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A Note on Government Gold Policies*

by

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Government gold policies are under active discussion. Recently there have been significant sales of gold by Belgium and the Netherlands, proposed future sales by Switzerland, and rumors of additional sales. This note is an analysis of several government gold policies, including the immediate sale of government gold stocks.

In Chart 1, the left-hand pie chart shows that governments own about one-fifth of the estimated total world gold stock of about 5900 million troy ounces, which is the sum of government stocks and estimates of private aboveground stocks and gold yet to be mined. The right-hand pie chart shows that the United States owns about one quarter of government gold stocks of about 1100 million ounces.

As shown in the middle panel, governments have been net sellers of gold over the period 1974-96. Cumulated net sales, the last number in the last column, have been 72 million ounces. Most recently, in the 1989-96 period, total net sales were 64 million ounces, including the sale by the Netherlands of about 10 million ounces, one third of its holdings, in late 1996.

The bottom panel shows the real gold price, that is the dollar price deflated by the U.S. CPI, over the period since 1968 when governments ended their defense of the official dollar price. Over the period as a whole, the price has varied widely. Since 1992, however, it has fluctuated within a range of about \$50. Actual, proposed, and rumored government sales have no doubt put downward pressure on the price during this later period, especially over the last year.

As shown in the top panel of Chart 2, gold has both government uses and private uses. Governments use gold as a monetary asset, as part of a "war chest", and as a strategic material. Private uses can be divided into two categories: depletion uses that reduce the stock and service uses that do not. Depletion uses include electronics, other industrial uses, and dentistry. Service uses include jewelry, bars, coins, and medals.

The bottom panel lists two important considerations that underlie the analysis in this note. First, total economic welfare increases if making government gold available to private agents raises

welfare from private uses by more than it reduces welfare from government uses. Second, each government makes more revenue if it sells its gold before other governments either sell or announce a sale. Thus, without coordination there could be a rush to sell, which could strain relations among countries and cause abrupt changes in the gold market.

In this note, we focus on the effects of several government gold policies on the gold market and on welfare from private uses. The top panel of Chart 3 lists two principles for maximizing welfare from private uses. The first principle is that when a resource can be obtained from one stock with no extraction cost, costly extraction from other stocks should be delayed. Violation of this principle leads to a "production inefficiency." If governments withhold their gold for a time, gold is made available from the mines by incurring sizeable costs of extraction instead of from government stocks with no costs of extraction. There is a production inefficiency unless extraction is costless. The second principle listed in the panel is that a resource that can generate welfare should not be withheld from users. Violation of this principle leads to a "use inefficiency." If governments withhold their gold for a time, private uses of gold are too low now and too high later. There is a use inefficiency even if extraction is costless.

It is important to get a sense for the orders of magnitude of the effects of different government gold policies. In order to do so, we use a simulation model described in detail in Henderson, Salant, Irons, and Thomas (1997). The model includes the three key relationships listed in the middle panel of Chart 3. The first relationship is that gold will be mined both today and tomorrow only if net revenue, that is the gold price minus the cost of extraction, is positive and only if net revenue from extraction today is equal to the discounted net revenue from extraction tomorrow. Users may obtain gold by outright purchase or through a gold loan. A gold loan involves receiving gold today and returning the same amount of gold and a loan fee at some future date. The second relationship is that gold will be held both today and tomorrow only if today's price is equal to the discounted sum of

tomorrow's price and the loan fee or, equivalently, only if the sum of the price increase and the loan fee expressed as percentages of today's price is equal to the interest rate. The third relationship is that the initial price must be set so that the sum of depletion uses from now on equals the total available stock, including both aboveground and belowground gold.

