What Explains Bank Asset Growth Since the Global Financial Crisis?

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Technical Appendix

Appendix A

Selected Cumulative Growth Rates

Table A-1: Cumulative Bank Asset Growth, 2010:Q2–2024:Q4

		Reported		Merger-adjusted (MA)		MA-CAGR	
Bank classification	Organizations (1)	Nominal (2)	Real (3)	Nominal (4)	Real (5)	Nominal (6)	Real (7)
GSIB	8	97.86	40.00	91.16	35.26	4.49	2.09
>$100 billion	9	108.61	47.60	57.69	11.58	3.15	0.76
$50–$100 billion	7	144.39	72.92	93.47	36.89	4.58	2.17
$10–$50 billion	21	207.32	117.45	101.77	42.76	4.87	2.46
<$10 billion	3,056	103.19	43.77	87.31	32.54	4.35	1.95

Table A-2: Cumulative Bank Asset Growth, 2010:Q2–2021:Q4

		Reported		Merger-adjusted (MA)		MA-CAGR	
Bank classification	Organizations (1)	Nominal (2)	Real (3)	Nominal (4)	Real (5)	Nominal (6)	Real (7)
GSIB	8	95.09	54.68	95.09	54.68	5.85	3.81
>$100 billion	9	98.62	57.48	56.49	24.07	3.91	1.88
$50–$100 billion	7	133.13	84.84	74.44	38.31	4.87	2.83
$10–$50 billion	21	136.38	87.42	77.31	40.58	5.01	2.97
<$10 billion	3,056	86.93	48.21	74.83	38.61	4.88	2.85

Table A-3: Cumulative Bank Asset Growth, 2021:Q4–2024:Q4

		Reported		Merger-adjusted (MA)		MA-CAGR	
Bank classification	Organizations (1)	Nominal (2)	Real (3)	Nominal (4)	Real (5)	Nominal (6)	Real (7)
GSIB	8	3.40	−7.72	1.93	−9.04	0.64	−3.14
>$100 billion	9	−1.02	−11.67	−2.87	−13.31	−0.97	4.74
$50–$100 billion	7	4.97	−6.32	0.26	−10.52	0.09	−3.69
$10–$50 billion	21	18.30	5.57	5.32	−6.01	1.73	−2.06
<$10 billion	3,056	8.13	−3.50	7.25	−4.28	2.34	−1.46

Appendix B

Derivation of Growth Rates and the Effect of Inflation

This section includes definitions and derivations for the growth rates used in this article along with an explanation of how using log terms rather than growth rates affects our measure of the effect of inflation.

Derivation of cumulative, merger-adjusted growth rates

Define the lagged merger-adjusted level as:

$$X_{t-1} = X_{t-1}^{s} + X_{t-1}^{NS}$$

where X_{t-1}^{S} and X_{t-1}^{NS} denote lagged survivor and non-survivor end-of-period assets, respectively.

Define cumulative growth from period $t - N$ to period t as:

$$g_t^C = \left[\frac{X_t}{X_{t-N}} - 1\right]$$

The cumulative growth rate formula can be rewritten as:

$$g_t^C = \left[\frac{X_t}{X_{t-1}} \times \frac{X_{t-1}}{X_{t-2}} \times \cdots \times \frac{X_{t-N+1}}{X_{t-N}} - 1\right]$$

The formula can be expanded again as:

$$g_t^C = \left[\left(1 + \frac{X_t}{X_{t-1}} - 1\right) \times \cdots \times \left(1 + \frac{X_{t-N+1}}{X_{t-N}} - 1\right) - 1\right]$$

Note that this expression is a function of merger-adjusted quarterly growth rates denoted by:

$$g_{t-N}^{Q} = \left[\frac{X_{t-N}}{X_{t-N-1}} - 1\right]$$

Hence,

$$g_t^C = \left[\left(1 + g_t^Q\right) \times \cdots \times \left(1 + g_{t-N+1}^Q\right) - 1\right]$$

$$g_t^C = \prod_{i=0}^{N+1}(1 + g_{t-i}^Q) - 1$$

where $g_{t-i}$is the merger-adjusted quarterly growth rate in period $t - i$. The growth rate can be expressed in percentage terms by multiplying by 100.

