Recalibrating Argentina's Ponzi Program

Today's sharp ARS adjustment from 45.3 per USD on Friday to about 53.0—a depreciation of 14½%—comes as no surprise to anyone who has been studying Argentina's macro-financial policies in recent years.

The catalyst for the sell-off in Argentine assets, of course, was the outcome of yesterday's primary election—where the opposition Fernandez-Kirchner ticket defeated the so-called market-friendly incumbent, President Macri, by 15½ percentage points. A return of populism to Buenos Aries can be expected.

However, as so often the case, while politics will be seen as the turning point for Argentina's program, a further sharp adjustment of ARS was already baked in the cake—only the timing was uncertain. Rather, failed macroeconomic policies are to blame. Why?

To understand Argentina's inevitable demise, it is necessary to recognize that the monetary-fiscal program currently in place—including as part of the IMF's largest ever program—is a Ponzi scheme. And as with all Ponzi schemes, it's demise is inevitable. In short, Argentina's central bank (BCRA) has very few interest-earning assets, but pays a large interest on its sterilization operations—currently Leliqs, previously Lebacs and various other instruments. Without the real resources needed to fund its operations, BCRA has no choice but to monetize the cost of its operations. But to prevent the impact of this on base money, with associated pressure on the exchange rate, BCRA must issue ever greater sterilization instruments as an offset. However, over a long enough horizon, this policy implies BCRA's monetary plus sterilization liabilities will grow exponentially. Inevitably, this must at some point unravel—all that was needed is a catalyst. Yesterday's election duly delivered.

Understanding Argentina's Ponzi program with the IMF, therefore, is a prerequisite for beginning to sketch how things will unfold from here—the true implications for sustainability and necessary and sufficient debt restructuring under any new administration. The mistake investors have been making until now is to believe there is a positive "market friendly" outcome, whereas under any administration the true challenge of restoring fiscal sustainability brought only downside for Argentine assets. Today's adjustment represents a belated imposition of fundamentals.

The evolution of BCRA balance sheet

To appreciate Argentina's monetary-fiscal dilemma, we need to dig deep into the BCRA balance sheet—and monetary-fiscal interactions in particular. Every year, around July, BCRA produces an [annual financial statement](#) for the previous calendar year. By piecing the information together from these statements, we can build links between BCRA and the fiscal authorities since 2011.

Table 1 shows the net interest income received by BCRA between 2011 and 2017, capturing the end of the previous Kirchner administration and the first part of Macri's term. In 2011 BCRA was running a deficit of 0.4% of GDP in terms if net interest income. Interest received of ARS3.8 billion, mainly on government securities and international reserves, was more than offset by interest paid of ARS12.9 billion, mainly on BCRA securities. This deficit was roughly unchanged (in % of GDP) through 2013, but increased every year since to reach deficit of 1.9% of GDP in 2017. Interest received increased to ARS29 billion in 2017 while interest paid reached ARS233 billion. Interest received increased 8-fold on a lower base, interest paid increased 18-fold.

Not shown in Table 1, the 2018 financial statement reveals the interest paid on BCRA securities increased to reach ARS383 billion in 2018, from ARS210 billion in 2017—despite a sharp fall in outstanding absorption instruments (more on which shortly.)

And so, while not counted in the fiscal position of the Federal government, BCRA has been running a growing deficit in recent years—to reach 2.2% of GDP in 2018. This hidden deficit is the essential challenge for restoring macro-financial sustainability in Argentina, as we discuss. But first, where has it come from?