The numerical assumptions used to calibrate the model are listed in the bottom panel of Chart 3. The constant real cost of extraction of \$300 per ounce is an approximation based on industry estimates. The estimate of the one-year real interest rate, 2.5 percent, is a common one. Depletion demand and service demand depend on the price, the loan fee, and population. Population is projected to level off at twice its current value by about 2050. The constant terms and elasticities in the demand equations are chosen so that initial depletion demand equals an average of depletion demand in recent years; the initial real price equals \$350, a value close to the current price; and initial service demand equals the current estimated private aboveground stock.

Chart 4 summarizes predictions of the impact on the gold market of two extreme government gold policies: no sale of government gold, the solid lines, and an immediate sale of all government gold, the dotted lines. The top left panel shows that an immediate sale causes the price to drop at once from \$350 to about \$309 per ounce and to remain below the no sale path thereafter. The top right panel shows that with an immediate sale the service stock--that is, the gold in jewelry, bars, coins, and medals--is higher initially and in most periods and is never lower.

As noted earlier, the postponement of costly mining is one source of the increase in welfare from private uses that is achieved by making government gold available. The middle left panel shows that with no sale, mining continues to occur and falls slowly until 2029 when the mines are projected to be exhausted. By contrast, with an immediate sale, the mines shut down at once, reopen again in the year 2008 and are exhausted in 2056. The reopening and exhaustion of the mines are predicted to be abrupt only because of the approximation of a constant unit cost of extraction. It is profitable to

postpone mining for several periods after an immediate sale because in each of those periods tomorrow's price is high relative to today's. Tomorrow's price must be high relative to today's in order to induce private aboveground stock owners to hold gold. This inducement is necessary because the loan fee must be lower given that the service stock is higher. The middle right panel shows that with an immediate sale depletion uses are higher in every period because the price is lower.

The bottom panel of Chart 4 shows the estimated effects on welfare from private uses of the sale of the total government gold stock at different times. These effects are measured in terms of economic surplus (consumer surplus and producer surplus). The first column shows how welfare changes with an immediate sale versus no sale. Total welfare increases by \$368 billion because the production and use inefficiencies are eliminated. Most of the increase takes the form of government revenue in the first instance. Depletion users and service users gain, but private aboveground stock owners and mine owners lose. The second column shows how welfare changes with a sale twenty years from now versus no sale. The pattern of gains and losses is similar, but the magnitudes are somewhat different. Some may find it implausible that governments would never sell their gold, so in the third column we present the welfare effects of an immediate sale versus a sale in 2017. Total welfare is \$130 billion higher with an immediate sale because the production and use inefficiencies are eliminated at once. An important result not shown in the chart is that a large share of the welfare gain, about 37 percent, comes from eliminating the production inefficiency.

The top panel of Chart 5 shows why government revenue is higher with an immediate sale versus a sale in 2017. With an immediate sale, the dotted line, the price falls to about \$309, then increases at a rate less than the rate of interest, and reaches \$332 by 2017. It increases at a rate less than the rate of interest because the return to holding gold includes not only price appreciation but also the loan fee. If governments invest their revenue, the dot/dash line, it grows at the real rate of interest of 2.5 percent and reaches about \$506 per ounce in 2017, a level considerably above the gold price at

that time, \$332. If governments do not sell until 2017, the solid line, the price is higher over the next 20 years; as a consequence, depletion is smaller. Therefore, in 2017, after a sale, the total stock is larger, and the price, at \$317 per ounce, is lower, than they would be with an immediate sale. It follows that with an immediate sale, government revenue is about \$189 per ounce higher in 2017, as indicated by the gap between the dot-dash line and the solid line.

Governments can achieve a welfare gain roughly equal to that from an immediate sale through alternative policies. One such policy is specified in the bottom panel of Chart 5. Under this alternative policy, governments loan out all their remaining gold in each period. In the future when all gold now owned by private agents, whether above or below ground, has been used up, governments sell in every period whatever gold is necessary to make the price be what it would have been if they had sold all their gold immediately. The quantities of gold available for private uses are the same under the alternative policy as with an immediate sale. However, there is an important difference: under the alternative policy, governments relinquish title to their gold in the future and then only gradually. Therefore, to the extent that government uses can be satisfied by owning gold but not physically possessing it, most if not all of the gains associated with maximizing welfare from private uses can be obtained with little or no reduction in welfare from government uses until sometime in the future.

