocks form an extremely irregular series, but it does now appear, from one of the statistical tests normally applied, to exhibit over the period 1971-77 significant seasonal variation: namely, that sales of stock are low in April and June-August, and highest in January. The low months may be explicable in terms of some traditional hesitation around the time of the Budget and of the summer holidays, but the estimated peak is largely due to the unusually high sales in January 1976 and 1977. Because of serious doubts about the persistence of the latter feature, no seasonal adjustment is made to this series at present.

Certificates of tax deposit were introduced in October 1975, but were little used until the autumn of 1977, when the rate of interest became out of line with market rates. There were sizable encashments in January 1978, but it is far too early to detect any regular seasonal pattern.

[1] See 'breaks in the series' in the notes to Table 6 in the statistical annex.

[2] London clearing banks only.

Table B

Interest adjustments [a]

1977: £ millions

	January		February		March		April		May		June	
	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector
Sight deposits [b]	-103	103	20	-20	19	-19	9	-9	20	-20	19	-19
Time deposits [b]	289	-289	-44	44	-44	44	-38	38	-44	44	-44	44
Bank lending [b]	-579	579	111	-111	111	-111	48	-48	111	-111	112	-112
Total identified financial transactions	-393	393	87	-87	86	-86	19	-19	87	-87	87	-87
	July		August		September		October		November		December	
	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector	Private sector	Banking sector
Sight deposits [b]	-87	87	16	-16	16	-16	8	-8	16	-16	16	-16
Time deposits [b]	214	-214	-23	23	-24	24	-18	18	-23	23	-24	24
Bank lending [b]	-493	493	91	-91	92	-92	40	-40	91	-91	92	-92
Total identified financial transactions	-366	366	84	-84	84	-84	30	-30	84	-84	84	-84

[a] To be subtracted from unadjusted flows.

[b] Changes in domestic holdings, sterling only.

Other adjustments

After the preliminary seasonal adjustments have been balanced, further adjustments are necessary. From mid-1974 to mid-1976, payments of housing subsidies to local authorities at end-June and end-December became so large that they seriously affected the balancing of the matrix, so the seasonal pattern was divided into two: a normal part based on averaging the past, which is included in the central government net balance, for balancing, and an extra part which is included in the 'other adjustments'. In 1975 and 1976, the Rate Support Grant Increase payments, which are usually made in the March quarter, also became much larger and the same technique has been used. In 1977, steps were taken to smooth out the payment of housing subsidies, and the RSG Increase transfers became much smaller again, so both sets of seasonal adjustments have been included in the normal balancing process.

It was necessary to decide how to allocate these 'other adjustments'. Because local authorities have only small bank deposits, the main impact of these seasonal movements must be in their market borrowing. Since it does not show up in their borrowing from the banks, it has been assumed to be reflected in borrowing from non-banks. But no monthly information on the latter is available, so this borrowing should influence the matrix indirectly when the non-banks use repayments of debt by local authorities to increase their holdings of certificates of deposit or other money-market assets (which are included in time deposits).

There are also adjustments reflecting the half-yearly debiting and crediting of interest by the London clearing banks. These affect bank lending and time deposits and, to a lesser extent, sight deposits, because about 15% of the interest on bank lending is believed to be debited to accounts that are then in credit. The interest adjustments are a type of seasonal adjustment, but are best handled separately, because the amounts can vary a good deal from one half-year to another, depending on movements in interest rates. The accrued interest is added as prior adjustments to the levels of the banking series before seasonal adjustment. The corresponding adjustments to the flows are shown, as additions to the balanced seasonal adjustments in Table B. Since the interest payments occur in

Table C

Other adjustments^[a]

