Asset Prices and Creation in a Global Economy

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Abstract

This paper analyses a two country stochastic open-economy framework in which countries differ in their ability to create liquid assets. We examine the consequences of this asymmetry on international asset prices and asset creation. Higher volatility and higher growth in emerging markets drive up the liquidity premium of assets created in advanced economies, and also stimulate the latter's production of liquid assets. Financial development (innovation) in advanced economies, on the other hand, also drive up the liquidity premium of these assets, and boost growth in both economies. Even if aggregate productivity shocks are uncorrelated, aggregate investment strongly comove across countries as shocks are propagated through asset prices.

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1 Introduction

Development of financial markets typically lags economic development. Fast growing emerging markets in the recent decades are of no exception. The question of how the world economy responds to financial integration of these economies without correspondingly rapid financial development has been at the centre of discussions surrounding global imbalances. Many accounts to explain the puzzling phenomenon of 'uphill' capital flows from emerging to advanced economies have appealed to financial integration without financial development (see Mendoza et al (2009), Caballero et al. (2008), Coeurdacier et al. (2014), and Bachetta and Benhima (2011), and others.).

There is also an aspect to the difference in financial development and a pattern of the global economy that has, at the same time, received less attention. Countries may differ in their ability to produce liquid assets—due to institutional differences in financial markets. How do these institutional differences affect the global production of liquid assets and influence international prices of liquid assets? The purpose of this paper is to provide a framework to think about the global demand for and supply of liquid assets in the context of asymmetries in financial development across economies, as well as the role of liquidity management, and real investments in both emerging and advanced economies.

The notion of liquidity in this framework is captured by the ability of firms in a country to pledge their future income. We assume that some part of a firm's income stream cannot be promised or pledged to investors. Moreover, firms in advanced economies can pledge a greater fraction of future output than those in emerging markets. Our framework consists of a two-country stochastic growth model in which countries are fully integrated financially and can also trade costlessly in goods. The only market imperfection is the constraint on pledgeability. Asset supply and asset demand are both endogenous in this model, and its equilibrium pins down asset prices.

Though advanced economies also have a liquidity needs due to the pledgeability constraint, we show that when the ability to pledge future income is low enough in emerging markets, advanced economies have the incentive to sell all of its pledgeable income abroad. Thus,

emerging markets agents are the marginal holders of liquid assets, and pin down international liquid asset prices. Emerging markets demand advanced economies assets both because it needs liquidity to insure against consumption fluctuations and also to meet investment demands in the event of potential adverse productivity shocks. Its inability to produce their own liquid assets implies that they are willing to pay a liquidity premium, which in turn raises advanced economies' incentives to produce them.

We show that the creation of liquid assets depends on a weighted average of the demand for these assets from different countries—the weights depending on the severity of the non-pledgeability constraint. Emerging markets' (higher) demand for liquid assets is weighted by the non-pledgeability constraint parameter as all liquid assets are pledged to agents of emerging markets. Thus, looser plegdeability constraints in advanced economies, by placing more weight on the emerging economies' demand, stimulates the production of these assets. We show that the demand for these assets tend to rise by more than the supply of these assets, thus driving up asset prices, and pushing down the interest rate. Moreover, output rises in both economies—in the advanced economies because these liquid assets are also inputs to production (capital), and in emerging markets because better insurance via the accumulation of foreign liquid assets enables them to undertake greater investment.

Fast growth in emerging markets and their greater volatility (due to commodity price shocks, world interest rate shocks etc) are important global trends of the last few decades. Our framework shows that even if purchasing domestic capital (investment) in the event of rapid growth is desirable—as is predicted by the neoclassical growth framework—they nevertheless also accumulate liquid foreign capital—thus causing the capital-effective labor ratio to rise *globally*. The implication is that financial integration and growth in emerging markets will exert upward pressure on asset prices in advanced economies, and at the same time, stimulate liquid asset production. This can serve as a plausible explanation for the explosion of liquid assets produced in the U.S. in the last two decades. At the same time, financial crises with a dry-up of liquidity suppress the liquidity premium and lowers output in both economies. A natural follow-up question that can be answered within this framework is to what extent asset

prices and liquid asset creation will be affected when the emerging markets are able to supply their own liquid assets—that is, when their pledgeability constraint is loosened over time.