Up to this point, we have considered actions that might be taken by all governments acting together. Of course, one government may sell even if others do not. As shown in Chart 6, if the United States sells all its gold but other governments do not, the price is estimated to drop only to about \$340. U.S. receipts are about \$89 billion, about 10 percent higher than if all governments sold. A credible announcement by other governments that they intend to sell gold soon has almost the same effect as an immediate sale. Thus, the U.S. example illustrates the consideration that each government makes more revenue if it sells before other governments either sell or announce a sale. This

consideration may be important in explaining why some governments have made sizeable sales over the last several years and why there are rumors of future sales.

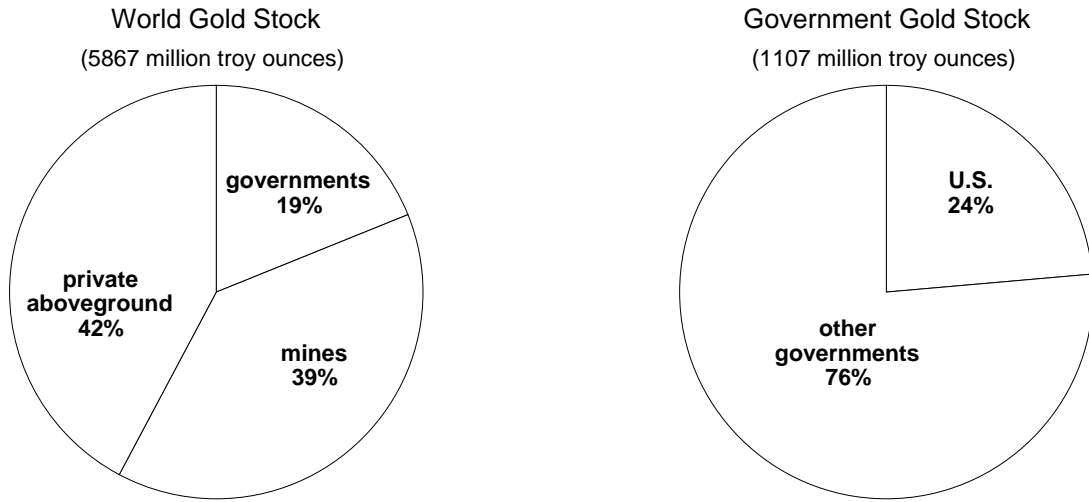
The estimate of the price drop caused by a U.S. sale reported in Chart 6 is based on the assumption that expected sales by other governments remain unchanged. One reason why the actual price drop might be larger is that a U.S. sale might cause an increase in expected sales by other governments.

Reference

Henderson, Dale, Stephen Salant, John Irons, and Sebastian Thomas, (1997), "Can Official Gold Be Put to Better Use?: Qualitative and Quantitative Effects of Alternative Policies"

