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檢視中國債務陷阱
Examining the Chinese Debt Trap

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Chapter 1: Introduction

As China's economic influence continues to grow, its lending practices to developing countries have come under scrutiny. The concept of DTD (hereinafter DTD), whereby China extends excessive loans to countries in exchange for political or economic concessions, has become a topic of heated debate Chellaney (2017). While some argue that the debt-trap problem poses a significant threat to the economic and political stability of vulnerable countries, others contend that it is overstated.

The concept of DTD has been the subject of much debate in recent years. Parker and Chefitz (2018) states that China DTD as a technique to achieve strategic objectives, such as projecting power across South Asian trading routes, undermining regional opposition to its South China Sea claims, and supporting its naval efforts to break out into the Pacific. Critics of this phenomenon argue that claims of DTD are often exaggerated or based on incomplete information. For example, Brautigam (2020) argues that the debt-trap is based on a flawed understanding of Chinese lending practices and the histories of the target countries, and that China is not strategically pursuing the DTD on developing countries.

The opacity in Chinese lending practices has been a longstanding challenge in the analysis of the DTD problem. The lack of transparency in the Chinese lending system, whereby loan terms, conditions and collateral requirements are not always disclosed to the borrowers, makes it difficult for economists and policymakers to fully grasp the magnitude of the issue. Specifically, China's official external lending is predominantly undertaken by state-owned entities and the government itself[1]. However, unlike other major economies, the Chinese government does not report or publish any data on its official international lending or outstanding overseas debt claims. This lack of transparency creates challenges for rating agencies, as official lending to sovereigns is not a regular part of their activities. Moreover, China is not a member of the Paris Club, which tracks sovereign borrowing from official bilateral creditors, and does not divulge data on its official flows with the OECD's Creditor Reporting System. Therefore, documentation of China's international lending has not been comprehensive, making it challenging to determine the true nature and extent of the debt-trap problem (Horn, Reinhart and Trebesch, 2021). With limited access to information on Chinese loans, it has been challenging to assess the sustainability of debts of borrowing countries and their ability to service their obligations, as well as the potential impact of China's lending practices on the economy of low income developing countries (LIDC), especially those in the Belt and Road Initiatives (BLI). As a result, recent studies on whether DTD is a myth have primarily been conducted normatively in the field of political science, rather than a positive economics analysis (See, e.g., Himmer and Rod, 2023; Chen, 2020).

However, with the emergence of new and detailed data on Chinese lending practices, recent studies have begun to shed light on the nature and implications of the DTD. In this thesis, I aim to shed light on this complex issue by applying a new and detailed data provided by Horn, Reinhart and Trebesch (2021), hereinafter referred to the "HRT database", on the sovereign debt model proposed by Na, Schmitt-Grohé, Uribe and Yue (2018), to provide insights into the sustainability of the debts of borrowing countries. By calibrating the model for a particular country, a set of tradable-output levels which would cause the country to default could be obtained, given its current debt level. Following the approach of Hinrichsen (2021), this set is presented graphically with each data point on the space representing a debt-output pair for a specific year. This visual representation allows for an examination of whether the country has been in the default zone but has managed to

[1] These include China's state-owned policy banks, such as China Development Bank (國家開發銀行, CDB) and China Export-Import Bank (中國進出口銀行, Ex-Im), as well as China's state-owned commercial banks such as Industrial and Commercial Bank of China (中國工商銀行, ICBC) or Bank of China (中國銀行, BoC)

avoid default due to other enforcement mechanisms, in this case the might be the political leverage from China.

Chapter 2: Literature Review

Chapter 3: Analytic Model

So far, most discussions on China's debt trap have been limited to narrative statistics. To objectively assess this issue, we adopt the up-to-date sovereign debt default model in the literature as a tool for our empirical analysis. Na et al. (2018) proposes a model to study the Argentine economy; Hinrichsen (2021) uses the model to study the enforcementof sovereign debt under war reparations. The model in my thesis strictly follows Na et al. (2018) and Hinrichsen (2021).

