THE DYNAMICS OF US SWAP YIELDS: A KEYNESIAN PERSPECTIVE

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HIGHLIGHTS

- Keynes claimed that the central bank's policy rate and other monetary policy actions influence the long-term government bond yields via the short-term interest rate.

- This conjecture is supported in the empirical literature: (Akram and Li 2017, 2022), Deleidi and Levrero (2021), and Gabrish (2022).

- However, does Keynes's claim hold for long-term US dollar interest swap yields? That is, does the short-term interest rate have a decisive influence on long-term interest rate swap yields?

HIGHLIGHTS

- We analyze US interest rate swap yields to examine whether Keynes conjecture holds.

- We find that the change in the short-term interest rate has decisive influence on the change in the long-term swap yield, after controlling for other macroeconomic factors, such as the change in core inflation, the change in the growth of industrial production, the percentage change in the equity index, and the percentage change in the exchange rate of the US dollar.

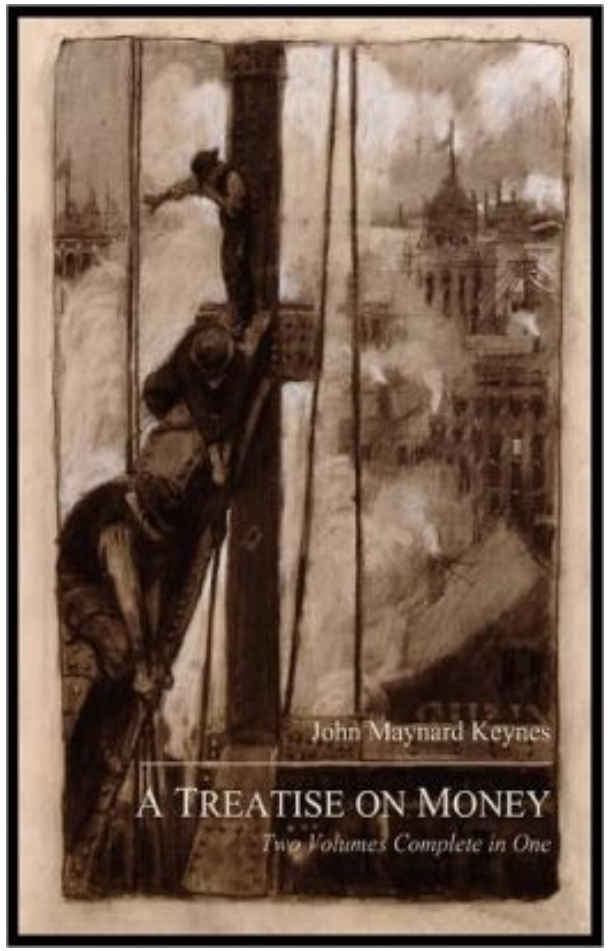
KEYNES ON THE DETERMINANTS OF THE LONG-TERM GOVT BOND YIELD

Monetary policy drives the long-term interest rate through the short-term interest rate.

- "The influence of the short-term rate of interest on the long-term rate is much greater than anyone ... would have expected" (Keynes, 1930, *Treatise on Money*, Vol II, p.315).
- "Short-term rates influence long-term rate more than the reader might expect … it is not difficult to find sufficient explanation for this observed fact." (1930, *ToM*, Vol II, p. 362)
- "There is no reason to doubt the ability of a Central Bank to make its short-term rate of interest effective in market." (1930, *ToM*, Vol II, p 363).

KEYNES ON THE IMPORTANCE OF THE POLICY RATE

- **"The efficacy of the Bank rate for the management of a managed money was a great discovery … its application in varying conditions were not clearly understood — and have not been clearly understood to this day."** (Keynes 1930, *ToM*, Vol I, p.17).



W. W. RIEFLER'S EMPIRICAL STUDIES PROMPTED KEYNES'S VIEWS

"[T]he surprising fact is not that [long-term] bond yields are relatively stable in comparison to short-term [interest] rates, but they have reflected fluctuations in short-term [interest] rates so strikingly and to a such a considerable extent."