Chart 1

Gold Stocks

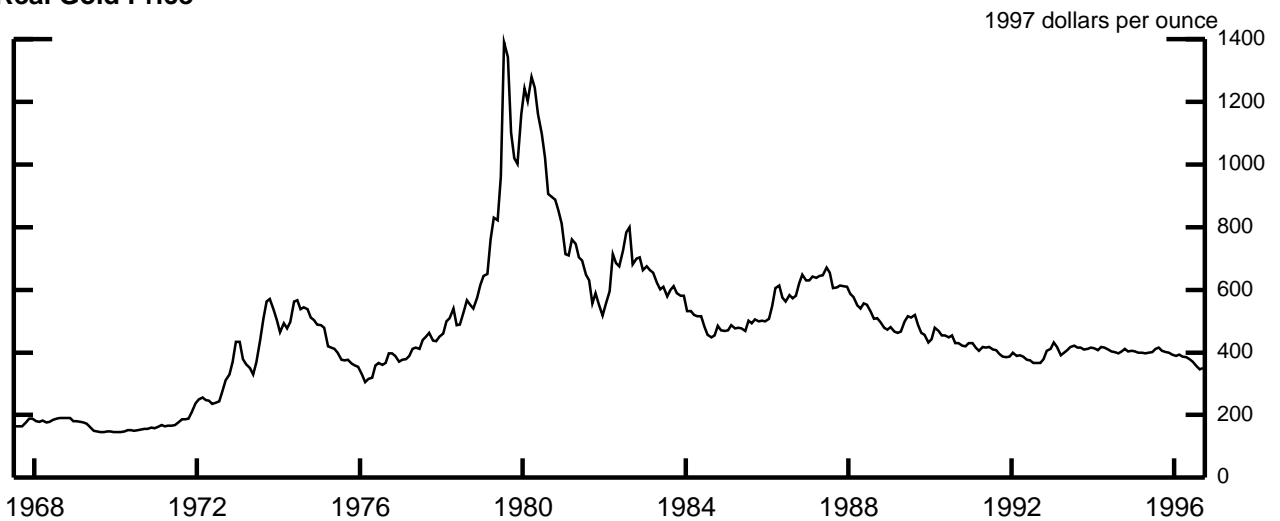


Net Sales of Government Gold
(millions of troy ounces)

Year	IMF	United States	Canada	Belgium	Netherlands	Other *	Net Sales*	Cumulative Net Sales
1974-79	21	17				2	40	40
1980-88	2		4			(38)	(32)	8
1989-96			12	21	23	8	64	72
memo:1996				7	10	(9)	7	

*numbers in () are purchases

Real Gold Price



Uses of Gold

Government Uses

- monetary asset
- part of a "war chest"
- strategic material

Private Uses

- **Depletion Uses**
 - electronics
 - other industrial uses
 - dentistry
- **Service Uses**
 - jewelry
 - bars, coins, medals

Two Important Considerations

- Total economic welfare increases if making government gold available to private agents raises welfare from private uses by more than it reduces welfare from government uses.
- Each government makes more revenue if it sells its gold before other governments either sell or announce a sale.

Two Principles for Maximizing Welfare from Private Uses

- When a resource can be obtained from one stock with no extraction cost, costly extraction from other stocks should be delayed.
Violation leads to a "production inefficiency."
- A resource that can generate welfare should not be withheld from users.
Violation leads to a "use inefficiency."