There are many reasons why part (or all) of future income is not pledgeable. According to Holmstrom and Tirole (2010), imperfect information and adverse selection may be prime causes. Firm managers may enjoy private benefits and perks that create a wedge between total returns and pledgeable returns. To the extent that these private benefits cannot be transferred or paid for up front, a part of the total surplus may not be pledge able to outside investors. Adverse selection further limits the extent to which firms can market their future income to investors. Thus, with the pledgeability constraint, firms can only count on liquidating only part of their wealth whenever they need funds.

The main difference between this model and the models of safe asset mechanism in Gourinchas and Jeanne (2014), Caballero and Farhi (2014), and the accumulation of liquid assets to overcome a working capital constraint in Bachetta and Benhima (2013) is that risk plays a large role, and our framework is stochastic. Moreover, we focus on liquidity premium and the endogenous creation of liquid assets, in contrast to Mendoza et al. (2012).

2 Model

2.1 Set-up

There are two countries in the world economy, indexed by $i \in \{A, E\}$. Each country produces a distinct intermediary good, which is traded freely and costlessly across countries. Preferences and production technologies have the same structure across countries. Labor is immobile across countries, and firms are subject to both aggregate and idiosyncratic productivity shocks.

Time is secrete, indexed by $t \in \{0, 1, ...\infty\}$. There is a continuum of infinitely-lived households, indexed by j and distributed uniformly over $[0, 1]$. Each household owns a single private firm, so that firm j is identified by the firm owned by household j. Firms employ labor in a competitive labor market and the capital accumulated by the household. Households are

endowed with a unit of labor, inelastically supplied in a competitive labor market. They invest capital in the firm that they own, and in no other firm.

Technology. Let k^i_{jt} denote the capital stock accumulated by a firm j in country i at the beginning of period t, and let n^i_t denote the total labor input hired by the firm at period t. The gross output of a country-specific good is therefore given by

$$y^i_{jt} = f\left(k^i_{jt}, n^i_{jt}, z^i_{jt}\right) \tag{1}$$

where production technology $f(\cdot)$ satisfies $f' > 0 > f''$. The idiosyncratic firm-level productivity z^i_t evolves according to a Markov process, with $z^i_{j,t+1} \sim G^i\left(\cdot|z^i_{jt}\right)$. We also allow for an aggregate productivity shock where $z^i_{t+1} \sim G^i\left(\cdot|z^i_{jt}\right)$.

Preferences. The utility function is assumed to be CRRA, $u(c) = c^{1-\sigma}/(1-\sigma)$. The consumption good of each country i is a composite of intermediary goods produced by country A and country E that takes the form of

$$c^A_t = \left[\omega^{1/\eta}\left(c^A_t\right)^{(\eta-1)/\eta} + (1-\omega)^{1/\eta}\left(c^E_t\right)^{(\eta-1)/\eta}\right]^{\frac{\eta}{\eta-1}} \tag{2}$$

$$c^E_t = \left[\omega^{1/\eta}\left(c^E_t\right)^{(\eta-1)/\eta} + (1-\omega)^{1/\eta}\left(c^A_t\right)^{(\eta-1)/\eta}\right]^{\frac{\eta}{\eta-1}}, \tag{3}$$

where ω denotes the degree of home bias, and $0 < \omega < 1$.

A representative household j in country A consumes c^A_{jt} amount of consumption goods, invests $k^A_{i,t+1}$, and purchases assets $a^{Ai}_{j,t+1}$ from country $i = A, E$. Each of these assets cost q^i_t, and represents a claim to z^i_{t+1} units of date $t+1$ output from country i. The budget constraint of a household j in country A requires that

$$k^A_{j,t+1} + c^A_{jt} + \sum_{i=A,E} q^i_t a^{Ai}_{j,t+1} \leq p^A_t y^A_{jt} + \sum_{i=A,E} p^i_t z^i_t a^{Ai}_{jt} + w^A_t.$$

A similar budget constraint holds for a representative household in country E. Naturally, consumption and physical capital need to be non-negative: $c^i_{jt} \geq 0$ and $k^i_{jt} \geq 0$ for all t.

Heterogeneity in Financial Markets. The inherent asymmetry between country A and country E lies in their financial markets, and in particular— the amount of assets firms can pledge in a given country. That is, the pledgebility constraint requires that at most $\theta^i f(k^i_{t+1}, n^i_{t+1})$ units of the firm's assets can be pledged in date t, where $\theta^E < \theta^A_t$ and $\theta^i \in [0, 1]$.