---**Winfield W. Riefler** (1930, 123) cited in Keynes (1930, II: 354-355)

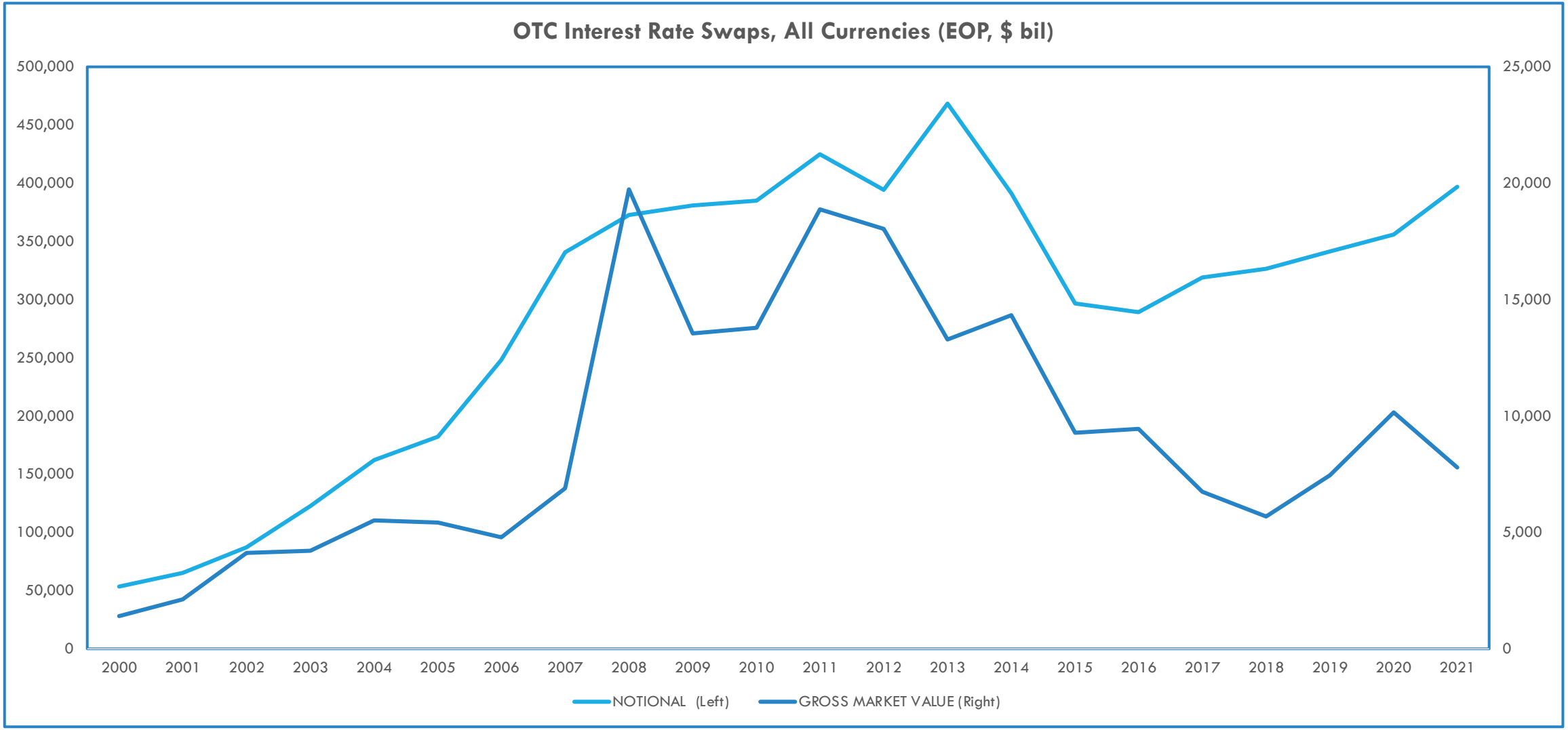
KEYNES ON THE POWER OF THE CENTRAL BANK AND ITS LIMITS

- "The short-term interest rate is easily controlled by the monetary authority. … But the long-term rate may be more recalcitrant" (*General Theory*, 2007 [1936]], 202-203).
- "If the monetary authority were prepared to deal both ways on the specified terms in debt of all maturities, and … in debts of varying degrees of risks, the relationship with the complex rate of interest and the quantities of the money would be direct" (*GT*, 2007 [1936], 205)
- "A complex offer by the central bank to buy and sell at stated prices gilt-edged bonds of all maturities, in place of the single bank rate for short-term bills, is the most important practical improvement that can be made in the technique of monetary management. " (*GT*, 2007 [1936], 206).