Key Relationships

1. Gold will be mined both today and tomorrow only if

$$(Net\ Revenue)_t = (Price)_t - (Cost\ of\ Extraction) > 0$$

and

$$(Net\ Revenue)_t = \frac{(Net\ Revenue)_{t+1}}{(1 + Interest\ Rate)}$$

2. Gold will be held both today and tomorrow only if

$$(Price)_t = \frac{(Price)_{t+1} + (Loan\ Fee)_{t+1}}{(1 + Interest\ Rate)}$$

or

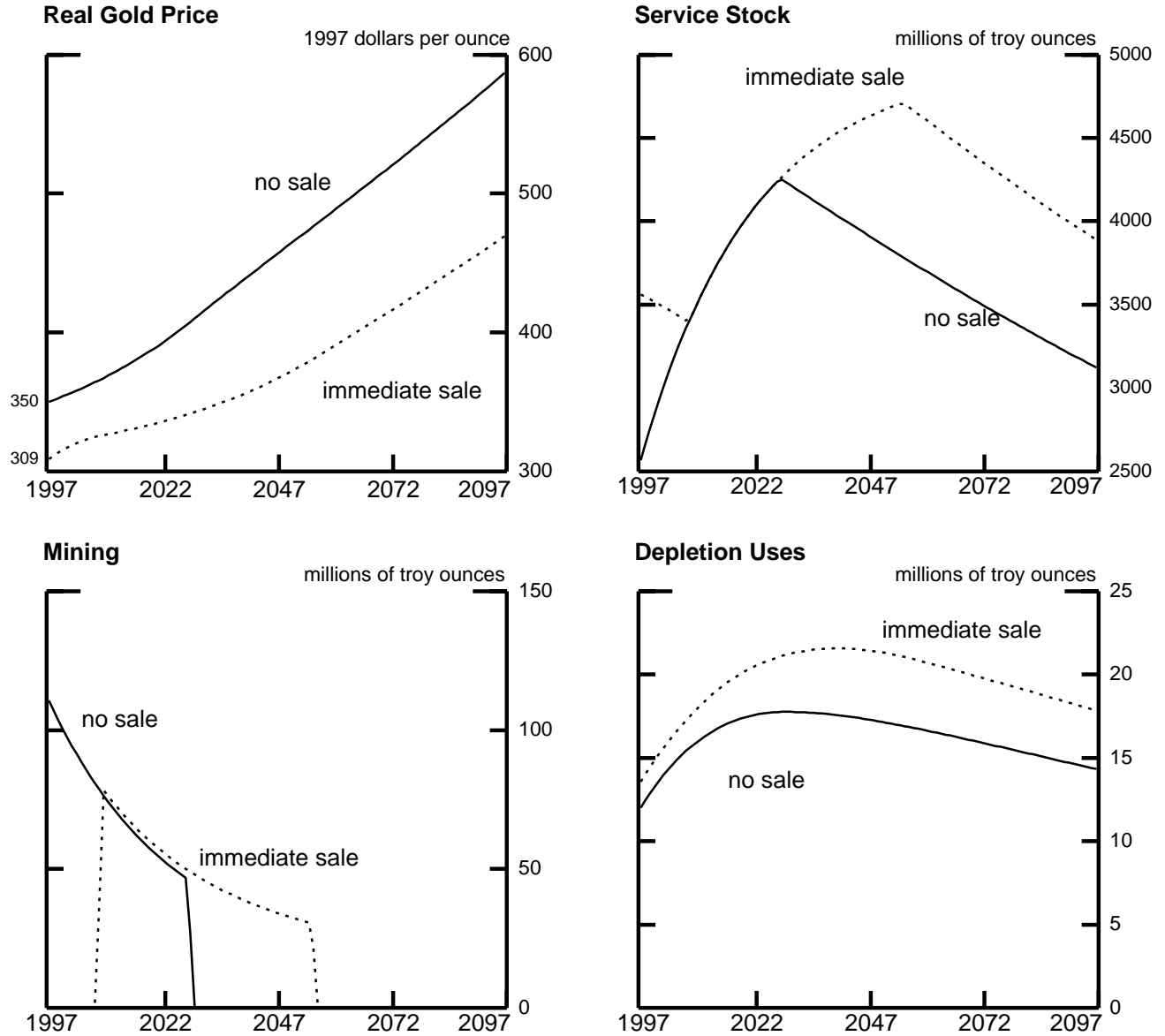
$$\frac{(Price)_{t+1} - (Price)_t}{(Price)_t} + \frac{(Loan\ Fee)_{t+1}}{(Price)_t} = Interest\ Rate$$

3. Initial price set so that sum of depletion uses from now on equals total available stock.

Numerical Assumptions

Cost of extraction	\$300 per ounce
Real interest rate	2.5%
Depletion demand	(price) ^{-0.98} x population x constant
Service demand	(loan fee) ^{-0.98} x population x constant
Population index	2 - (.96) ^{t-1} starts at one and levels off at two by about 2050