Table 1: BCRA net interest income (ARS millions)

	2011	2012	2013	2014	2015	2016	2017
Interest received on:	3,846	3,331	3,030	3,151	4,523	24,067	29,236
International reserves	339	255	211	142	214	773	2,218
Government securities	3,193	2,754	2,369	2,474	3,787	22,462	26,743
Loans	74	266	389	417	335	201	93
Other assets	238	55	61	118	187	632	183
Interest paid on:	12,900	13,126	16,027	43,604	79,887	163,554	233,108
BCRA securities	11,472	11,359	14,805	42,197	77,239	153,344	209,576
Loans from international agencies	34	96	65	46	163	3,699	253
Other transactions with financial system	875	1,660	967	1,000	2,251	6,138	23,040
Other liabilities	613	66	70	75	112	254	71
Set-up allowances	-95	-54	121	286	122	119	168
Net interest received	-9,054	-9,795	-12,997	-40,452	-75,364	-139,487	-203,872
(%GDP)	-0.42	-0.37	-0.39	-0.88	-1.27	-1.70	-1.92

Since at least 2011, BCRA has been a source of finance for the Federal government in various ways. One of the several ways has been through the transfer of BCRA net income (including valuation adjustment) to the Federal government.

Table 2 shows the stock of BCRA capital, reserves, and retained earnings, as well as the contribution to the change in BCRA capital due to net income. Note, this net income measure includes valuation adjustments. Since BCRA has a positive net open position in foreign currency, owing to holdings of international reserves, whenever ARS depreciates this creates positive valuation gains. And ARS was on a secular depreciation path over the period—something continued today—meaning there were positive valuation gains throughout. However, this did not result in large upward valuation of BCRA capital and reserves. Why not?

The Federal government implemented a profit sharing rule whereby net income from the previous year—*including* these valuation gains—was transferred to the Federal government as income. This was not quite 100% in the final years shown, but exactly true for the first 5 years. Consider how net income including valuation gains of ARS78 billion in 2014 was transferred in full in 2015 to the Federal government. Thus, even though there as negative net income cash flows throughout the period, the valuation adjustment was to more than enough to offset this. And so, despite negative realized cash income, BCRA was continuing to transfer profits to the Federal government throughout. Over the 7 years covered, BCRA transferred ARS375 billion to the government, averaging 0.9% of GDP per year. Crucially, it was valuation gains that were being transferred, even if these valuation gains were yet to be realized and all the while BCRA capital was shrinking from 1.4% of GDP in 2011 to 0.7% of GDP in 2017.

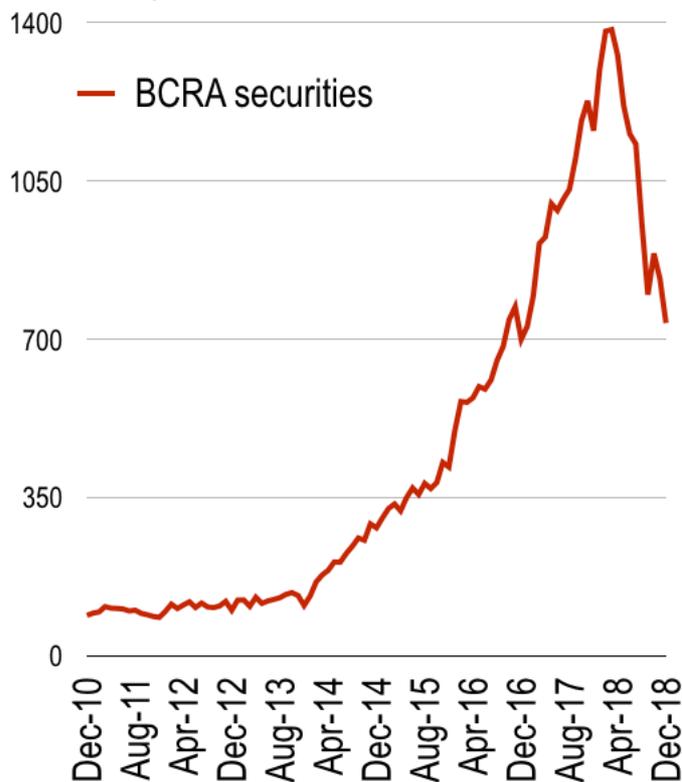But this wasn't the only source of financing between BCRA and Federal government over the period.