INTEREST RATE SWAPS ARE IMPORTANT

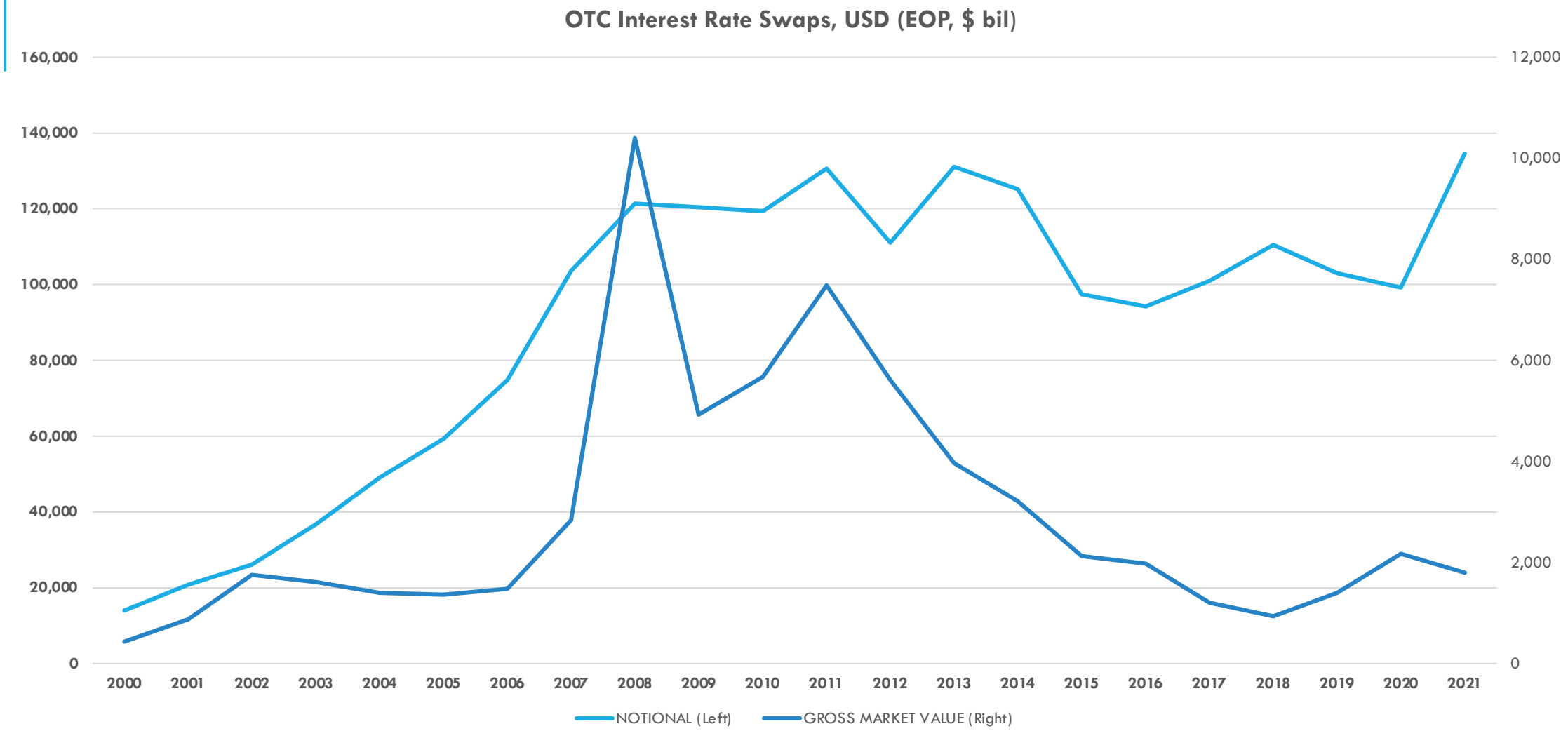
- The total amount of outstanding interest rate swaps, as of 2021, in all currencies, was: almost $400 trillion (in USD) in notional terms, and $8 trillion in gross market value.
- The total amount of outstanding US dollar interest rate swaps, as of 2021, was more than $135 trillion in notional terms, and around $1.8 trillion in gross market value.
- Interest rate swaps are an important part of the over-the-counter (OTC) derivatives in global financial markets and the global financial market.