Chart 4

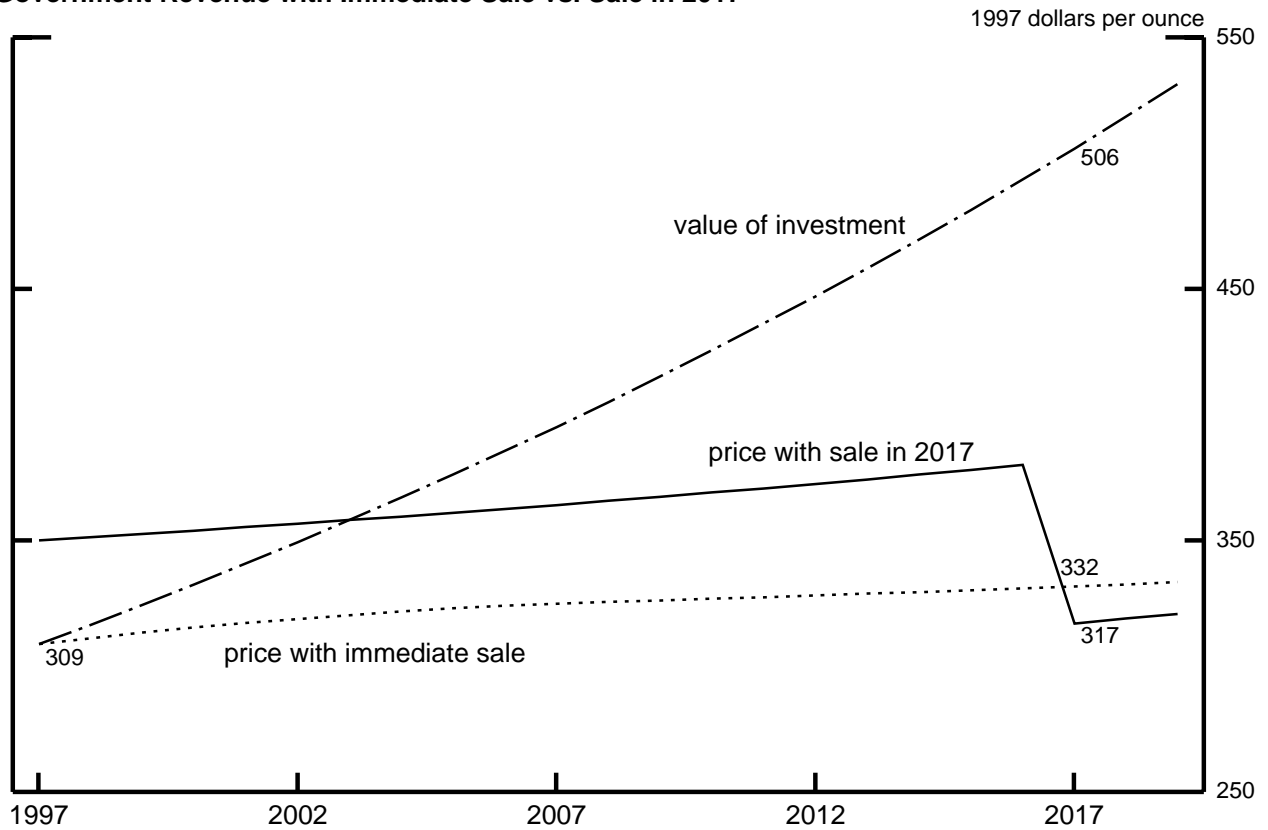


Estimated Effects on Welfare from Private Uses
(billions of 1997 dollars)

	(1) Immediate sale vs. <u>No sale</u>	(2) Sale in 2017 vs. <u>No sale</u>	(1) - (2) Immediate sale vs. <u>Sale in 2017</u>
Total	368	238	130
Government Revenue	342	214	128
Depletion Users	49	41	8
Service Users	149	155	-6
Private Aboveground Stock Owners	-102	-153	51
Mine Owners	-70	-19	-51

Chart 5

Government Revenue with Immediate Sale vs. Sale in 2017



Alternative Policy with Same Private Uses As Immediate Sale

- Governments loan out all their remaining gold in each period.
- When all gold now owned by private agents has been used up, governments sell whatever gold necessary to make price what it would have been if they had sold all their gold immediately.
- Quantities of gold available for private uses same as with immediate sale.
- Main difference is governments relinquish title to gold in future and then only gradually.
- Most of gains associated with maximizing welfare from private uses can be obtained with little or no reduction in welfare from government uses until sometime in future.

