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## FUNDING EXTERNALITIES, ASSET PRICES, AND INVESTORS' "SEARCH FOR YIELD"

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# Funding Externalities, Asset Prices, and Investors' "Search for Yield"

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## Abstract

This note presents a simple model that nests the "excess liquidity" and "savings glut" hypotheses of the debate on the recent asset price boom. It clarifies the notion of investors' 'search for yield' and shows how financial frictions influence asset price dynamics.

*Keywords:* Search for Yield; Funding Externalities

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## Abstract

This note presents a simple model that nests the “excess liquidity” and “savings glut” hypotheses of the debate on the recent asset price boom. It clarifies the notion of investors’ ‘search for yield’ and shows how financial frictions influence asset price dynamics.

## 1. Introduction

Recent asset price developments in the major economies have been the subject of much debate. Real long-term interest rates are historically low, credit spreads appear unusually compressed, and prices in a range of financial markets – from gold to real estate – have risen rapidly. King (2006) summarises the two main explanations for this behaviour. On one view, rapid money and credit growth has prompted investors to migrate to higher-yielding, riskier assets. The greater flow of funds into more innovative and riskier asset classes as investors *search for yield* has, arguably, driven asset prices up and interest rates down, inducing migration yet further down the risk spectrum.

Figures 1 and 2 show how real long-term interest rates and broad money growth across the advanced industrial countries have evolved in recent years.<sup>1</sup> The low policy rates in many of the major economies also appear to have contributed to a buildup of “carry trades”, with investors borrowing in low-yielding currencies (eg the yen) to invest in high-yielding currencies, such as the Australian dollar. Galati and Melvin (2004) document the surge in foreign exchange market turnover between 2001 and 2004 and emphasise the role played by carry trade activities. Data on foreign bonds purchased by Japanese retail investors also reveal significant ongoing outflows from yen to the Australian and New Zealand dollars (BIS Annual

Report, 2007).<sup>2</sup>

An alternative view attributes the decline in real interest rates, and the implied rise in asset prices, to structural shifts in saving and investment patterns (see Bernanke, 2005, Rajan, 2006a). In recent years, these patterns have been dominated by developments in China and the investment patterns of industrial country corporations. IMF (2006) estimates suggest that the gross domestic savings rate in China increased from around 35 percent of GDP to 50 percent of GDP between 2000 and 2005, while gross capital formation also rose to 45 percent of GDP over the same period. By contrast, investment rates have fallen across industrial countries to about 20% of GDP. The issue of whether the excess of desired savings over realised investment reflects savings behaviour in China (due, perhaps, to mercantilist exchange rate policies (Dooley et.al, 2003) or investment restraint following the boom of the late nineties and the advent of investment in intangible assets (Rajan, 2006b) remains an open question.

We present a simple model, inspired by Blanchard (1981) and Krugman (1991), that nests the "excess liquidity" and "savings glut" hypotheses of the current debate on the global asset market boom. Our paper clarifies the notion of a *search for yield* and shows how financial frictions affecting the ability of agents to make markets for risky securities might influence asset price dynamics. Our analysis also demonstrates how asset prices driven by investors' "search for yield" could have negative consequences for financial stability.

## 2. Model

A closed economy is populated by a continuum of risk-neutral investors with unit mass. Each investor holds an endowment which needs to be transformed or

invested for it to produce a stream of returns. Time is continuous and indexed by  $t \in [0, \infty)$ .

Investors can choose to invest their endowment into a high-yielding asset whose technology is associated with an externality. Specifically, investors create positive externalities for each other as they transform their endowment into the high-yield asset. The greater the flow of funds into the high-yield sector, the greater the flow profit. Plantin and Shin (2007) and Brunnermeier and Pedersen (2007) highlight how funding externalities influence speculative dynamics and asset market liquidity.

The property sector is one example of such a market. A flow of money into housing assets increases prices, raising the value of collateral and strengthening the balance sheets of all home owners in the economy. Home owners are able to refinance their extant mortgages at a lower interest rate, increasing the flow profits (or, rather, reducing the funding costs) on their initial investment. Following Shin (2005) and Plantin and Shin (2007), the high-yield asset can also be viewed as a carry-trade position, where the funding costs of maintaining a position depend on changes in the value of collateral in the funding currency. With such a position, the trader can incur a profit or loss even if the price of the asset (or the exchange rate) remains unchanged over time. For instance, before the 1997 crisis, Asian financial institutions borrowed at (low) dollar rates and invested in high-yielding local assets. This carry-trade strategy was profitable with fixed exchange rates, and the profits were increasing as long as higher foreign inflows served to reduce the funding costs.