Derivation of cumulative average growth rates (CAGR)

Define the level of a variable at time t as X_t.

The CAGR over an interval N is defined as the geometric mean denoted by:

$$CAGR_{t+N} = 100 * \left[\left(\frac{X_{t+N}}{X_t}\right)^{-N} - 1\right]$$

The cumulative level at time $t + N$ can be derived as:

$$X_{t+N} = X_t\left[\left(1 + \frac{X_{t+1}}{X_t} - 1\right)\left(1 + \frac{X_{t+2}}{X_{t+1}} - 1\right)\cdots\left(1 + \frac{X_{t+N}}{X_{t+N-1}} - 1\right)\right]$$

Period level growth rates are given by:

$$r_{t+N} = \frac{X_{t+N}}{X_{t+N-1}} - 1$$

So the cumulative level from time t to time $t + N$ is given by:

$$X_{t+N} = X_t[(1 + r_{t+1})(1 + r_{t+2})\cdots(1 + r_{t+N})]$$

The CAGR can be rewritten as:

$$CAGR_{t+N} = 100 * \left[\left(\frac{1}{X_t} * X_t(1 + r_{t+1})(1 + r_{t+2})\cdots(1 + r_{t+N})\right)^{-N} - 1\right]$$

$$CAGR_{t+N} = 100 * [(1 + r_{t+1})(1 + r_{t+2})\cdots(1 + r_{t+N})^{-N} - 1]$$

$$CAGR_{t+N} = 100 * \left(\left[\prod_{i=1}^{N}(1 + r_{t+i})\right]^{-N} - 1\right)$$

Impact of inflation on log differences versus growth rates

Log terms

Define the real level of a variable at time t as r_t. The log-differences approximation of growth is:

$$g_t^r = ln\left(\frac{r_t}{r_{t-1}}\right)$$

Define the price deflator at time t as d_t. The rate of inflation is given by:

$$\pi = ln\left(\frac{d_t}{d_{t-1}}\right)$$

The nominal level at time t is given by $r_t d_t$. The nominal growth rate is:

$$g_t = ln\left(\frac{r_t d_t}{r_{t-1} d_{t-1}}\right)$$

We can see that the relationship between real and nominal growth rates is constant by rewriting:

$$g_t = ln\left(\frac{r_t}{r_{t-1}}\right) + ln\left(\frac{d_t}{d_{t-1}}\right)$$

So that:

$$g_t = g_t^r + \pi$$

And

$$g_t - g_t^r = \pi$$

So the difference between the nominal and real growth rates is the inflation rate.

Growth rate terms

Define the real level of a variable at time t as r_t. The real growth rate is defined as:

$$g_t^r = \frac{r_t}{r_{t-1}} - 1$$

Define the price deflator at time t as d_t. The rate of inflation is given by:

$$\pi = \frac{d_t}{d_{t-1}} - 1$$

The nominal level at time t is given by $r_t d_t$. The nominal growth rate is:

$$\mathrm{g_t} = \frac{r_t d_t}{r_{t-1} d_{t-1}} - 1$$

Rewrite each term:

$$(1 + g_t^r) = \frac{r_t}{r_{t-1}}$$

$$(1 + \pi) = \frac{d_t}{d_{t-1}}$$

$$(1 + g_t) = \frac{r_t}{r_{t-1}} \frac{d_t}{d_{t-1}}$$

We can write:

$$(1 + g_t^r)(1 + \pi) = \frac{r_t}{r_{t-1}} \frac{d_t}{d_{t-1}}$$

$$(1 + g_t^r)(1 + \pi) = (1 + g_t)$$

We can expand and solve to find the relationship between real and nominal growth rates:

$$1 + \pi + g_t^r + g_t^r \pi = 1 + g_t$$

$$g_t - g_t^r = \pi + g_t^r \pi$$

$$g_t - g_t^r = \pi(1 + g_t^r)$$

$$g_t - g_t^r = \pi \frac{r_t}{r_{t-1}}$$

so the difference in nominal and real growth rates is dependent on the relative real levels.