Chart 6

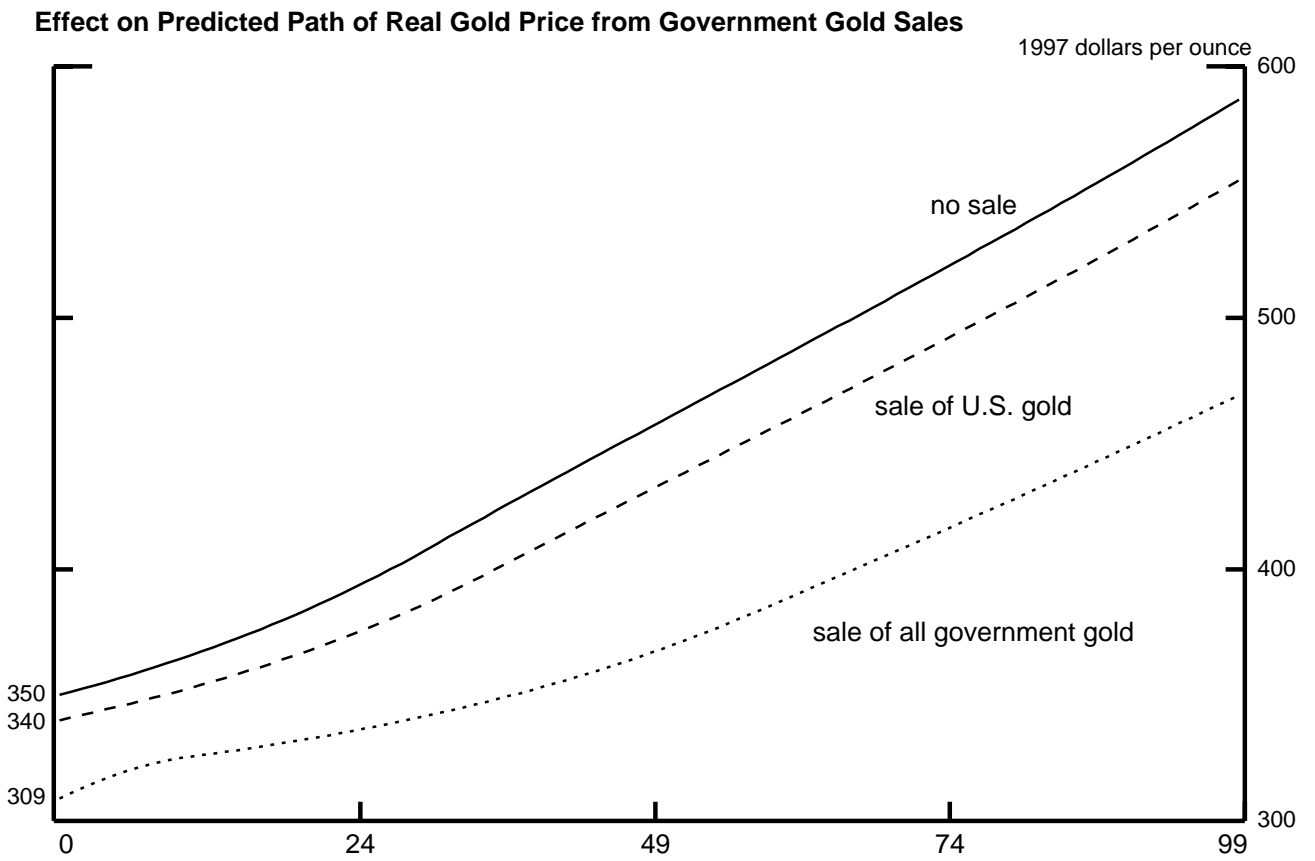


Chart A

Gold Stocks
(end 1995)

