Dynamic Simulation of the Thai-Boosty ARC–USDC Stimulus

A DSGE-Inspired Model with Tiered Leak Control,
Entrepreneurial Emergence, and VAT Feedback

AI Tensiblity (Kan Yuenyong)

October 26, 2025

Abstract

This paper develops a tractable macroeconomic framework to evaluate Thailand's proposed *Thai-Boosty* digital stimulus executed on the ARC network with USDC settlement. The model integrates: (i) endogenous money creation via domestic circular spending with *tiered* leakage controls by province; (ii) a probabilistic mechanism for new-venture formation induced by local liquidity density; and (iii) fiscal recapture via VAT. We combine a short-run New Keynesian (NK) backbone with a provincial multiplier block and a Markov-chain simulator for spending propagation across tiers. Closed-form multipliers, VAT yields, and venture-formation elasticities are derived; numerical recipes are provided in the appendices.

1 Policy Context and Network Assumptions

The policy transfers THB 10,000 per adult to geo-fenced wallets; spending is restricted to registered vendors within a beneficiary's province (Bangkok within ≤ 2 subdistricts). Settlement occurs on a permissioned, EVM-compatible L1 with (i) deterministic < 1s finality, (ii) fiat-denominated gas (USDC) and (iii) opt-in privacy suitable for audit.[1] The Bank of Thailand (BOT) fronts a USDC float (THB 300B equivalent) from FX reserves; the Treasury earmarks budget over time to replenish the float.

2 Baseline Provincial Multiplier Block

Let provinces be indexed by $i \in \{1, \ldots, N\}$. An initial transfer G_i triggers iterative local outlays with marginal propensity to spend $\lambda_i \in (0, 1)$ and a provincial leak share $L_i \in [0, 1)$ (share escaping the province or the registered-vendor set).

Define the effective money creation in i:

$$M_i = G_i \left[1 + \lambda_i(1 - L_i) + \lambda_i^2(1 - L_i)^2 + \cdots\right] = G_i \frac{1}{1 - \lambda_i(1 - L_i)}. \tag{1}$$

Hence the provincial multiplier

$$k_i \equiv \frac{M_i}{G_i} = \frac{1}{1 - \lambda_i(1 - L_i)}, \qquad 0 < \lambda_i(1 - L_i) < 1. \tag{2}$$

Aggregate multiplier:

$$k \equiv \frac{\sum_i M_i}{\sum_i G_i} = \sum_i \omega_i k_i, \quad \omega_i := \frac{G_i}{\sum_j G_j}. \tag{3}$$

[1] ARC design: USDC as native gas, deterministic finality via BFT consensus, opt-in privacy; see references.

2.1 Tiered leakage calibration

We parameterize *tiers* to embody policy-enforced circularity:

$$\text{Tier 1: } L_1 = 0.0, \quad \text{Tier 2: } L_2 = 0.5, \quad \text{Tier 3: } L_3 = 0.7.$$

With a representative $\lambda = 0.8$,

$$k_1 = \frac{1}{1-0.8} = 5.0, \quad k_2 = \frac{1}{1-0.8(0.5)} = 2.5, \quad k_3 = \frac{1}{1-0.8(0.3)} \approx 1.538.$$

For a spending mix $(\omega_1, \omega_2, \omega_3) = (0.3, 0.5, 0.2)$,

$$k = 0.3(5) + 0.5(2.5) + 0.2(1.538) \approx 3.16.$$

With a THB 300B injection, the implied money creation is

$$\Delta M = k\,G \approx 3.16 \times 300\text{B} \approx 948\text{B THB}.$$

3 NK-DSGE Backbone for Output and Prices

We embed the multiplier in a short-run New Keynesian structure.

Households. Maximize

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left[\ln C_t - \frac{\phi}{2} N_t^2 \right], \qquad 0 < \beta < 1, \tag{4}$$

subject to

$$P_t C_t = W_t N_t + \Pi_t + T_t, \tag{5}$$

where T_t includes the transfer (net of taxes).

Firms. Production is Cobb–Douglas:

$$Y_t = A_t K_t^{1-\alpha} N_t^{\alpha}, \qquad A_t > 0, \tag{6}$$

with Calvo price setting leading to the NK Phillips curve:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa\, x_t, \quad x_t := \frac{Y_t - Y_t^*}{Y_t^*}, \tag{7}$$

where x_t is the output gap and κ the slope.

Resource constraint with controlled leakage. In the transfer period,

$$Y_t = C_t + I_t + G_t(1 - \bar{L}_t), \tag{8}$$

where $\bar{L}_t$ is the *effective* economy-wide leakage (weighted by ω_i). As $1 - \bar{L}_t$ rises via tiering, demand expands with limited import leakage, raising x_t and π_t mildly. For practical calibrations with $x_t \approx 0.02$, standard NK slopes imply $\Delta\pi$ on the order of 0.2–0.3 pp.