Table 2: Contributions to changes in BCRA capital and reserves (ARS billions)							
	2011	2012	2013	2014	2015	2016	2017
Capital, reserves, and retained earnings (eop)	**37.3**	**61.8**	**108.0**	**107.7**	**176.7**	**134.5**	**7.5**
o/w retained earnings	7.7	32.2	78.4	78.1	147.1	67.4	-67.0
capital and reserves	29.6	29.6	29.6	29.6	29.6	67.1	74.5
Change in capital and reserves		**24.5**	**46.2**	**-0.3**	**69.0**	**-42.2**	**-127.0**
Net income plus distribution of income	**-1.0**	**24.5**	**46.2**	**-0.3**	**69.0**	**-42.2**	**-127.0**
Net income	7.7	32.2	78.4	78.1	147.1	67.4	-67.0
Valuation adjustment	16.9	44.0	88.4	114.8	250.9	212.1	137.7
Interest income (net)	-9.1	-9.8	-13.0	-40.5	-75.4	-139.5	-203.9
Other*	-0.1	-2.0	3.0	3.8	-28.4	-5.2	-0.8
Distribution of income to government	-8.7	-7.7	-32.2	-78.4	-78.1	-109.6	-60.0
Memo items:							
Distribution to govn (%GDP)	*-0.4*	*-0.3*	*-1.0*	*-1.7*	*-1.3*	*-1.3*	*-0.6*
Capital and reserves/GDP (%)	*1.4*	*1.1*	*0.9*	*0.6*	*0.5*	*0.8*	*0.7*
GDP	2,179	2,638	3,348	4,579	5,955	8,228	10,645

* Includes net income on trading fx and other financial instruments, monetary issuance and general expense.

Table 3 provides the best decomposition of contributions to changes in base money in Argentina possible (by me at least) from the varying annual financial statements. The change in base money of ARS840 billion cumulative, averaged about 2.4% of GDP, whereas the change in contributions owing to transactions with the government of various kinds summed to ARS1279 billion, averaging about 3% of GDP. These transactions on behalf of the government include the purchase of FX in later years (when international markets were open for borrowing), the drawdown of deposits, temporary advances to the government, and transfer of BCRA earnings noted above. With respect to the latter, there is a difference between the flows reported in BCRA income statement (Table 2) and the smaller implied cash flow (Table 3) which is assumed without investigation an accrual versus cash distinction.

Figure 1: BCRA securities (ARS billions)

In any case, the decomposition shown in Table 3 reveals fiscal dominance in Argentina over the period 2011-17. Most important, to contain the creation of base money BCRA expanded the total stock of outstanding securities—sterilization instruments—by about ARS380 billion (or 3.5% of 2017 GDP.) Crucially, this is a *net*

figure, meaning the interest on outstanding BCRA securities which would otherwise contribute to greater base money creation is being mopped up here; the total increase is considerably larger.

In fact, the total stock of BCRA securities increased from ARS89 billion end-2010 to ARS1,160 billion end-2017 (Figure 1). This exponential increase in BCRA securities, later rolled off somewhat in the crisis of 2018, is a pictorial representation of the challenge of monetary stability with inadequate central bank resources. In effect, to achieve monetary stability BCRA was issuing its own securities in lieu of government debt. This quasi-fiscal debt sits on BCRA balance sheet instead of government. This ought not be overlooked in assessing overall macro-financial sustainability, however.

Table 3 Contributions to change in BCRA base money (ARS billions)