GROSS MARKET VALUE OF INTEREST RATE SWAPS ~$8.0 TRILLION IN 2021



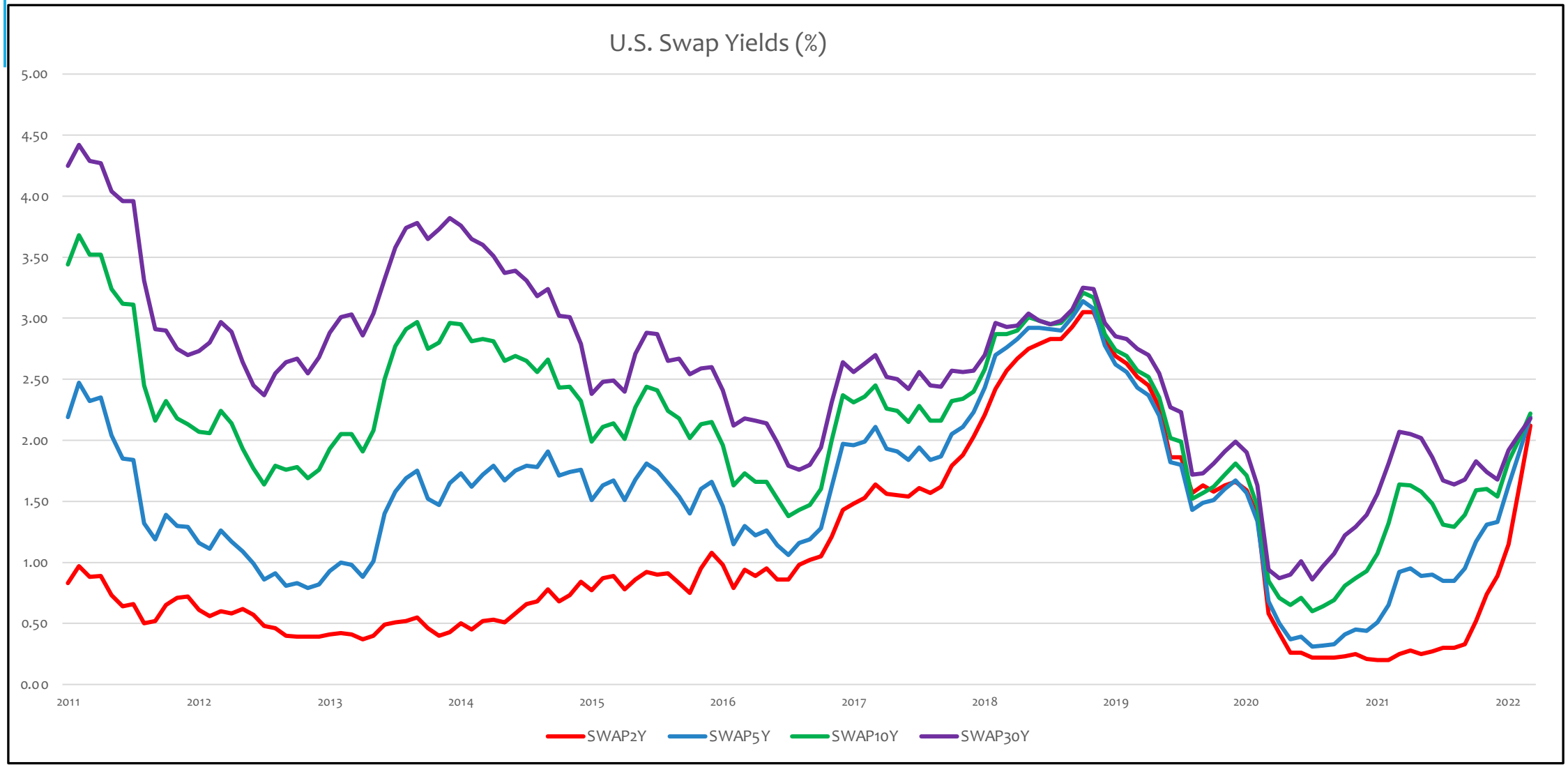
Source: Bank of International Settlements (BIS) 2022.

