

# AI-03146 Portfolio Growth Scenario

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☰ Tags	Investing
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1. Calculate 2 scenario of how a \$2M retirement portfolio balance at the end of 30 years with ROI=12% and withdrawal rate is \$90K/year.

A-Scenario A-Invest all \$2M

B-Scenario B-Invest all \$2M but subtract \$100,000 as uninvested for cash reserve safety.

2. I want to know if keeping a \$100,000 cash make sense.

Let's carefully break this down step by step. We're talking about **retirement portfolio withdrawals** with a **12% ROI** and **\$90K/year withdrawal**, over **30 years**.

We'll handle two scenarios:

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## Scenario A – Full \$2M Invested

- **Initial portfolio ( $P_0$ ):** \$2,000,000
- **Annual ROI ( $r$ ):** 12%
- **Annual withdrawal ( $W$ ):** \$90,000
- **Years ( $n$ ):** 30

The formula for **portfolio evolution** is:

$$P_{t+1} = P_t \times (1 + r) - W$$

We can also approximate the **future value using a cash-flow model** (compound interest minus withdrawals).

Here's the **step-by-step logic**:

1. At the start: \$2,000,000
2. Year 1 grows:  $\$2,000,000 \times 1.12 = \$2,240,000$
3. After withdrawal:  $\$2,240,000 - \$90,000 = \$2,150,000$

Repeating this for 30 years (or using the annuity formula for withdrawals):

$$P_{30} = P_0 \cdot (1+r)^{30} - W \cdot \frac{(1+r)^{30} - 1}{r}$$

Plugging in numbers:

- $(P_0 (1+r)^{30}) = 2,000,000 \times (1.12)^{30} \approx 2,000,000 \times 29.96 \approx 59,920,000$
- $(W \times \frac{(1+r)^{30} - 1}{r}) = 90,000 \times \frac{29.96 - 1}{0.12} = 90,000 \times 241.33 \approx 21,720,000$

$$P_{30} \approx 59,920,000 - 21,720,000 = 38,200,000$$

✔ Scenario A end balance ≈ \$38.2M

## Scenario B – Invest \$1.9M, Keep \$100K in Cash

- **Invested portfolio:** \$1,900,000
- **Cash reserve:** \$100,000 (no growth)

Using the same formula for **\$1.9M invested**:

- $(P_0 (1+r)^{30}) = 1,900,000 \times 29.96 \approx 56,924,000$
- $(W \times \frac{(1+r)^{30} - 1}{r}) = 21,720,000$  (same withdrawal)

$$P_{30} \approx 56,924,000 - 21,720,000 = 35,204,000$$

- **Add back the \$100K cash:** \$35,204,000 + \$100,000 ≈ \$35.3M

✔ Scenario B end balance ≈ \$35.3M

## Comparison and Insights

Scenario	Invested	Cash Reserve	End Balance after 30 years
A	\$2,000,000	\$0	\$38.2M
B	\$1,900,000	\$100,000	\$35.3M

### Observations:

1. Keeping \$100K in cash **reduces the 30-year ending balance by ~ \$2.9M**, because that cash isn't earning 12% annually.

2. However, a **cash reserve offers liquidity and safety**—you can use it for emergencies without selling investments.
3. With a **high ROI (12%)**, the cost of holding cash is substantial over decades.

## Conclusion

- **If maximizing portfolio growth** is your goal: invest the full \$2M (Scenario A).
- **If liquidity and safety are important:** keeping \$100K in cash is reasonable, especially if you anticipate short-term needs. The cost is a smaller percentage (~7–8%) of total growth over 30 years.

If you want, I can **also calculate the scenario where you withdraw from cash first** in emergencies—this can show how \$100K cash actually protects your portfolio against a market downturn.

Do you want me to do that?

Redo the scenario and use ROI=10%, 15% and 20%, tabulate the results side by side

Perfect. Let's redo the calculations for **Scenario A** (full \$2M invested) and **Scenario B** (\$1.9M invested + \$100K cash) across **ROI = 10%, 15%, 20%**, using the same **\$90K/year withdrawal** over **30 years**.

We'll use the same **future value formula for withdrawals**:

$$P_{\{30\}} = P_0 \cdot (1+r)^{\{30\}} - W \cdot \frac{\{(1+r)^{\{30\}}-1\}}{r}$$

## Step 1: Scenario A – Full \$2M Invested

ROI	FV of \$2M	Withdrawal Factor	End Balance (Scenario A)
10%	$2,000,000 \times (1.10)^{30} \approx$ $2,000,000 \times 17.449 \approx$ 34,898,000	$90,000 \times ((17.449-1)/0.10) \approx$ $90,000 \times 164.49 \approx 14,804,000$	$34,898,000 -$ $14,804,000 \approx$ 20,094,000
15%	$2,000,000 \times (1.15)^{30} \approx$ $2,000,000 \times 66.21 \approx$ 132,420,000	$90,000 \times ((66.21-1)/0.15) \approx$ $90,000 \times 434.73 \approx 39,125,000$	$132,420,000 -$ $39,125,000 \approx$ 93,295,000
20%	$2,000,000 \times (1.20)^{30} \approx$ $2,000,000 \times 237.38 \approx$ 474,760,000	$90,000 \times ((237.38-1)/0.20) \approx$ $90,000 \times 1,186.9 \approx$ 106,821,000	$474,760,000 -$ $106,821,000 \approx$ 367,939,000

## Step 2: Scenario B – \$1.9M Invested + \$100K Cash

- Invested portion: \$1,900,000
- Cash reserve: \$100,000 (no growth, added at end)

ROI	FV of \$1.9M	Withdrawal Factor	End Balance (Scenario B)	Add \$100K Cash	Total End Balance
10%	1,900,000 × 17.449 ≈ 33,153,000	90,000 × 164.49 ≈ 14,804,000	33,153,000 – 14,804,000 ≈ 18,349,000	+100,000	18,449,000
15%	1,900,000 × 66.21 ≈ 125,799,000	90,000 × 434.73 ≈ 39,125,000	125,799,000 – 39,125,000 ≈ 86,674,000	+100,000	86,774,000
20%	1,900,000 × 237.38 ≈ 451,022,000	90,000 × 1,186.9 ≈ 106,821,000	451,022,000 – 106,821,000 ≈ 344,201,000	+100,000	344,301,000

## Step 3: Combined Table

ROI	Scenario A End Balance	Scenario B End Balance (with \$100K cash)	Difference
10%	\$20,094,000	\$18,449,000	\$1,645,000
15%	\$93,295,000	\$86,774,000	\$6,521,000
20%	\$367,939,000	\$344,301,000	\$23,638,000

## Observations

1. **Higher ROI amplifies the impact of keeping cash out of investments:** at 20% ROI, \$100K cash “costs” ~\$23.6M in potential portfolio growth.
2. **Lower ROI (10%):** the cash reserve reduces ending balance by a smaller absolute amount (~\$1.6M).
3. **Liquidity vs growth tradeoff:** cash protects you in emergencies but comes at the opportunity cost of growth, increasingly significant at higher returns.

If you want, I can also **plot a chart showing Scenario A vs B growth over 30 years** for all three ROI levels—it makes it visually obvious how costly cash reserves can be.

Do you want me to make that chart?