International debt often lacks enforcement, and governments hold the decision of whether to repay the debt or default, based on the comparison of future values (Eaton and Gersovitz, 1981). Therefore, default can be considered an optimal policy for a country that faces unsustainable debt levels. By defaulting, the country avoids the burden of paying interest on the debt, but it also faces the consequence of being excluded from the international credit market for a period of time. As a result, the country would have to rely solely on its own financial resources until it regains access to international credit markets. Moreover, studies have pointed out that sovereign debt defaults are often accompanied by a devaluation of the currency; Reinhart (2002) refers to this phenomenon as "Twin Ds." Empirical analysis by Na et al. (2018) further observes that the devaluation rate often decreases after the time of default, suggesting that the Twin Ds phenomenon is the joint result of an optimal policy. They proposed a model that incorporates two key frictions: limited commitment to repay external debts and downward nominal wage rigidity. It is a decentralized version of the Eaton-Gersovitz sovereign debt model. The model predicts that default will occur only after a series of increasingly negative output shocks. Prior to default, domestic absorption experiences a severe contraction, which leads to a decline in demand for labor. However, due to downward nominal wage rigidity, real wages fail to adjust downward, resulting in involuntary unemployment. To prevent this situation, the optimal policy is to devalue the domestic currency, thereby reducing the real value of wages. As a result, both the model and the data show that default episodes are usually accompanied by significant currency devaluations (Na, Schmitt-Grohé, Uribe and Yue, 2018).

Therefore, for the sovereign debt model, I closely follow Na et al. (2018) to examine the set of conditions under which default is the optimal decision. The calibrated model will then serve as a benchmark metric that allows us to investigate whether China has potentially trapped heavily indebted poor counties into default, using the approach proposed by Hinrichsen (2021).

3.1 Households

The model assumes that the economy is populated by a large number of representative households who maximize their expected lifetime utility

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t), \tag{1}$$

where $\beta \in (0, 1)$ denotes the discount factor, and c_t represents the consumption good, which is composed of tradable consumption c_t^T and nontradable consumption c_t^N. Assume that c_t follows an aggregate technology

$$c_t = A(c_t^T, c_t^N), \tag{2}$$

where A is an increasing, concave, and linearly homogeneous function that captures characteristics such as the ratio or elasticity of substitution between tradable and nontradable consumption. The period utility function $U(c_t)$ follows the standard assumption, which is a strictly increasing and strictly concave function.

Assume that the household only has access to the one-period and state non-contingent bond. The household spends on consumption of tradable and nontradable goods, along with their debt which comes due in the current period. Its resources consist of labor incomes, dividend incomes, lump-sum transfers from the government, and incomes from borrowing from foreign lenders. The household is also endowed with tradable goods, which follow a stochastic process. The budget constraint of the representative household is then

$$P_t^T c_t^T + P_t^N c_t^N + P_t^T d_t = P_t^T \tilde{y}_t^T + W_t h_t + (1-\tau_t^d) P_t^T q_t^d d_{t+1} + F_t + \Phi_t, \tag{3}$$

where $P_t^T (P_t^N)$ denotes the nominal price of tradable (nontradable) goods, d_t the bond denominated in tradable goods which is due in period t, q_t the price of debt to be repaid at $t+1$, $\tilde{y}_t^T$ the endowment of traded goods to the household, W_t the nominal wage, h_t the hours worked, τ_t^d the tax on debt, F_t a lump-sum transfer from the government, and finally Φ_t the nominal profits from owning firms. The household's working hour is bounded by an upper limit

$$h_t \leq \bar{h}, \tag{4}$$

and it takes the working hour h_t as given.