THE GROSS MARKET VALUE OF USD SWAPO AMOUNTED TO >$2.0 TRILLION

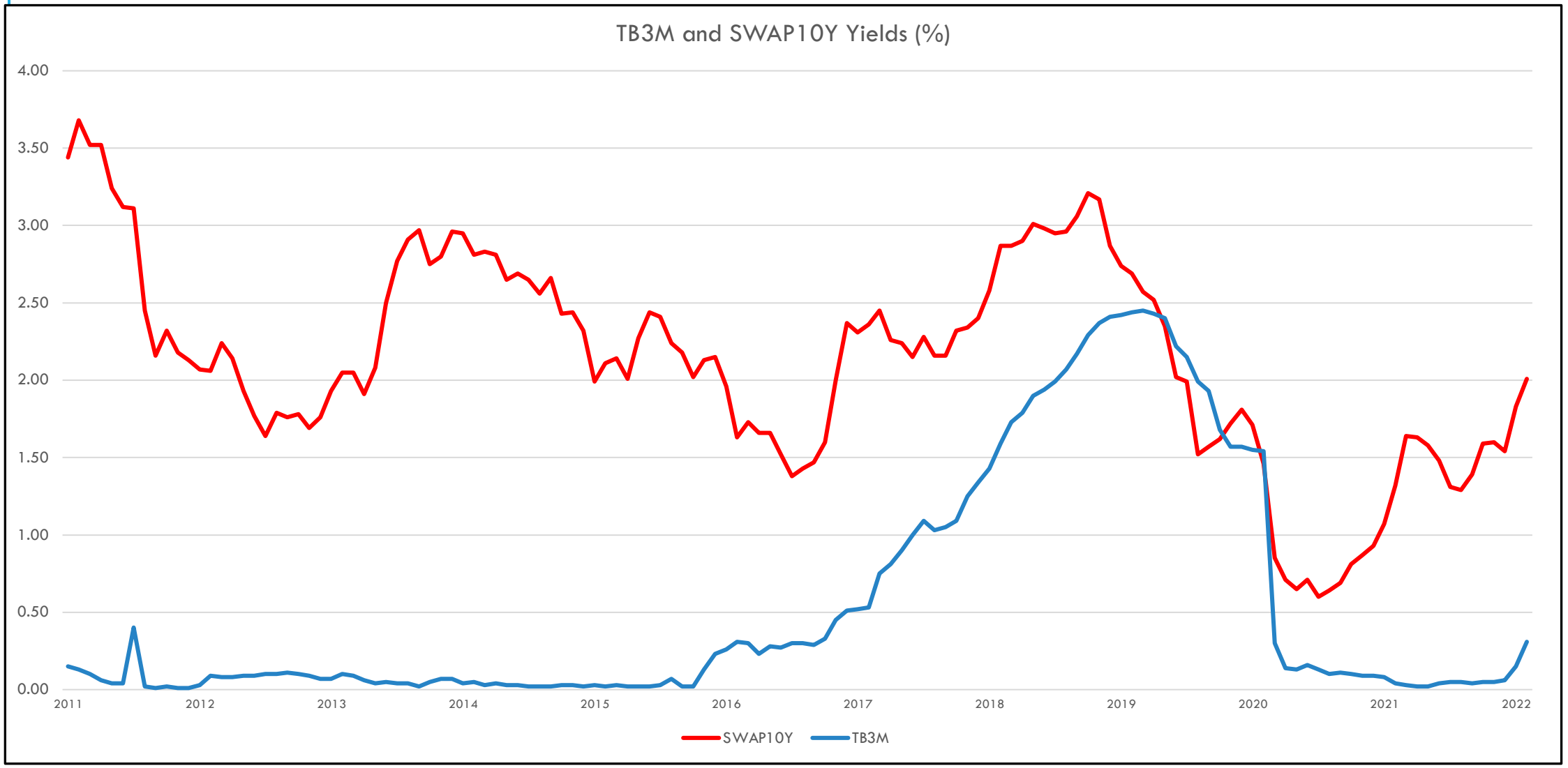


Source: Bank of International Settlements (BIS) 2022.

THE EVOLUTION OF US INTEREST RATE SWAPS, 2011-2022



THE COEVOLUTION OF THE 3-MONTH TREASURY AND THE 10YR SWAP YIELDS



MONTHLY DATA & DATA SOURCES

- **Swap yields:** SWAP2Y, SWAP5Y, SWAP10Y, SWAP30Y
- **Short-term interest rate:** TB3M and TB6M (%)
- **Inflation:** CORECPI (% change, YoY), CPI (% change, YoY)
- **Economic activity:** IPYOY (% change, YoY)
- **Financial variables:** YEN(¥/$), EURO($/€), DJIA, S&P500, VIX (index)
- **Monthly data:** January 2011 to March 2022 (134 observations)
- **Sources:** Federal Reserve Bank (FED), Tullet Prebon Information, Bureau of Economic Analysis (BEA), Bureau of Labor Statistics (BLS), Wall Street Journal (WSJ), Standard and Poor's