2.2 Optimization Problem and Equilibrium

Let $s^i_t \equiv (z^i_t, z^i_t)$ be the pair of aggregate productivity shocks in each country i. The optimisation problem of an individual household j in country A can be written as

$$
\begin{aligned}
V^A_{jt}(a^A_{jt}, k^A_{jt}, s_t, z^j_t) = \max_{c^A_{jt}, a^A_{j,t+1}, k^A_{j,t+1}} \; & c^A_{jt} + \beta \mathbb{E}_t \left[V^A_{j,t+1}(a^A_{j,t+1}, k^A_{j,t+1}, s^A_{j,t+1}) \middle| s^A_{jt} \right], \\
\text{s.t.} \quad & k^A_{j,t+1} + c^A_{jt} + \sum_{i=A,E} q^i_t a^{Ai}_{j,t+1} \leq p^A_t y^A_{jt} + \sum_{i=A,E} p^i_t z^i_t a^{Ai}_{jt} + w^A_t, \\
& a^A_{j,t+1} \geq -\theta^A f(k^A_{j,t+1}, n^A_{j,t+1}) \\
& c^A_{jt}, k^A_{j,t+1} \geq 0.
\end{aligned}
$$

The same problem holds for country E agents except for the parameter θ^i which differs across countries.

Given the pledgeability parameter θ^i, initial wealth distributions $M^i_0(s, k, a)$ for $i = A, B$, an equilibrium with perfect international capital mobility is defined by (i) a sequence of agents' policies $\left\{c^i_{jt}, k^i_{j,t+1}, a^{iA}_{j,t+1}, a^{iE}_{j,t+1}\right\}^\infty_{t=0}$, value functions $\left\{V^i_{jt}\right\}^\infty_{t=0}$, prices $\{p^i_t, q^i_t, w^i_t\}^\infty_{t=0}$ and distributions $\{M^i_t(s, k, a)\}^\infty_{t=1}$ such that (i) the policy rules solve problem and $\left\{V^i_{jt}\right\}^\infty_{t=0}$ are the associated value functions; (ii) goods market clear:

$$\sum_i c_{At}^i + x_{At}^i = y_{At}^i$$
$$\sum_i c_{Bt}^i + x_{Bt}^i = y_{Bt}^i$$

(iii) asset markets clear:

$$\int_j k_{jt}^i = k_t^i$$
$$\int_j a_{jt}^{AA} + \int_j a_t^{EA} = 0$$
$$\int_j a_{jt}^{AE} + \int_j a_t^{EE} = 0$$

(iv) labor markets clear:

$$\int n_{jt}^i = 1$$

for all t.

2.3 Non-Pledgeability in Emerging Markets

When $\theta^E = 0$, the first order conditions associated with problem ... amounts to

$$q_t = \mathbb{E}_t \left\{ m_{t+1}^E p_{t+1}^A z_{t+1}^A \right\}$$
$$1 = \mathbb{E}_t \left\{ m_{t+1}^E p_{t+1}^E z_{t+1}^E f'(k_{t+1}^E, n_{t+1}^A) \right\}$$

where $m_{t+1}^E \equiv \beta \frac{u'(c_{t+1}^E)}{u'(c_t^E)}$ is the stochastic discount factor for country-A agents. The first equation refers to the demand for assets in country E, and the second equation determines the

optimal investment made at t. For country A, the first order conditions amount to

$$q_t = \mathbb{E}_t \left\{ m^A_{t+1} p^A_{t+1} z^A_{t+1} \right\} + \frac{\gamma_t}{u'(c^A_t)},$$
$$1 = \mathbb{E}_t \left\{ \left[m^A_{t+1} p^A_{t+1} z^A_{t+1} + \frac{\theta^A_t \gamma_t}{u'(c^A_t)} \right] f'(k^E_{t+1}, n^E_{t+1}) \right\},$$

where $m^A_{t+1} \equiv \beta \frac{\mu^A_{t+1}}{u'(c^A_{t+1})}$ is the stochastic discount factor for country-A agents, γ_t is the Lagrangian multiplier associated with the pledgeability constraint.

Liquidity Premium. There is a liquidity premium so long as $q_t = \mathbb{E}_t \left\{ m^E_{t+1}, p^A_{t+1} z^A_{t+1} \right\} > \mathbb{E}_t \left\{ m^A_{t+1} p^A_{t+1} z^A_{t+1} \right\}$. In other words, the Lagrangian multiplier satisfies $\gamma_t > 0$.