The household's problem is to choose $\{c_t, c_t^T, c_t^N, d_{t+1}\}$ such that its utility (1) is maximized subject to the budget constraints (2) – (4) and the no-Ponzi-game debt limit. Further, denote the relative price of nontradable in terms of tradable goods as $p_t \equiv \frac{P_t^N}{P_t^T}$, we have the following first order conditions

$$p_t = \frac{A_2(c_t^T, c_t^N)}{A_1(c_t^t, c_t^N)} \tag{5a}$$

$$\lambda_t = U'(c_t) A_1(c_t^T, c_t^N) \tag{5b}$$

$$(1 - \tau_t^d) q_t^d \lambda_t = \beta E_t \lambda_{t+1}, \tag{5c}$$

where λ_t is the Lagrange multiplier. $A_1(\cdot, \cdot) = \frac{\partial A}{\partial c_t^T}$ and $A_2(\cdot, \cdot) = \frac{\partial A}{\partial c_t^N}$ is respectively the first derivative of the aggregation function with respect to tradable and nontradable consumption.

3.2 Firms

Perfectly competitive firms produce nontradable goods y_t^N according to the production technology

$$y_t^N = F(h_t), \tag{6}$$

where F is strictly increasing and strictly concave. Each firm maximizes its profit by choosing the amount of labor. Profit is given by

$$\Phi_t(h_t) = P_t^N F(h_t) - W_t h_t, \tag{7}$$

and the optimal labor demand is then

$$P_t^N F'(h_t) = W_t.$$

Dividing both side by the price of tradable goods, and define $w_t \equiv \frac{W_t}{P_t^T}$ as the real wage in terms of tradable goods, the first order condition can be written as

$$p_t F'(h_t) = w_t. \tag{8}$$

3.3 Downward Nominal Wage Rigidity

The key assumption in Schmitt-Grohé and Uribe (2016) and Na et al. (2018) is the downward nominal wage rigidity. As the wage is unable to be adjusted to a lower level, involuntary unemployment is inevitable, hence the government has the incentive to allow devaluation. The model imposes a lower bound to the growth rate of nominal wage

$$W_t \geq \gamma W_{t-1}, \qquad \gamma > 0. \tag{9}$$

This implies that the growth rate $\frac{W_t - W_{t-1}}{W_{t-1}} \geq \gamma - 1$. When this inequality is unbinding ($W_t > \gamma W_{t-1}$), the economy is fully employed ($h_t = \bar{h}$). However, if the condition binds, the economy might have unemployment ($h_t < \bar{h}$). This relationship can be written as the following equation

$$(\bar{h} - h_t)(W_t - \gamma W_{t-1}) = 0. \tag{10}$$

3.4 Government

We assume here that, under the lack of enforcement in the international credit market, the government has the option to benevolently free up domestic balance sheet by choosing to default or not. Denote I_t as the indicator of whether the government chooses to honor its debt in period t. If the government repays in this period ($I_t = 1$), the country will be able to borrow in the following period, hence $d_{t+1} > 0$. However, if the government chooses to default ($I_t = 0$), then the country will enter the status of financial autarky and is unable to have any sovereign debt in the next period, hence $d_{t+1} = 0$. The above scenario can be written as a slackness condition

$$(1 - I_t)d_{t+1} = 0. \tag{11}$$

To model the duration of financial exclusion, assume that once the country is in bad standing in the international credit market, it can regain reputation and access to financial markets with probability $\theta \in [0, 1)$, and remain in bad standing with probability $1 - \theta$. This implies that the country has an average exclusion duration of $\frac{1}{\theta}$ periods[1].

Assume that the government distributes the proceeds from the debt tax to households as a lump-sum payment. If the government honors the debt, it repays d_t, but if the government decides to default, it will not make any payments to foreign lenders, and instead will return any payments made by households directly to them. The budget constraint for the government can then be expressed as

$$f_t = \tau_t^d q_t^d d_{t+1} + (1 - I_t) d_t, \tag{12}$$

where $f_t \equiv \frac{F_t}{P_t^T}$ is the lump-sum transfer in terms of tradable goods. Right-hand side of the equation states that the transfer to households will include d_t when $I_t = 0$, which is when the country decides to default. Nevertheless, the transfer of debt tax will be zero after default since $d_{t+1} = 0$ when $I_t = 1$, according to Equation (11).