4 Entrepreneurial Emergence

Liquidity density D_i (per-capita circulating stock) fosters venture formation. Let $P_{v,i}$ be the probability that a representative recipient/SME initiates a new venture in i:

$$P_{v,i} = \alpha_0 + \alpha_1 D_i + \alpha_2 \sigma_i^2(\pi), \quad D_i := \frac{M_i}{P_i}, \tag{9}$$

where $\sigma_i^2(\pi)$ proxies opportunity dispersion (local spread in markups/profits). With baseline $P_{v,0} = 0.02$ and elasticity $\alpha_1 \approx 0.03$, tripling D_i (through Tier 1 circularity) yields

$$P_{v,i}^{\text{new}} \approx 0.02 + 0.03 \times 3 = 0.11,$$

suggesting ∼10–11% venture-formation probability among active participants. The expected count is

$$V_i = P_{v,i}\, N_i^{\text{active}}, \qquad V = \sum_i V_i. \tag{10}$$

5 VAT Recapture

VAT at rate τ on domestic spend yields

$$T_i = \tau \cdot M_i(1 - L_i) = \tau\, G_i \,\frac{1 - L_i}{1 - \lambda_i(1 - L_i)}, \qquad T = \sum_i T_i. \tag{11}$$

For $\tau = 7\%$ and the tier calibration above,

$$T \approx 0.07 \times 300\text{B} \times \Big[0.3 \cdot 5 \cdot 1 + 0.5 \cdot 2.5 \cdot 0.5 + 0.2 \cdot 1.538 \cdot 0.3\Big] \approx 49.6\text{B THB}.$$

Thus, a ∼16.5% fiscal feedback within-year.

6 Scenarios

Scenario	Leak profile	k	VAT (B THB)	ΔM (B)	ΔGDP (%)	P_v (peak)
Baseline (open)	avg $L = 0.7$	~ 1.5	~ 16	~ 450	+0.3	$\sim 3\%$
Thai-Boosty (tiered)	$(0.0, 0.5, 0.7)$	3.16	~ 50	~ 948	+0.8	10–11%
Optimized regional	$L = 0.3$	~ 4.0	~ 63	~ 1200	+1.1	12–13%

7 Policy Implications

Tiered circularity doubles (or more) the effective fiscal potency versus open spending; VAT feedback covers ∼15–20% of outlays; venture formation is materially boosted by liquidity density. Inflationary risks remain mild due to reserve-backed funding and controlled import leakage.

8 Conclusion

ARC–USDC settlement paired with geo-fenced wallets enables a programmable, auditable implementation of a digital Keynesian transfer with superior domestic multipliers. The framework here—provincial multipliers embedded in an NK backbone and a Markov-chain simulator—provides decision-grade estimates for output, VAT, and entrepreneurship effects.

A Appendix A: Markov-Chain Spending Propagation

We model spending as a finite Markov process over tiers, taxes, and leakage.

State space

Define states $\mathcal{S} = \{T_1, T_2, T_3, \mathrm{VAT}, \mathrm{LEAK}\}$. At each transaction round, the monetary unit moves across states according to a transition matrix $\boldsymbol{P}$.

Transition structure

Let $\theta_j^{(m)} \in [0,1]$ be the probability that a payment originating in tier $j \in \{1,2,3\}$ remains within the *registered domestic network* after merchant share m and inventory/wholesale effects; let ℓ_j be the exogenous leakage share to external/non-eligible uses from tier j; and let τ be VAT.

We define a round's transition out of T_j:

$$\begin{aligned}
\Pr(T_j \to \mathrm{VAT}) &= \tau, \\
\Pr(T_j \to \mathrm{LEAK}) &= \ell_j, \\
\Pr(T_j \to T_j) &= (1 - \tau - \ell_j) \cdot \pi_{jj}, \\
\Pr(T_j \to T_k) &= (1 - \tau - \ell_j) \cdot \pi_{jk}, \quad k \neq j,
\end{aligned}$$

where $\sum_k \pi_{jk} = 1$. Tier-1 policy aims $\ell_1 = 0$; Tier-2, $\ell_2 \approx 0.5$; Tier-3, $\ell_3 \approx 0.7$. VAT and LEAK are *absorbing* states:

$$\Pr(\mathrm{VAT} \to \mathrm{VAT}) = 1, \quad \Pr(\mathrm{LEAK} \to \mathrm{LEAK}) = 1.$$

Matrix form

Partition $\boldsymbol{P}$ as

$$\boldsymbol{P} = \begin{bmatrix} \boldsymbol{Q} & \boldsymbol{R} \\ \boldsymbol{0} & \boldsymbol{I}_2 \end{bmatrix}, \qquad \boldsymbol{Q} \in \mathbb{R}^{3\times 3},\ \boldsymbol{R} \in \mathbb{R}^{3\times 2},$$

with transient block $\boldsymbol{Q}$ over T_1, T_2, T_3 and absorbing block for {VAT, LEAK}. The *fundamental matrix* is

$$\boldsymbol{N} = (\boldsymbol{I}_3 - \boldsymbol{Q})^{-1} = \sum_{r=0}^{\infty} \boldsymbol{Q}^r.$$