Contributions to change in monetary base:	2011	2012	2013	2014	2015	2016	2017
Change in monetary base	**62.5**	**84.4**	**69.8**	**85.4**	**161.3**	**197.8**	**179.4**
Purchases of foreign currency (net)	13.3	41.5	-31.8	48.3	-39.9	57.8	-5.4
For monetary regulation purposes	…	…	…	…	-91.7	31.1	…
Decrease in fx deposits of financial institutions	…	…	…	…	21.3	17.8	…
Purchase of fx from dealers	0.0	0.0	0.0	23.0	30.5	8.9	0.0
Transactions on behalf of government	14.1	9.4	54.7	100.2	125.4	198.1	269.0
Foreign exchange purchases	…	…	…	…	…	160.3	271.7
Deposit changes	…	…	…	…	…	37.8	-2.7
Advances to government	20.0	40.8	44.3	62.5	66.3	123.2	150.9
Temporary advances to the govn.	18.0	32.8	35.8	22.5	39.5	50.4	90.0
Distribution of earnings to govn. (from BCRA capital)	1.9	7.7	8.3	39.7	26.3	72.1	60.0
Contributions to general revenue**	0.2	0.2	0.3	0.4	0.5	0.7	0.9
Other	-2.4	-2.3	-3.4	-8.2	5.6	-32.4	-31.8
Loans to domestic financial institutions	1.7	2.0	7.4	0.7	-0.7	-1.8	-1.2
Administrative and monetary issuance expense	1.3	1.9	2.3	3.3	4.4	6.0	6.9
Premiums paid for reverse repo transactions	0.8	1.6	0.9	0.9	1.7	3.6	15.2
IADB/IBRD loans, micro/SMEs program, "other"	0.7	0.2	-2.2	1.1	1.6	1.7	1.4
Net liquidity from government security transactions	-2.0	-2.0	-4.8	-3.5	8.9	-15.0	-8.4
Other financial institution deposits	-1.0	-1.1	-0.5	-2.6	-3.4	-16.4	-33.5
Multilateral credit agreements (SML)	-3.9	-4.9	-6.5	-8.0	-6.9	-10.4	-12.2
Liquidity management	17.4	-4.9	6.0	-117.5	3.9	-148.9	-203.1
Net BCRA securities	15.0	-3.3	-4.5	-95.9	-8.4	-100.5	-180.3
Reverse repos	2.5	-1.6	10.5	-21.7	12.2	-48.4	-22.8
Memo items:	2011	2012	2013	2014	2015	2016	2018
Change in base money (%GDP)	*2.9*	*3.2*	*2.1*	*1.9*	*2.7*	*2.4*	*1.7*
Cashflow from transactions for/advances to govn. (%GDP)	*1.6*	*1.9*	*3.0*	*3.6*	*3.2*	*3.9*	*3.9*
GDP	2179	2638	3348	4579	5955	8228	10645

* Under Communiqué "A" 5563 / 5822 / 5852
** Budget Law No. 26728 / Decree 1446/11 (2011-14) and Budget Law No.27.198 / 27.008 (2015-17)

To assess overall sustainability, of course, requires consolidating the Federal government with BCRA to produce a true assessment of overall State position. But to do so would have stretched to breaking point the intellectual capacity of the Fund—their debt sustainability framework has no meaningful role for consolidated public sector assessment—while working against the political imperative to be seen to support Argentina's efforts to reintegrate into the international community. And so the IMF's program was fudged.

The IMF program: death foretold

In brief, the IMF program—amounting so far to a prospective USD56 billion, of which about USD50 billion is a done deal, the largest in Fund history—took note up front of the lack of BCRA capital and the need for action in the future on this, but decided not to deal with this as a prior action. For example, the staff report at program initiation notes the need to update accounting standards at BCRA while setting as a "structural benchmark" for end-2019 the need to "Recapitalize the central bank to ensure it has the adequate level of capital as percent of the monetary base plus the outstanding stock of LEBACs."