1977: £ millions

	January					February					March				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Banks' net external transactions			71		- 71			0		0			0		0
Notes and coin	0			0	0	0				0	0				0
Sight deposits [b]		88		- 83	- 5		- 88		127	- 39		0		- 17	17
Time deposits [b]				145	-145				- 43	43				16	- 16
Bank lending [b]				- 56	56				85	- 85				- 12	12
Treasury bills [b]	-165			0	165	-81			0	81	13			0	- 13
Total identified financial transactions	-165	88	71	+ 6	0	-81	- 88	0	169	0	13	0	0	- 13	0
	April					May					June				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Banks' net external transactions			0		0			0		0			0		0
Notes and coin	- 98			55	43	98			- 55	- 43	- 71			19	52
Sight deposits [b]		190		-300	110		-190		285	- 95		0		40	- 40
Time deposits [b]				0	0				0	0		0		0	0
Bank lending [b]				-163	163				154	-154				40	- 40
Treasury bills [b]	316			0	-316	-292			0	292	- 28			0	28
Total identified financial transactions	218	190	0	-408	0	-194	-190	0	384	0	- 99	0	0	99	0
	July					August					September				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Banks' net external transactions			0		0			0		0			0		0
Notes and coin	71			- 19	- 52	0			0	0	0			0	0
Sight deposits [b]		231		-317	86		-231		296	- 65		194		-251	57
Time deposits [b]				1	- 1				- 3	3				15	- 15
Bank lending [b]				-224	224				197	-197				-167	167
Treasury bills [b]	257			0	-257	-259			0	259	209			0	-209
Total identified financial transactions	328	231	0	-559	0	-259	-231	0	490	0	209	194	0	- 403	0
	October					November					December				
	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector	Central government	Other public sector	Overseas sector	Private sector	Banking sector
Banks' net external transactions			0		0			0		0			71		- 71
Notes and coin	0			0	0	0			0	0	0			0	0
Sight deposits [b]		-89		145	- 56		-105		113	- 8		0		- 17	17
Time deposits [b]				6	- 6				- 11	11				- 59	59
Bank lending [b]				96	- 96				76	- 76				- 11	11
Treasury bills [b]	-158			0	158	- 73			0	73	16			0	- 16
Total identified financial transactions	-158	-89	0	247	0	- 73	-105	0	178	0	16	0	71	- 87	0

[a] To be subtracted from unadjusted flows.

[b] Changes in domestic holdings, sterling only.

banking January and July, these adjustments sum to zero over half-years ending in these months.

The remaining adjustments, which have no analogue in the quarterly matrix, reflect variations of central government transactions in the banking month due to different make-up dates, and sundry short-term timing adjustments (see Table C). For example, the regular weekly Rate Support Grant payments to local authorities are adjusted for length-of-month until the end of 1976–77. [1] As in the case of RSG Increase payments, this is assumed to affect the authorities' non-bank borrowing and hence indirectly to influence private sector time deposits. The other main component of Table C is the make-up date variation in government transactions with the private sector; these are estimated from the make-up date variations in government revenue and expenditure, combined with those of public sector deposits (see appendix, revenue item 7). The effect on the private sector is divided 60/40 between sight deposits and bank lending, as shown in Table D. This ratio is the same as that used for transit items; it corresponds quite closely to the relative sizes of the correlations between the total make-up date effect and the movements of sight deposits and bank lending.

It will be clear from the foregoing that the adjustments in Table C sum to zero over short periods, but not over years ending in mid-December, since they begin and end on differing dates.

Table D
Make-up date effects on income tax

	Central government	Other public	Private	Banking sector
Bank sight deposits		<i>P</i>	$-0.6(M + P)$	$0.6M - 0.4P$
Bank lending			$-0.4(M + P)$	$0.4(M + P)$
Treasury bills	<i>M</i>			$-M$
Identified financial transactions	<i>M</i>	<i>P</i>	$-(M + P)$	—

Notes

M denotes tax received by central government.

P denotes tax held by Inland Revenue with commercial banks.

Results

The success of the foregoing procedures may perhaps be measured by the smoothness of the adjusted series. The criterion used is the root mean square (a form of average) of the first differences of the flows. For sterling M_3 , this criterion is £450 million for the unadjusted series, £358 million, using unbalanced seasonal adjustments [2], £346 million using balanced ones [2], and £334 million when the 'other adjustments' are added in. So there is prima facie evidence of an improvement, albeit rather small, in the smoothness of sterling M_3 .

Money stock: M_1 and M_3

The seasonal adjustments for the flows of M_1 are simply the sum of those for private sector sight deposits and notes and coin. For the flows of sterling M_3 , the adjustments for public sector deposits and private sector time deposits are added in. The seasonal adjustments to the *levels* of M_1 and M_3 could be derived by cumulating the balanced adjustments to the flows from the starting date. But the direct application of these adjustments (called 'method 1' below) has serious disadvantages, and three other methods are discussed.