Because country E is less insured than country A due to its inability to pledge future assets, we know that so that $a^A_{t+1} = -\theta^A_t f(k^A_{t+1}, n^A_{t+1})$. In other words, country E gobbles up all of pledgeable assets by country A. Since country-A agents are not financially constrained, the correlation between m^A_{t+1} and $p^E_{t+1} z_{A,t+1}$ tends to be low. This drives up the wedge between $\mathbb{E}_t \left(m^E_{t+1} p^A_{t+1} z^A_{t+1} \right)$ and $\mathbb{E}_t \left(m^A_{t+1} p^A_{t+1} z^A_{t+1} \right)$, and thus incentivises country A agents to sell its assets at a premium to country E agents. In fact, they sell the maximum amount of claims allowed by the pledgeability constraint.

Asset Creation. Country A is the supplier of assets in the world. The amount of assets supplied (left hand side) depends on a weighted-average of asset demand from the two economies, the weights being the portion of assets that is pledgeable:

$$\frac{1}{f'(k_{Bt+1}, n^A_{t+1})} = (1 - \theta^A_t) \mathbb{E}_t \left\{ m^A_{t+1} p^A_{t+1} z^A_{t+1} \right\} + \theta^A_t \mathbb{E}_t \left\{ m^E_{t+1} p^A_{t+1} z^A_{t+1} \right\}$$

Asset creation is increasing in q_t and the liquidity premium (second term on the RHS). This equation illustrates two points. First, it shows that higher productivity risk in emerging markets increases liquid asset supply k^A_{t+1}. This comes from a greater demand for liquid assets by country E. Second, financial development in advanced economies also tend to increase

asset supply, as more weight is put on the higher demand for assets in country E.

Assumption 1 *Country E agents have log utility, while Country A agents have linear utility.*

With the assumption of log utility, we can guess that the consumption of agents in E is a constant fraction of its wealth at t:

$$c_t^E = (1-\beta)\left(Y_t^E + \theta_t^A Y_t^A\right),$$

where $Y_t^j \equiv p_t^j y_t^j$ is country j's nominal output. This implies that the price of asset in E is:

$$q_t = \beta E_t \left[\frac{Y_t^E + \theta_t^A Y_t^A}{Y_{t+1}^E + \theta_t^A Y_{t+1}^A} p_{t+1}^A z_{t+1}^A\right]$$

The expression for asset prices demonstrates the factors that can affect it. For simplicity, assume that there is only one good so that the relative price is 1. Then, it is clear that higher expected productivity or terms of trade in advanced economies tends to drive up asset prices. An increase in the correlation of A's dividends, $p_{t+1}^A z_{t+1}^A$ with world output at $t+1$ increases the riskiness of A's assets and thus lowers asset prices. A rise in the correlation of productivity between the two economies also reduces asset prices. The expression also shows that higher growth in E economies, however, may *raise* asset prices, as more weight is placed on emerging markets in determining output and their (greater) volatility in productivity.

3 Numerical Illustration

We proceed to conduct a numerical experiment to analyze how important global trends and shocks characteristic of the last few decades impact the world economy. The simple experiment helps build intuition for the mechanism at hand.

We consider two economies, A and E, with non-pledgeability constraint parameters $\theta_t^A = 0.8$, and $\theta^E = 0$. These represent Advanced economies and Emerging Asia, respectively. The experiment assumes that both regions are already in full financial integration during period $t = 0$ (corresponding to 1990). We allow country E to be initially capital scarce. Preference

and technology parameters are standard. We maintain the assumption of log utility, and let the discount factor $\beta = 0.96$ on an annual basis. The capital share α is set at 0.28.[1]

We assume that total factor productivity is uncorrelated between Asia and Advanced economies. productivity in Advanced economies grows at the steady-state growth rate of 1.5% throughout. For experiments with faster growth in emerging markets, we calibrate their productivity growth, along with the initial relative values of effective labor and capital-effective-labor ratios, k^E_{-1}/k^A_{-1}, to match relative output share in 1970 and 2010, as well as the relative capital-effective-labor ratios of the two regions in 1990, as measured by Hall and Jones (1999).

We first show conduct a benchmark experiment in which the growth rates are the same across countries, at 1.5% per year, except that E has higher volatility in productivity. Subsequently, three experiments are considered: 1) Benchmark scenario; 2) higher growth in emerging Asia ; 3) a rise in volatility in emerging Asia and 4) a drop in θ^A from 0.8 to 0.08. The liquidity premium in the benchmark scenario is about 10% per year. In the event of higher growth the liquidity premium rises to about 14% on average per year. Investment comoves across countries in all cases, and capital effective labor ratio also rise in the long run.

[To be continued]

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