3.5 Foreign Lenders

The behavior of foreign lenders is not explicitly modeled in this framework, but as all rational agents, the expected marginal benefit of lending to the domestic country must be equivalent to the opportunity cost of funds. Let r^* represent the opportunity cost for the foreign lenders; this could be the world interest rate. Since q_t is the price of debt that repays one unit of d_{t+1} tomorrow, the return on the debt is $\frac{1}{q_t}$. The lenders take the risk of default into consideration, therefore, the expected return will actually be lower. Assume that foreign lenders are risk neutral and don't require risk premium, this gives

$$\frac{\Pr(I_{t+1} = 1 \mid I_t = 1)}{q_t} = 1 + r^*. \tag{13}$$

[1]The expected exclusion period $= \sum_{t=1}^{\infty} t\theta(1-\theta)^{t-1} = \theta \sum_{t=1}^{\infty} t(1-\theta)^{t-1} = \frac{1}{\theta}$.

Equivalently, the equation can be written as

$$I_t\left[q_t - \frac{E_t I_{t+1}}{1+r^*}\right] = 0.$$

3.6 Competitive Equilibrium

Under equilibrium, the households' consumption equals the production of firms

$$c_t^N = y_t^N. \tag{14}$$

The tradable goods are purely endowed exogenously under an AR(1) process

$$\ln\left(y_t^T\right) = \rho \ln\left(y_{t-1}^T\right) + \mu_t, \tag{15}$$

where $\mu_t \overset{\text{iid}}{\sim} \mathcal{N}(0, \sigma_\mu^2)$ is an i.i.d. shock, and $|\rho| \in [0, 1)$ is the autocorrelation parameter. When the country decides to default, it is in bad standing, hence it faces an output loss defined by $L(y_t^T)$. The loss function is non-negative and increasing in the tradable goods. The endowment of tradable goods to the household is then

$$\tilde{y}_t^T = \begin{cases} y_t^T - L(y_t^T) & \text{if } I_t = 0 \\ y_t^T & \text{otherwise} \end{cases} \tag{16}$$

When the country defaults ($I_t = 0$), the endowment decreases.

Price of debt offered by foreign lenders q_t should be equal to the price of the domestic debt q_t^d, but only during the good standing

$$I_t(q_t^d - q_t) = 0. \tag{17}$$

The market clearing condition can be established by combining various equations, including the household budget constraint (3) and (4), the firm's production function (6) and profit equation (7), the government's constraint on debt (11) and lump-sum return (12), and conditions from (14), (16), and (17). Eventually, the clearing condition for tradable goods is

$$c_t^T = y_t^T - (1 - I_t)L(y_t^T) + I_t(q_t d_{t+1} - d_t) \tag{18}$$

Assume that the law of one price applies to tradable goods. The foreign currency price of tradable goods is denoted as P_t^{T*}, while the nominal exchange rate is represented by $\mathcal{E}_t$. The law of one price states that the price of tradable goods in the domestic currency is equal to the foreign currency price multiplied by the nominal exchange rate.

$$P_t^T = P_t^{T*}\mathcal{E}_t$$

This implies that the price of a tradable good should be the same in both domestic and foreign currency terms in an efficient market. Without loss of generosity, the foreign-currency price of the tradable goods is normalized to 1 ($P_t^{T*} = 1$), hence the nominal price for tradable goods can be expressed as the nominal exchange rate

$$P_t^T = \mathcal{E}_t. \tag{19}$$

For convenience, also define the devaluation rate of domestic currency as

$$\epsilon_t \equiv \frac{\mathcal{E}_t}{\mathcal{E}_{t-1}} = \frac{P_t^T}{P_{t-1}^T}. \tag{20}$$

The conditions are now sufficient to define a competitive equilibrium.