Method 1 leads to adjusted December levels which are the same as the unadjusted ones (as far as strictly seasonal adjustments are concerned). For M_1 and M_3 , where December is the high point of the year, this means that the seasonally-adjusted series would be higher than the unadjusted one in every other month — and by substantial amounts. The average difference for sterling M_3 is nearly £800 million in 1977, and it would seem very undesirable to have differences of this magnitude between the two series.

In method 2, one year is selected as the base and a constant centring adjustment is made to the whole adjusted series derived by method 1, so that its average level in the base year is the same as that of the unadjusted series. This method was tried some years ago and abandoned because the choice of base year is arbitrary. Either the base has to be changed every few years, or the calendar year averages of the adjusted and unadjusted series gradually diverge more and more as the seasonal pattern becomes larger.

In method 3, a separate centring adjustment is applied to each year to equalise the averages of the two series. This method has the effect of seriously distorting the change in seasonally-adjusted levels between December and January, when the centring adjustment changes.

In method 4 (that currently used) a twelve-month moving average of the cumulated seasonals is subtracted from them, before they are applied. This keeps the average level of seasonally-adjusted and unadjusted series closely in line. This moving average has been increasing over the years, as the seasonal swings have become larger, so that, for this method, there are discrepancies between the seasonally-adjusted flows and the corresponding changes in levels. For sterling M_3 , these amount to as much as £30–40 million in some months of 1977. Moreover, because the moving average correction is increasing, the discrepancies tend to be in the same direction, so that the growth over a year measured as a change in levels is always less than the flow — in 1977, this difference was about 0.3%. In published comment, it has been the practice to measure percentage growth in terms of flows, because sometimes there are minor breaks in the unadjusted levels, the effect of which is removed in obtaining the flows.

For the accrued interest and make-up date adjustments, the simple accumulation of method 1 is used in the levels series.

Forecast adjustments

It is necessary to make forecasts of the balanced adjustments, even though, for many of the series in the matrix, multiplicative (i.e. percentage) adjustments are used. The forecast unbalanced seasonals for these series are derived by what has become known as the pseudo-additive method (see appendix, revenue item 1). As forecasts are updated during the year, and the pattern of government payments and receipts becomes firmer, the forecast pseudo-additive adjustments are revised, but they are usually fixed about a month before publication of the monthly money figures. It is therefore proposed, starting in June, to publish with the latest money and banking figures, forecasts of the total adjustments for the next month, relating to M_1 , sterling M_3 , notes and coin, and bank lending in sterling to the private sector. It might, however, be

[1] This adjustment is not needed for subsequent years (see appendix).

[2] Including the accrued interest adjustments which are similar to seasonals.

necessary occasionally to revise these forecasts before the next announcement (especially for January and February when there are uncertainties connected with corporation tax); in that event, the revised adjustments would be made known at the time of the publication of eligible liabilities, that is, about a week before the money announcement. This procedure for revision will probably also be necessary before the publication of the April money and banking figures, when the annual update of the seasonal adjustments is being completed.

Summary

The foregoing describes a method for seasonally adjusting the flows of M_1 , sterling M_3 and other monthly financial series in a consistent way. It includes adjustments for other types of recurrent variation not related to the month of the year. The estimates are updated annually as a rule, and substantial improvements of method were made both in April 1977 and April 1978; but the need to take account of institutional changes in the system is likely to be a continuing problem.

Appendix

Central government revenue and expenditure [1]

Revenue

1 *Mainstream corporation tax* (MCT) is now chiefly concentrated in January. However, before 1976, taxpayers had a sixty-day period of grace without interest penalty, and the peak was in February with substantial amounts not paid till March. Before seasonal adjustment, the figures for 1976 and 1977 have been prior adjusted to move the tax out of January into February and March. The resulting seasonal pattern is appropriate for the earlier years; but for 1976 and 1977 it is combined with 'post adjustments' (equal in magnitude to the prior adjustments) to give a set of seasonal adjustments corresponding to the new pattern. The seasonal variation is so strong that a modified multiplicative method of adjustment has to be used — the pseudo-additive method. In this, a seasonally-adjusted series is obtained in the usual way and hence, by moving average, a trend (T). This trend has to be extrapolated into the forecast period. An 'unadjusted' series is obtained by multiplying the trend by the seasonal factor (S), and the trend subtracted from this. The result, i.e. $T(S - 1)$ is the pseudo-additive adjustment, and it is subtracted from the original series.