EMPIRICAL FINDINGS: Summary Statistics at Level

	Obs	Mean	Std. Dev.	Max	Min	Skewness	Kurtosis	JB	Probability
SWAP2Y	134	1.05	0.77	3.05	0.20	1.13	3.23	28.56	0.00
SWAP5Y	134	1.56	0.66	3.14	0.31	0.31	2.79	2.41	0.30
SWAP10Y	134	2.13	0.67	3.68	0.60	-0.18	2.74	1.09	0.58
SWAP30Y	134	2.58	0.77	4.42	0.86	-0.04	2.93	0.07	0.97
TB3M	134	0.55	0.78	2.45	0.01	1.35	3.28	41.38	0.00
TB6M	134	0.61	0.80	2.54	0.04	1.30	3.17	37.67	0.00
COREPCE	134	1.83	0.76	5.40	0.91	2.91	11.84	625.56	0.00
CORECPI	134	2.13	0.85	6.41	0.95	2.95	12.66	715.30	0.00
IPYOY	134	0.96	4.31	17.81	-17.69	-0.57	8.76	192.78	0.00
LNYEN	134	4.64	0.13	4.82	4.34	-1.08	2.97	25.82	0.00
LNEURO	134	0.19	0.09	0.37	0.05	0.47	1.96	10.85	0.00
LNDIJA	134	9.89	0.33	10.49	9.32	0.11	1.94	6.54	0.04
LNSP500	134	7.71	0.36	8.45	7.07	0.14	2.28	3.36	0.19
LNVIX	134	2.83	0.31	4.06	2.32	1.01	4.54	35.92	0.00

EMPIRICAL FINDINGS: Summary Statistics at First Diff.

	Obs	Mean	Max	Min	Std. Dev	Skewness	Kurtosis	JB	Probability
ΔSWAP2Y	133	0.01	0.47	-0.80	0.13	-1.66	13.91	720.68	0.00
ΔSWAP5Y	133	0.00	0.39	-0.66	0.16	-0.67	4.95	30.95	0.00
ΔSWAP10Y	133	-0.01	0.42	-0.66	0.17	-0.55	4.73	23.18	0.00
ΔSWAP30Y	133	-0.02	0.37	-0.69	0.17	-0.88	5.23	44.68	0.00
ΔTB3M	133	0.00	0.36	-1.24	0.13	-6.24	59.76	18714.27	0.00
ΔTB6M	133	0.00	0.31	-1.21	0.13	-6.36	62.96	20820.06	0.00
ΔCOREPCE	133	0.03	1.11	-0.79	0.17	1.45	17.06	1142.47	0.00
ΔCORECPI	133	0.04	1.31	-0.66	0.21	2.32	14.74	883.01	0.00
ΔIPYOY	133	0.02	15.96	-12.35	2.23	1.60	28.90	3774.27	0.00
ΔLNYEN	133	0.00	0.07	-0.04	0.02	0.79	4.41	24.90	0.00
ΔLNEURO	133	0.00	0.04	-0.06	0.02	-0.34	3.65	4.98	0.08
ΔLNDIJA	133	0.01	0.11	-0.23	0.04	-2.44	17.95	1370.40	0.00
ΔLNSP500	133	0.01	0.09	-0.21	0.03	-2.47	16.58	1157.36	0.00
ΔLNVIX	133	0.00	1.08	-0.37	0.20	1.69	9.77	317.60	0.00

EMPIRICAL FINDINGS: Unit root tests and Stationarity tests

	ADF Unit Root Tests (H_0: Nonstationary)			PP Unit Root Tests (H_0: Nonstationary)			KPSS Tests (H_0: Stationarity)	
	None	Intercept	Trend	None	Intercept	Trend	Intercept	Trend
SWAP2Y	– 0.28	– 1.54	– 1.91	– 0.48	– 1.47	– 1.72	0.35*	0.17**
SWAP5Y	– 0.91	– 2.14	– 2.08	– 0.77	– 2.05	– 1.94	0.14	0.14*
SWAP10Y	– 1.35	– 2.92**	– 2.66	– 1.18	– 2.49	– 2.34	0.45*	0.08
SWAP30Y	– 1.53	– 2.82*	– 3.03	– 1.45	– 2.36	– 2.53	0.89***	0.05
TB3M	– 0.88	– 1.22	– 1.12	– 1.05	– 1.38	– 1.33	0.45*	0.16**
TB6M	– 0.77	– 1.28	– 1.36	– 0.96	– 1.45	– 1.53	0.46*	0.17**
COREPCE	1.05	0.01	– 0.48	2.27	2.18	1.40	0.46*	0.15**
CORECPI	1.13	– 0.72	– 1.50	2.05	1.62	0.86	0.51**	0.14*
IPYOY	– 2.38**	– 2.41	– 2.40	– 3.01***	– 3.10**	– 3.04	0.16	0.07
LNYEN	1.13	– 1.54	– 1.69	1.14	– 1.51	– 1.62	0.80***	0.28***
LNEURO	– 1.53	– 1.74	– 2.13	– 1.34	– 1.65	– 2.17	0.85***	0.20**
LNDIJA	2.67	– 0.36	– 3.45**	4.15	– 0.05	– 3.43**	1.42***	0.06
LNSP500	3.47	– 0.05	– 2.78	3.96	0.16	– 2.68	1.39***	0.11
LNVIX	– 0.19	– 3.73***	– 3.80**	0.30	– 3.57***	– 3.64**	0.28	0.23***