Definition 1 (Competitive Equilibrium in Na et al. (2018))**.** A competitive equilibrium is a set of stochastic process $\left\{c_t^T, h_t, w_t, d_{t+1}, \lambda_t, q_t, q_t^d\right\}$ satisfying

$$
\begin{aligned}
c_t^T &= y_t^T - (1-I_t)L(y_t^T) + I_t(q_t d_{t+1} - d_t), && (21)\\
(1-I_t)d_{t+1} &= 0, && (22)\\
\lambda_t &= U'(A(c_t^T, F(h_t)))A_1(c_t^T, c_t^N), && (23)\\
(1-\tau_t^d)q_t^d\lambda_t &= \beta E_t \lambda_{t+1}, && (24)\\
I_t(q_t^d - q_t) &= 0, && (25)\\
\frac{A_2(c_t^T, F(h_t))}{A_1(c_t^t, F(h_t))} &= \frac{w_t}{F'(h_t)}, && (26)\\
w_t &\geq \gamma \frac{w_{t-1}}{\epsilon_t}, && (27)\\
h_t &\leq \bar{h}, && (28)\\
\left(h_t - \bar{h}\right)\left(w_t - \gamma\frac{w_{t-1}}{\epsilon_t}\right) &= 0, && (29)\\
I_t\left[q_t - \frac{E_t I_{t+1}}{1+r^*}\right] &= 0, && (30)
\end{aligned}
$$

given processes $\left\{y_t^T, \epsilon_t, \tau_t^d . I_t\right\}$ and initial conditions w_{-1} and d_0.

As proven by Na et al. (2018), if the government is able to set the devaluation rate and the tax on debt freely, then the stochastic process of the variables $\left\{c_t^T, h_t, d_{t+1}, q_t\right\}$ can be determined by the process of $\left\{y_t^T, I_t\right\}$ and the initial debt level d_0.

As discussed previously, the decision of I_t is an optimal policy for the government due to lack of commitment to repay in the international credit market. Furthermore, the default decision of the government in the next period $t+1$ is also affected by the current decision. To see this argument, first notice that the default decision in $t+1$ is determined by the state variables $\left\{y_{t+1}^T, d_{t+1}\right\}$. However, d_{t+1} is determined in period t, which means that the government in period t understands that it is able to affect the default decision in $t+1$ via the choice of d_{t+1}. As y_{t+1}^T follows a first-order Markov process, the expected value of y_{t+1}^T is a function of y_t^T, hence the expected value for the default decision on period t

is actually a function of y^T and d_{t+1}. Recall that the price for the debt q_t is related to the probability of default in the next period, according to Equation (13), it can be expressed in the contemporary variables

$$q_t = q(y_t^T, d_{t+1}). \tag{31}$$

On the one hand, this provides us the economic intuition that the government internalizes the fact that its choice of debt in the next period can affect the price of the debt. On the other hand, this allows us to clarify the dependencies of variables in the value function.

3.7 Default Decision

Following the standard Eaton-Gersovitz framework, this model considers the following three value functions: value of continuing to repay the debt v^c, value of being in good standing v^g, and value of being in bad standing v^b.

Under the period of being in good financial standing, the value for the government to continue repaying the debt is the maximum value of the utility gained by the households this period, plus the discounted value of being in a good financial standing, subject to the households' budget constraints. Formally,

$$\begin{aligned} v^c(y_t^T, d_t) = \max_{\left\{c_t^T, h_t, d_{t+1}\right\}} \quad & \left\{U\left(A\left(c_t^T, F(h_t)\right)\right) + \beta E_t v^g\left(y_{t+1}^T, d+t+1\right)\right\} \\ \text{s.t} \quad & c_t^T + d_t = y_t^T + q(y_t^T, d_{t+1})d_{t+1} \\ & h_t \leq \bar{h}. \end{aligned} \tag{32}$$

Where the first constraint is obtained by setting $I_t = 1$ in Equation (18), and the second is the constraint on working hour.