For an initial distribution $\boldsymbol{s}_0$ over tiers (e.g., all mass in T_1 if wallets are provincial), the expected number of *visits* to tier states is

$$\boldsymbol{v}^\top = \boldsymbol{s}_0^\top \boldsymbol{N}.$$

Expected absorption into VAT and LEAK:

$$\boldsymbol{a}^\top = \boldsymbol{s}_0^\top \boldsymbol{N}\boldsymbol{R}.$$

The expected VAT intake per unit injected equals a_{VAT}; leak loss equals a_{LEAK}. If each *visit* triggers an average marginal spend λ of the current unit, the expected *effective multiplier* is proportional to $\boldsymbol{v}$ scaled by λ; in the limit with constant λ this nests the geometric form of Section 2.

Calibrated example

Let

$$\boldsymbol{Q} = \begin{bmatrix} (1-\tau-\ell_1)\pi_{11} & (1-\tau-\ell_1)\pi_{12} & (1-\tau-\ell_1)\pi_{13} \\ (1-\tau-\ell_2)\pi_{21} & (1-\tau-\ell_2)\pi_{22} & (1-\tau-\ell_2)\pi_{23} \\ (1-\tau-\ell_3)\pi_{31} & (1-\tau-\ell_3)\pi_{32} & (1-\tau-\ell_3)\pi_{33} \end{bmatrix}, \quad \boldsymbol{R} = \begin{bmatrix} \tau & \ell_1 \\ \tau & \ell_2 \\ \tau & \ell_3 \end{bmatrix}.$$

Set $\tau = 0.07$, $(\ell_1, \ell_2, \ell_3) = (0, 0.5, 0.7)$, and local stickiness

$$\pi = \begin{bmatrix} 0.85 & 0.10 & 0.05 \\ 0.10 & 0.80 & 0.10 \\ 0.05 & 0.10 & 0.85 \end{bmatrix}.$$

With $\boldsymbol{s}_0 = (1, 0, 0)$, compute $\boldsymbol{N}$ and $\boldsymbol{a}$ to obtain implied VAT share a_{VAT} and leak share a_{LEAK}, and compare with Section 5's closed-form VAT under geometric spending. The Markov approach naturally accommodates heterogeneous routing (π) and time-varying ℓ_j from enforcement intensity.

B Appendix B: VAT and Multiplier in Closed Form

For constant λ and fixed L_j, the expected VAT from province i can be written

$$T_i = \tau\, G_i \sum_{r=0}^{\infty} \left[\lambda(1-L_i)\right]^r (1-L_i) = \tau\, G_i \,\frac{1-L_i}{1-\lambda(1-L_i)}.$$

Summing across i yields $T = \sum_i T_i$. Equivalently, using the Markov absorption, $T = a_{\text{VAT}} \times G$ when states are normalized per monetary unit.

C Appendix C: Venture Diffusion as an Absorbing Markov Process

Augment the state space with {NV} (new venture) so that a fraction of flows convert into an entrepreneurial state. Let $\psi_i(D_i)$ be the *conversion hazard* per round in tier i:

$$\psi_i(D_i) = \min\{\bar{\psi},\ \eta_0 + \eta_1 D_i\},$$

with cap $\bar{\psi}$. Extend $\boldsymbol{R}$ to include NV as absorbing with row entries $\psi_i(D_i)$. The expected number of new ventures per unit is a_{NV}; total is $V = a_{\text{NV}} \times G \times$ (beneficiary density), which recovers the reduced-form probability model in Section 4 when integrated over the spending tree.

D Appendix D: Numerical Recipe (Pseudocode)

Given $(\tau, \ell_j, \pi_{jk}, \lambda)$ and initial mass $\boldsymbol{s}_0$:

1. Build $\boldsymbol{Q}$, $\boldsymbol{R}$ as above.
2. Compute $\boldsymbol{N} = (\boldsymbol{I} - \boldsymbol{Q})^{-1}$.
3. Visits: $\boldsymbol{v}^\top = \boldsymbol{s}_0^\top \boldsymbol{N}$; absorptions: $\boldsymbol{a}^\top = \boldsymbol{s}_0^\top \boldsymbol{N}\boldsymbol{R}$.
4. Effective multiplier (per unit): $k_{\text{MC}} = 1 + \lambda\, \boldsymbol{v}^\top \mathbf{1}$ (or calibrate to geometric).
5. VAT share: a_{VAT}; VAT yield for outlay G: $T = a_{\text{VAT}}\, G$.
6. If venture absorption included, a_{NV} gives venture count per unit; scale by beneficiaries.