But such measures, which would have clear fiscal implications, including for sustainability assessments, were illogically postponed. As a result, staff could present a more favourable picture of Federal debt sustainability. However, this overlooked a fundamental inconsistency within the program. While Federal government sustainability requires secular real *appreciation*, BCRA sustainability in contrast requires secular real exchange rate *depreciation* to continually revalue foreign assets relative to local currency liabilities.
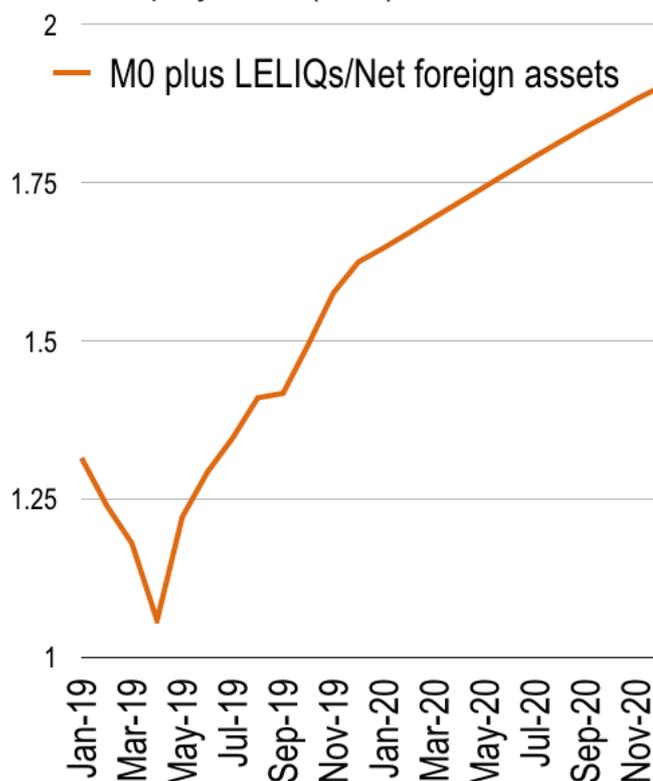
Absent real depreciation, the BCRA's monetary policy would be exposed as a Ponzi game in which the value of liabilities would grow exponentially larger than net foreign assets (at any prevailing exchange rate.)

This inherent contradiction sits at the heart of the Argentina program today—as it has from the start. Thus, BCRA securities and overall liabilities (including base money)—despite the apparently tight monetary stance— would far exceed the local currency value of net foreign assets in finite time. The latest IMF 4th Review forecast of this is shown in Figure 2. The only way to correct the imbalance of growing local currency liabilities is through discrete ARS depreciation, to revalue international reserves relative to local currency liabilities. With substantial dollarization of Federal government liabilities, however, this will reveal Federal government debt to be larger relative to GDP than previously thought—as in 2018. Thus, the quasi-fiscal debt of the government imposed on BCRA will show up when BCRA resolves her own unsustainable position.

Figure 2: BCRA liabilities/net foreign assets projection (ratio)

— M0 plus LELIQs/Net foreign assets

All this has made ARS adjustment inevitable at some point. For example, the average Leliq interest rate—the interest rate on 7-day absorption instruments— during January through July this year was 61%. The stock of Leliqs was less than ARS500 billion in October 2018, but was on track to exceed ARS1,800 billion by end-2019. BCRA Leliqs were destined in a few weeks from now to exceed base money in

size once again. By end-2020, the IMF was forecasting M0 plus Leliqs in Argentina to be nearly double net foreign assets—despite expected exchange rate weakness. Roughly speaking, in the past few weeks, BCRA has been rolling over into 7-day liquidity absorbing instruments about ARS250 billion per day—that's about 20% of base money each working day. On each occasion, the holders of these claims on BCRA have to ask whether the reward of a 60%-70% annualized interest rate on this one week lending to the central bank is worth the risk that on one of the next 4 days other holders will decide to liquidate the claims and try to purchase USD. If on any day there is a reason to fear rollover in the next week, there is an incentive to run for the exits—precipitating a currency crisis. This is due to the lack of BCRA capital and resources to fund monetary stability, and the ultimate need to monetize the cost of monetary policy.

Ultimately, the need to recap BCRA by end-2019 will have an impact on the fiscal position of the Federal government that has so far been swept under the program. The precise size of the recap is impossible to say, but it's easy to generate (that is, simulate) steady states with an increase of Federal government debt of between 10% and 30% of GDP; with assumed 5% coupon on this debt transferred to the government, this could create an additional interest cost of 2% of GDP per year. This implies the fiscal adjustment in the program would require further painful future efforts to restore monetary sustainability. Alternatively, given the monetary-fiscal adjustment so far has taken a huge toll on the population, fiscal adjustment will likely be paused in favour of substantial debt restructuring. This will be the case regardless of who wins the election in October. It's time to restore macro-financial stability to Argentina. I believe the existing fiscal DSA ought to add around 20% of GDP in debt in perpetuity to do so, which upends all existing assumptions about fiscal sustainability and the need for restructuring.