Note: Significance levels *** for 1%, ** for 5% and * for 10%

EMPIRICAL FINDINGS: Unit root tests and Stationarity tests (First Difference)

	ADF Unit Root Tests (H_0: Nonstationary)			PP Unit Root Tests (H_0: Nonstationary)			KPSS Tests (H_0: Stationarity)	
	None	Intercept	Trend	None	Intercept	Trend	Intercept	Trend
ΔSWAP2Y	– 6.29***	– 6.29***	– 6.32***	– 6.49***	– 6.49***	– 6.68***	0.10	0.10
ΔSWAP5Y	– 8.32***	– 8.29***	– 8.38***	– 8.47***	– 8.44***	– 8.52***	0.12	0.10
ΔSWAP10Y	– 8.30***	– 8.29***	– 8.37***	– 8.32***	– 8.29***	– 8.37***	0.12	0.08
ΔSWAP30Y	– 7.92***	– 7.95***	– 8.01***	– 7.92***	– 7.95***	– 8.01***	0.11	0.06
ΔTB3M	– 9.69***	– 9.66***	– 9.64***	– 9.96***	– 9.93***	– 9.91***	0.14	0.12*
ΔTB6M	– 8.43***	– 8.41***	– 8.37***	– 8.71***	– 8.69***	– 8.65***	0.11	0.10
ΔCOREPCE	– 4.68***	– 4.80***	– 5.08***	– 7.15***	– 7.31***	– 7.43***	0.45*	0.21**
ΔCORECPI	– 3.13***	– 3.30**	– 3.41*	– 5.51***	– 5.49***	– 5.29***	0.48**	0.22***
ΔIPYOY	– 5.57***	– 5.53***	– 5.57***	– 9.18***	– 9.12***	– 9.20***	0.10	0.05
ΔLNYEN	– 8.29***	– 8.38***	– 8.37***	– 8.33***	– 8.34***	– 8.32***	0.12	0.08
ΔLNEURO	– 8.74***	– 8.77***	– 8.74***	– 8.90***	– 8.90***	– 8.86***	0.06	0.05
ΔLNDIJA	– 11.18***	– 11.71***	–11.68***	– 11.18***	–12.59***	– 12.62***	0.07	0.05
ΔLNSP500	–10.34***	– 9.70***	– 9.70***	–10.31***	– 11.16***	– 11.24***	0.08	0.05
ΔLNVIX	–12.07***	–12.03***	–12.00***	–16.91***	–16.87***	–18.46***	0.18	0.11

Note: Significance levels *** for 1%, ** for 5% and * for 10%

ECONOMETRIC METHOD

Autoregressive Distributed Lag Model (ARDL)

$$\Delta y_t = \beta_0 + \beta_1 \Delta y_{t-1} + \ldots\ldots + \beta_k \Delta y_{t-p} + \alpha_0 \Delta x_t + \alpha_1 \Delta x_{t-1} + \ldots\ldots\ldots + \alpha_q \Delta x_{t-q} + \varepsilon_t$$

where y and x are the swap and treasury rates respectively and ε_t is a random "disturbance" term.

We adopt the ARDL model:

- No ARCH effect
- No Bidirectional relationship
- No Cointegrating relationship

ECONOMETRIC MODELS

Basic Models

- $\Delta SWAP2Y = F^{1}(\Delta TB3M)$
- $\Delta SWAP5Y = F^{2}(\Delta TB3M)$
- $\Delta SWAP10Y = F^{3}(\Delta TB3M)$
- $\Delta SWAP30Y = F^{3}(\Delta TB3M)$

Extended Models

- $\Delta SWAP2Y = F^{7}(\Delta TB3M, \Delta COREPCE, \Delta IPTYOY, \Delta LNSP500, \Delta LNEURO)$
- $\Delta SWAP5Y = F^{8}(\Delta TB3M, \Delta COREPCE, \Delta IPYOY, \Delta LNSP500, \Delta LNEURO)$
- $\Delta SWAP10Y = F^{9}(\Delta TB3M, \Delta COREPCE, \Delta IPYOY, \Delta LNSP500, \Delta LNEURO)$
- $SWAP30Y = F^{9}(\Delta TB3M, \Delta COREPCE, \Delta IPYOY, \Delta LNSP500, \Delta LNEURO)$