	<u>Million Troy Ounces</u>	<u>Percent</u>
Government¹	1107	19
United States	262	4
Other industrial countries, EMI, BIS	585	10
Developing countries	157	3
IMF	103	2
Private Aboveground Stock	2468	42
Jewelry	1862	32
Bars, coins, medals	607	10
Mines	2292	39
United States	196	3
South Africa	1190	20
Former Soviet Union	215	4
Other	691	12
Total	5867	100

1. End November 1996

Chart B

Depletion Uses, Increases in Service Stock, and Sources
(millions of troy ounces)

	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>Average 1993 - 95</u>
Depletion Uses	11	12	12	12
Electronics	6	6	7	6
Other industrial uses	3	3	4	3
Dentistry	2	2	2	2
Increases in Service Stock	93	95	103	97
Fabrication of jewelry	82	84	88	85
Increase in bars, coins, medals	11	11	15	12
Sources	(105)	(93)	(98)	(99)
Mining	(74)	(73)	(73)	(73)
Recycled scrap	(18)	(19)	(19)	(19)
Official sales	(16)	(3)	(6)	(8)
Gold loan repayments	2	2	1	2
Discrepancy	1	(14)	(17)	(10)

Chart C

Net Sales of Official Gold and Large Sales by Selected Holders
(millions of troy ounces)

<u>Year</u>	<u>IMF</u>	<u>United States</u>	<u>Canada</u>	<u>Belgium</u>	<u>Netherlands</u>	<u>Other *</u>	<u>Net Sales*</u>	<u>Cumulative Net Sales</u>
1974	--	--	--	--	--	0.6	0.6	--
1975	--	1.3	--	--	--	(1.0)	0.3	0.9
1976	3.9	--	--	--	--	(2.0)	1.9	2.8
1977	6.0	--	--	--	--	2.6	8.6	11.4
1978	5.9	4.1	--	--	--	1.6	11.6	23.0
1979	5.5	11.8	--	--	--	0.2	17.5	40.5
1974-79	21.3	17.2	--	--	--	2.0	40.5	40.5
1980	2.2	--	1.2	--	--	(10.8)	(7.4)	33.1
1981	--	--	--	--	--	(8.9)	(8.9)	24.2
1982	--	--	--	--	--	(2.7)	(2.7)	21.5
1983	--	--	--	--	--	4.6	4.6	26.1
1984	--	--	--	--	--	2.7	2.7	28.8
1985	--	--	--	--	--	(4.2)	(4.2)	24.6
1986	--	--	--	--	--	(4.7)	(4.7)	19.9
1987	--	--	1.2	--	--	(3.5)	(2.3)	17.6
1988	--	--	1.4	--	--	(10.6)	(9.2)	8.4
1980-88	2.2	--	3.8	--	--	(38.1)	(32.1)	8.4
1989	--	--	1.0	2.0	--	8.8	11.8	20.2
1990	--	--	1.3	--	--	(1.0)	0.3	20.5
1991	--	--	1.8	--	--	(1.0)	0.8	21.3
1992	--	--	3.0	6.5	12.9	(2.4)	20.0	41.3
1993	--	--	3.9	--	--	10.4	14.3	56.6
1994	--	--	--	--	--	2.5	2.5	58.1
1995	--	--	0.5	5.6	--	0.4	6.5	64.6
1996	--	--	--	6.5	9.6	(9.4)	6.7	71.3
1989-96	--	--	11.5	20.6	22.5	8.3	62.9	71.3

*numbers in () are purchases