ANNEX: Restoring macro-financial stability to Argentina

The central bank's balance sheet can be summarized as:

$$K_t + \xi_t NFA_t^* + NDA_t + \xi_t NDA_t^* = BM_t + CB_t + NW_t$$

where:
K_t is the CB capital, which we assume to be dominated in local currency;
ξ_t is the nominal exchange rate;
NFA_t^* net foreign assets (mainly gross international reserves) dominated in dollars;
NDA_t net domestic assets, such as holdings of government bonds in local or foreign currency;
CB_t is the outstanding quantify of central bank bills (BCRA bills, which are all denominated in pesos);
BM_t is base or high-powered money of the central bank;
NW_t is the net worth of the central bank—the difference in value between assets and liabilities.

In other words, net worth is:

$$NW_t = K_t + \xi_t NFA_t^* + NDA_t + \xi_t NDA_t^* - BM_t - CB_t$$

The change in net worth from t-1 to t reflects the valuation adjustment on net foreign and domestic assets dominated in foreign exchange plus the net interest income on assets—where we assume zero interest on base money:

$$\Delta NW_t = [T_t - W_t] + \Delta K_t + \Delta \xi_t NFA_{t-1}^* + \Delta \xi_t NDA_{t-1}^*$$
$$+ \left(i_t^K K_{t-1} + i_{F,t}^* \xi_t NFA_{t-1}^* + i_t NDA_t + i_{D,t}^* \xi_t NDA_{t-1}^* - i_t^B CB_{t-1} \right)$$

which is the change in balance sheet, including valuation adjustments, plus net interest income.

From the central bank balance sheet, the change in net worth can be written:

$$\Delta NW_t = \Delta K_t + \xi_t \Delta NFA_t^* + \Delta \xi_t NFA_{t-1}^* + \Delta NDA_t + \xi_t \Delta NDA_t^* + \Delta \xi_t NDA_{t-1}^* - \Delta BM_t$$
$$- \Delta CB_t$$

substituting in the definition of the change in net worth, the change in capital and valuation adjustments cancel, to get the flow budget constraint facing the central bank:

$$(1 + i_t^B) CB_{t-1} = [T_t - W_t] + i_t^K K_{t-1} + (1 + i_t^*) \xi_t NFA_{t-1}^* + (1 + i_t) NDA_{t-1}$$
$$+ \left(1 + i_{D,t}^* \right) \xi_t NDA_{t-1}^* + \Delta BM_t + [CB_t - \xi_t NFA_t^* - NDA_t - \xi_t NDA_t^*]$$

Subtract $(1 + i_t^B)[\xi_{t-1}NFA_{t-1}^* + NDA_{t-1} + \xi_{t-1}NDA_{t-1}^*]$ from each side, we get:

$$
\begin{aligned}
(1 + i_t^B)\,\Omega_{t-1} = {}& \Omega_t + [T_t - W_t] + i_t^K K_{t-1} + [(1 + i_t^*)\xi_t - (1 + i_t^B)\xi_{t-1}]NFA_{t-1}^* \\
& + [(1 + i_t) - (1 + i_t^B)]NDA_{t-1} + \big[(1 + i_{D,t}^*)\xi_t - (1 + i_t^B)\xi_{t-1}\big]NDA_{t-1}^* \\
& + \Delta BM_t
\end{aligned}
$$

where $\Omega_t = CB_t - \xi_t NFA_t^* - NDA_t - \xi_t NDA_t^*$.

Divide through by nominal GDP—using lower case letters to reflect variables relative to GDP, we get

$$
\begin{aligned}
\frac{1 + i_t^B}{1 + g_t}\,\varphi_{t-1} = {}& \varphi_t + [t_t - w_t] + \frac{i_t^K}{1 + g_t}K_{t-1} + \left[\frac{(1 + i_t^*)\,\xi_t/\xi_{t-1} - (1 + i_t^B)}{1 + g_t}\right]nfa_{t-1}^* \\
& + \left[\frac{(1 + i_t) - (1 + i_t^B)}{1 + g_t}\right]nda_{t-1} + \left[\frac{(1 + i_{D,t}^*)\,\xi_t/\xi_{t-1_t} - (1 + i_t^B)}{1 + g_t}\right]nda_{t-1}^* \\
& + \Delta bm_t + \frac{g_t}{1 + g_t}bm_{t-1}
\end{aligned}
$$

where $nfa_{t-1}^* = \xi_{t-1}NFA_{t-1}^*/Y_{t-1}$ and $nda_{t-1}^* = \xi_{t-1}NDA_{t-1}^*/Y_{t-1}$.