If the country is in bad standing, the consumption on tradable goods experiences a loss. The government has probability θ of regaining access to international financial markets, and probability $1-\theta$ of continuing in bad standing. During the period in bad standing, the country obtains no international borrowing, hence, the state variable for debt is excluded.

Formally,

$$v^b(y_t^T) = \max_{\{h_t\}} \quad \left\{U\left(A\left(y_t^T - L(y_t^T), F(h_t)\right)\right) + \beta E_t\left[\theta v^g\left(y_{t+1}^T, 0\right) + (1-\theta)v^b\left(y_{t+1}^T\right)\right]\right\}$$
$$\text{s.t} \quad h_t \leq \bar{h}. \tag{33}$$

The tradable consumption $c_t^T = y_t^T - L(y_t^T)$ again follows Equation (18) by setting $I_t = 0$, and is substituted explicitly into the value function.

If the country is in good standing, the government has the freedom to choose which is best for the country: to continue or to default. The decision is made by comparing the value functions of the two scenarios, given the current output shock for tradable goods and the current level of debt

$$v^g(y_t^T, d_t) = \max\left\{v^c(y_t^T, d_t), v^b(y_t^T)\right\}. \tag{34}$$

Define the default set $D(d_t)$ as the set of tradable-output levels y_t^T examined by the government in period t, in which the government's optimal respond is to default. Formally,

$$D(d_t) = \left\{y_t^T : v^b(y_t^T) > v^c(y_t^T, d_t)\right\}. \tag{35}$$

In other words, given a current debt level d_t, if the government observes that y_t^T is inside $D(d_t)$, it chooses to default.

Under rational expectations, the foreign lenders recognize the default set, hence the price for debt is determined by Equation (13), given by

$$q(y_t^T, d_{t+1}) = \frac{1 - \Pr\left\{y_{t+1}^T \in D(d_{t+1}) \mid y_t^T\right\}}{1 + r^*}. \tag{36}$$

Note that the price of debt enters the value function of continuing, $v^c(y_t^T, d_t)$.

It is obvious that the optimal labor supply is $h_t = \bar{h}$ since all functions, F, A, U, are monotonic, which implies that under the freedom to choose the devaluation rate and the tax on debt, the government can ensure full employment. Denote $w^f(c_t^T)$ the equilibrium wage function under full employment given the consumption of tradable goods. Combining Equation (8) and the Euler equation in (5a) and impose the optimal policy $h_t = \bar{h}$, we have

$$w_t = w^f(c_t^T) \equiv \frac{A_2(c_t^T, F(\bar{h}))}{A_1(c_t^T, F(\bar{h}))} F'(\bar{h}). \tag{37}$$

Knowing that the wage has downward nominal rigidity, the government sets the devaluation rate accordingly. The downward rigidity (10) states that

$$\gamma \leq \frac{W_t}{W_{t-1}} = \frac{w_t}{w_{t-1}} \frac{P_t^T}{P_{t-1}^T} = \epsilon \frac{w_t}{w_{t-1}},$$

where the second equal sign comes from Equation (20). Substitute the wage under full employment, we get

$$\epsilon_t \geq \gamma \frac{w_{t-1}}{w^f(c_t^T)}. \tag{38}$$

This is the family of optimal devaluation policies. Following Na et al. (2018) and Hinrichsen (2021), we assume that the government chooses the minimal devaluation target that stabilizes nominal wages, that is, $\epsilon_t = \gamma \frac{w_{t-1}}{w^f(c_t^T)}$.

Chapter 4: Empirical Results

Chapter 5: Conclusion and Discussion

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