2 *Advance corporation tax* (ACT) is payable quarterly on 14th January etc. But the division between the first and second months of the quarter depends on the make-up date. This tax has only been collected since July 1973, so its seasonal pattern cannot yet be estimated very precisely. A regression method is used at present, assuming the intra-quarterly pattern is the same in each quarter.

3 *Pay as you earn* (PAYE) has a strong length-of-month effect, that is, the total collected is almost proportionate to the number of weeks; this effect is removed by prior adjustment before estimating the seasonal pattern. Also, since it is due on the 19th of the month, Consolidated Fund receipts are boosted on the 21st and the following days, but this shows up in item 7.

4 *Schedule D* income tax is concentrated in January/February and July/August and it has been speeded up, like MCT, by the abolition of the period of grace. Again, prior and post-adjustments are made and the pseudo-additive method is used.

5 and 6 *Other income tax and other Inland Revenue collections* also have adjustments for make-up date.

7 *Inland Revenue unallocated*. This series represents changes in the volume of 'late receipts,' i.e. those received by collectors after the last Friday in the banking month which still reach the Consolidated Fund before the end of the month. The greater part of the collections take two working days to arrive, so this item covers local receipts from the Monday before the make-up day, as well as part of Tuesday's. The adjustments for this series are based on a regression in which it is the dependent variable: the regressors are products of monthly flows of individual taxes and the relevant make-up date variations, plus purely seasonal regressors associated with the months in which MCT, ACT and Schedule D income tax are concentrated. The amounts of tax, received in the last few days of the banking month, which do not reach the Consolidated Fund by the make-up date are reported as public sector bank deposits, and are the main cause of variation in this item.

8 *Value added tax* (VAT), like ACT, has a strong intra-quarterly pattern, due to the three types of taxpayers (manufacturers, wholesalers and retailers) being out of phase. Receipts are largest in the first two months of the quarter, the distribution depending on the make-up date. But this tax, too, was only introduced in 1973, so the seasonal adjustments are still not well-established and it is possible that the pattern is changing. A regression method is used at present.

9 *Cartax*. This tax is another 1973 entrant, and is adjusted by estimating the average percentage division of each banking quarter into months, and then applying these percentages to the quarterly totals.

10-15 *Other receipts* are adjusted using a moving average method, except for North Sea oil royalties and petroleum revenue tax, which have only recently started.

Expenditure

1 *Housing subsidies* until mid-1976 were paid mainly on 30th June and 31st December; but the amounts became so large in 1975 and 1976 that the series

could not be adjusted by a moving average method. It was, therefore, necessary to use a deterministic adjustment, in this case spreading the June (banking July) and December (banking January) payments evenly through each half-year. From mid-1976, the seasonal pattern is much smaller, as the large payments are now made in ten monthly instalments.

2 *Rate Support Grant* (RSG) comprises two parts, the basic element, paid in equal weekly instalments up to the end of 1976/77, and the RSG Increase, announced each November and usually payable in the March quarter. The former used to vary precisely with the length of banking month, but was not strictly seasonal; adjustments to bring payments to a standard month of $4\frac{1}{2}$ weeks are, therefore, included in the 'other adjustments' in Table C. In 1977/78, the weekly payments to authorities in England and Wales were replaced by equal calendar month payments ($\frac{1}{4}$ on the 8th and $\frac{3}{4}$ on the 23rd), so no equalising adjustment is necessary. In 1978/79 a payment of $\frac{1}{4}$ on the 15th has been introduced and that on the 23rd reduced to $\frac{1}{2}$. The RSG Increase payments are seasonally adjusted deterministically because the amount varies so much from year to year, that is, the adjustment merely spreads the payments in January to March evenly over the twelve months. In 1975/76, there was an extra Increase payment in the September quarter, which has been treated as non-seasonal.

3 *Other supply expenditure* includes drawings on the Contingency Fund. It is adjusted to exclude expenditure recorded under the appropriate Supply Votes but still standing on accounts with the Paymaster General, and also public dividend capital issued to public corporations. It is adjusted for length-of-month before seasonal adjustment.

4 *Interest on inter-government loans* refers mainly to the North American loans payable on 31st December: the adjustment spreads this evenly through the year.

5 *Interest on government stocks* has a marked pattern, as dividends are paid six-monthly [2] and the adjustments equalise them over each half of the year.

6 *Other interest* includes that on national savings and Treasury bills, and is adjusted by a moving average method.

[1] Items are numbered to correspond with the lists in the main article.

[2] Except on 2½% Consols.