Rearrange as the flow budget constraint facing the central bank

$$
\begin{aligned}
\varphi_{t-1} = {}& \frac{1 + g_t}{1 + i_t^B}\,\varphi_t + \frac{1 + g_t}{1 + i_t^B}[t_t - w_t] + \frac{i_t^K}{1 + i_t^B}k_{t-1} + \frac{g_t}{1 + i_t^B}bm_{t-1} \\
& + \left[\frac{(1 + i_t^*)(1 + e_t) - (1 + i_t^B)}{1 + i_t^B}\right]nfa_{t-1}^* + \left[\frac{(1 + i_t) - (1 + i_t^B)}{1 + i_t^B}\right]nda_{t-1} \\
& + \left[\frac{(1 + i_{D,t}^*)(1 + e_t) - (1 + i_t^B)}{1 + i_t^B}\right]nda_{t-1}^* + \frac{1 + g_t}{1 + i_t^B}\Delta bm_t
\end{aligned}
$$

where $1 + e_t = \xi_t/\xi_{t-1}$.

We obtain the inter-temporal budget constraint, including the no-Ponzi condition, by iterating forward on this flow constraint. For simplicity, we assume a steady state for all variables, dropping the t sub-scripts:

$$\varphi_{t-1} = \left(\frac{1+g}{i^B - g}\right)[t - w] + \left(\frac{i^K}{i^B - \gamma}\right)k_{t-1} + \left(\frac{g}{i^B - g}\right)bm_{t-1} + \left(\frac{1+g}{i^B - g}\right)\Delta bm$$
$$+ \left[\frac{(1 + i^*)(1 + e) - (1 + i^B)}{i^B - \lambda}\right]nfa^*_{t-1} + \left[\frac{(1 + i) - (1 + i^B)}{i^B - \delta}\right]nda_{t-1}$$
$$+ \left[\frac{(1 + i^*_D)(1 + e) - (1 + i^B)}{i^B - \theta}\right]nda^*_{t-1} + NPC$$

where the no-Ponzi condition is given by:

$$NPC = \lim_{N\to\infty} \left(\frac{1 + g}{1 + i^B}\right)^{N+1} \varphi_N$$

Simplify by letting $\Delta bm = 0$, $\lambda = \delta = \theta = g$ and rearranging to get an expression for the capital of the central bank needed to assure the NPC condition obtains:

$$i^K k_{t-1} \geq (i^B - \gamma)\varphi_{t-1} + \left(\frac{i^B - \gamma}{i^B - g}\right)(1 + g)[w - t] - \left(\frac{i^B - \gamma}{i^B - g}\right)g \cdot bm_{t-1}$$
$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1 + i^B) - (1 + i^*)(1 + e)]nfa^*_{t-1}$$
$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1 + i^B) - (1 + i)]nda_{t-1}$$
$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1 + i^B) - (1 + i^*_D)(1 + e)]nda^*_{t-1}$$

We can simplify further by recalling the definition of φ_{t-1} and substituting in:

$$\varphi_{t-1} = cb_{t-1} - nfa^*_{t-1} - nda_{t-1} - nda^*_{t-1}$$

such that:

$$i^K k_{t-1} \geq (i^B - \gamma)cb_{t-1} + \left(\frac{i^B - \gamma}{i^B - g}\right)(1+g)[w-t] - \left(\frac{i^B - \gamma}{i^B - g}\right)g \cdot bm_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1+g) - (1+i^*)(1+e)]nfa^*_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1+g) - (1+i)]nda_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1+g) - (1+i^*_D)(1+e)]nda^*_{t-1}$$