ARDL (1, 1): Results

	ΔSWAP2Y	ΔSWAP2Y	ΔSWAP5Y	ΔSWAP5Y	ΔSWAP10Y	ΔSWAP10Y	ΔSWAP30Y	ΔSWAP30Y
Main Equation								
ΔTB3M	0.59*** (0.00)	0.53*** (0.00)	0.57*** (0.00)	0.43*** (0.00)	0.54*** (0.00)	0.37*** (0.00)	0.55*** (0.00)	0.39*** (0.00)
ΔTB3M(-1)	–0.17** (0.04)	–0.16 (0.12)	–0.17 (0.10)		–0.21* (0.06)		–0.27*** (0.00)	–0.16** (0.05)
ΔSWAP_Y(-1)	0.34** (0.01)	0.39*** (0.00)	0.24** (0.01)	0.25*** (0.00)	0.29*** (0.00)	0.29*** (0.00)	0.36*** (0.00)	0.37*** (0.00)
ΔCOREPCE	0.07 (0.33)	0.05 (0.49)	0.06 (0.52)	0.04 (0.72)	–0.009 (0.92)	–0.04 (0.69)	–0.06 (0.50)	–0.08 (0.38)
ΔIPYOY	–0.002 (0.56)	–0.001 (0.69)	0.0001 (0.99)	–0.003 (0.63)	0.002 (0.66)	–0.001 (0.81)	0.002 (0.61)	–0.0003 (0.96)
ΔLNSP500		–0.15 (0.83)		0.55 (0.54)		0.62 (0.50)		0.50 (0.55)
ΔLNEURO		–0.08 (0.87)		0.09 (0.90)		0.69* (0.37)		1.36* (0.07)
ΔLNVIX		–0.10 (0.30)		–0.09 (0.51)		–0.14 (0.37)		–0.17 (0.26)
Intercept	0.001 (0.89)	0.003 (0.77)	–0.01 (0.62)	–0.01 (0.54)	–0.01 (0.49)	–0.01 (0.45)	–0.02 (0.42)	–0.01 (0.43)

Note: all vars are in diff, *p*-values are in parenthesis. Significance levels *** for 1%, ** for 5% and * for 10%

ARDL (1, 1): Model information and diagnostic tests

	ΔSWAP2Y	ΔSWAP2Y	ΔSWAP5Y	ΔSWAP5Y	ΔSWAP10Y	ΔSWAP10Y	ΔSWAP30Y	ΔSWAP30Y
Model information								
Obs	132	132	132	132	132	132	132	132
Adj R^2	0.51	0.51	0.29	0.30	0.25	0.27	0.29	0.35
AIC	– 1.89	– 1.87	– 1.11	– 1.12	– 0.90	– 0.93	– 0.98	– 1.05
Diagnostic tests								
Joint significance F-Test	27.94 (0.00)	17.91 (0.00)	11.61 (0.00)	8.88 (0.00)	9.53 (0.00)	8.06 (0.00)	11.92 (0.00)	10.03 (0.00)
Serial correlation Durbin-Watson Statistic	1.98	1.98	1.93	1.91	1.95	1.92	1.96	2.00
Serial correlation Breusch-Godfrey LM Test	0.65 (0.52)	0.67 (0.52)	0.42 (0.66)	0.21 (0.81)	0.24 (0.79)	0.22 (0.80)	0.09 (0.90)	0.20 (0.82)
Heteroskedasticity Breusch-Pagan-Godfrey test	1.02 (0.41)	1.13 (0.35)	0.40 (0.85)	1.50 (0.17)	0.79 (0.56)	2.51 (0.02)	0.87 (0.50)	2.24 (0.03)
Normality test Jarque-Bera statistic	3.63 (0.16)	1.48 (0.48)	0.58 (0.75)	0.15 (0.93)	0.41 (0.81)	0.87 (0.65)	1.01 (0.60)	1.18 (0.55)
Stability diagnostic Ramsey RESET Test	1.59 (0.21)	2.07 (0.13)	1.49 (0.23)	2.53 (0.08)	1.62 (0.20)	3.81 (0.02)	0.61 (0.54)	3.45 (0.03)

Note: BG LM and Ramsey RESET tests are with 2 lags.

CONCLUSION

- **A significant impact of short-term interest rate on the interbank SWAP yield.**
- **The impact decreases slightly for higher maturity term SWAP yields**
- **Past SWAP yield has a significant and positive impact on current yield**
- **Post-estimation diagnostic tests reveals:**
  - No serial correlation and heteroskedasticity
  - Errors are normally distributed and models are stable
- **Keynes's view that the central bank decisively influences the long-term interest rate via the short-term interest rate holds for USD interest rate swap yields.**