Start with the simple case where $\gamma = 0$, $g = 0$, and $e = 0$ and $t = 0$.

$$i^K k_{t-1} \geq i^B cb_{t-1} + w - (i^* nfa^*_{t-1} + i \cdot nda_{t-1} + i^*_D \cdot nda^*_{t-1})$$

More complicated, where $\gamma = 0$, $g > 0$, and $e > 0$ and $t = 0$.

$$i^K k_{t-1} \geq i^B cb_{t-1} + \left(\frac{i^B}{i^B - g}\right)(1+g)w - \left(\frac{i^B}{i^B - g}\right)g \cdot bm_{t-1}$$

$$+ \left(\frac{i^B}{i^B - g}\right)[(1+g) - (1+i^*)(1+e)]nfa^*_{t-1}$$

$$+ \left(\frac{i^B}{i^B - g}\right)[(1+g) - (1+i)]nda_{t-1}$$

$$+ \left(\frac{i^B}{i^B - g}\right)[(1+g) - (1+i^*_D)(1+e)]nda^*_{t-1}$$

$$i^K k_{t-1} \geq (i^B - \gamma)\varphi_{t-1} + \left(\frac{i^B - \gamma}{i^B - g}\right)(1+g)[w-t] - \left(\frac{i^B - \gamma}{i^B - g}\right)g \cdot bm_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1+i^B) - (1+i^*)(1+e)]nfa^*_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1+i^B) - (1+i)]nda_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - g}\right)[(1+i^B) - (1+i^*_D)(1+e)]nda^*_{t-1}$$

Such that our condition becomes:

$$i^K k_{t-1} \geq (i^B - \gamma) cb_{t-1} + \left(\frac{i^B - \gamma}{i^B - g}\right)(1 + g)[w - t] - \left(\frac{i^B - \gamma}{i^B - g}\right) g \cdot bm_{t-1}$$

$$- \left(\frac{i^B - \gamma}{i^B - g}\right)(1 + g)\Delta bm + \left(\frac{i^B - \gamma}{i^B - \lambda}\right)[(1 + \lambda) - (1 + i^*)(1 + e)]nfa^*_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - \delta}\right)[(1 + \delta) - (1 + i)]nda_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - \theta}\right)[(1 + \theta) - (1 + i^*_D)(1 + e)]nda^*_{t-1}$$

$$i^K k_{t-1} \geq (i^B - \gamma) \varphi_{t-1} + \left(\frac{i^B - \gamma}{i^B - g}\right)(1 + g)[w - t] - \left(\frac{i^B - \gamma}{i^B - g}\right) g \cdot bm_{t-1}$$

$$- \left(\frac{i^B - \gamma}{i^B - g}\right)(1 + g)\Delta bm + \left(\frac{i^B - \gamma}{i^B - \lambda}\right)[(1 + i^B) - (1 + i^*)(1 + e)]nfa^*_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - \delta}\right)[(1 + i^B) - (1 + i)]nda_{t-1}$$

$$+ \left(\frac{i^B - \gamma}{i^B - \theta}\right)[(1 + i^B) - (1 + i^*_D)(1 + e)]nda^*_{t-1}$$

as such we can write the change in base money, substituting in the definition of the change in net worth, as:

$$\Delta BM_t = \xi_t \Delta FA^*_t + \Delta DA_t - \Delta DL_t - \Delta CB_t - (i^*_t \xi_t FA^*_{t-1} + i_t DA_t - i^B_t CB_{t-1})$$

suppose we set the change in base money and domestic assets and liabilities to zero, as approximately in the IMF program, then we can calculate the change in central bank bills outstanding:

$$\Delta CB_t = \xi_t \Delta FA^*_t + (i^B_t CB_{t-1} - i^*_t \xi_t FA^*_{t-1} - i_t DA_t)$$

in other words, in the absence of yielding assets (either foreign or domestic) the central bank must issue ever greater quantities of central bank bills to make the payment on the interest falling due. This is a Ponzi scheme.