Let the real flow profit generated from entering such trades with a fraction,  $k_t$ ,

of the endowment be

$$v_t = \bar{v} + \gamma(k_t - k^*), \quad (1)$$

where  $\gamma \geq 0$  and  $0 \leq k_t \leq 1$ . The parameter  $\gamma$  governs the sensitivity of flow profits to the flow of funds into the high-yield asset. If  $\gamma = 0$ , the price of the asset is insensitive to the flow of funds into and out of the market and  $v_t = \bar{v}$ , the fundamental value of the asset. But if  $\gamma > 0$ , there are externality effects commensurate with the "weight of money" that has accumulated in market.<sup>3</sup> At the fixed point,  $k_t = k^*$ , the overall level of inflows is such that the investor receives the fundamental value of the high-yield asset.<sup>4</sup>

To sharpen our focus on investors' search for high-yielding assets, we restrict their portfolio choice to be binary. As an alternative to the high-yield asset, investors may invest the endowment in short- or long-term bonds offering real rates of return  $r_t$  and  $R_t$  respectively.<sup>5</sup> Assets are assumed to be perfect substitutes, so they have the same short-term (instantaneous) rate of return, i.e.

$$r = \frac{v_t}{q_t} + \frac{\dot{q}_t}{q_t}, \quad (2)$$

where  $v_t$  is the cash flow from the high-yield asset and  $\dot{q}_t/q_t$  is the rate of capital gain on it. Rearranging (2) gives a dynamic equation for  $q_t$ , the price of having a unit of capital in the high-yield sector, namely

$$\dot{q}_t = r q_t - v_t. \quad (3)$$

Arbitrage between short- and long-term bonds also means

$$r = R_t - \frac{\dot{R}_t}{R_t}. \quad (4)$$

The efficiency with which savings can be channelled towards investment depends on financial development and the degree to which intermediaries are able

to solve informational problems (Levine 1997). We assume that capital is transformed into the high-yield asset at a rate determined by intermediation costs,  $\mu$ , and the price of the asset relative to its fundamental value, i.e.

$$\dot{k}_t = \mu \left( q_t - \frac{\bar{v}}{r_t} \right). \quad (5)$$

Agents in the economy recognise the existence of funding externalities and are therefore willing to invest in the high-yielding asset when the price exceeds its fundamental value. The parameter  $\mu > 0$ , captures factors that influence financial sector development. A low value of  $\mu$  means that financial intermediation costs are high and asset transformation is slow, whereas large values are consistent with well developed financial markets and the rapid movement of funds into new financial transactions. Rajan (2006b) stresses that different financial systems have very different abilities to create savings instruments and points to the shortage of collateralisable real assets in the global economy. Recent events in sub-prime credit markets also illustrate how informational problems in mature (as well as emerging) markets can disrupt the asset transformation process.<sup>6</sup>

### 2.1. Steady state equilibria and the 'search for yield'

The conditions for arbitrage (3) and capital market equilibrium (5) comprise a simple linear dynamic system in  $q, k$  space. Figure 3 illustrates. Capital market equilibrium,  $\dot{k}_t = 0$ , is depicted by the horizontal isocline parallel to the  $x$ -axis. The intercept is  $\bar{v}/r$ , the discounted fundamental value of the high-yielding asset. The upward sloping isocline,  $\dot{q}_t = 0$ , has slope  $\gamma/r$  and intercept  $(\bar{v} - \gamma k^*)/r$  since steady state asset prices are given by

$$q^* = \frac{\bar{v}}{r} + \frac{\gamma}{r}(k - k^*). \quad (6)$$

Two conditions must be met if the two isoclines are to intersect. These also specify the two stable steady state equilibria of this system.

- An equilibrium in which *all investors* “search for yield” and transform their endowment into the high-yielding asset. Specifically,

$$k_H = 1 \text{ and } q_H = \frac{\bar{v} + \gamma(1 - k^*)}{r} > \frac{\bar{v}}{r}.$$

If all investors “search for yield” the actual value of holding the high-yield asset must exceed the fundamental value of the asset.

- An equilibrium in which *none of the investors* transform their endowment and where

$$k_L = 0 \text{ and } q_L = \frac{\bar{v} - \gamma k^*}{r} \leq \frac{\bar{v}}{r}.$$

In each case, the equilibrium depends on the strength of the funding externality,  $\gamma$ . If net inflows of funds are expected to rise, then the fraction of the endowment transformed increases – everyone invests in the high-yielding asset if they think others will do likewise. But if inflows are expected to fall then no one invests in the high-yield asset.

Figure 3 shows a third (unstable) steady state at the intersection of the isoclines, at  $k_t = k^*$  and  $q_t = \bar{v}/r$ . At  $k^*$ , investors are indifferent between the two steady states – so the distance between  $k^*$  and 1 defines the range of values over which a *search for yield* takes place. The intermediate fixed point is analogous to the mixed strategy equilibrium of a Nash game in which investors select between two pure strategies ( $k_H = 1$  and  $k_L = 0$ ).

## 2.2. Asset price dynamics

The dynamic behaviour of asset prices in our model are described by differential equations involving  $q_t$  and  $R_t$ . We therefore solve for both these variables in terms of the underlying frictions,  $\gamma$  and  $\mu$ , to show how funding externalities and financial innovation contribute to asset price behaviour. The characteristic equation of the dynamic system is

$$\lambda^2 - r\lambda + \mu\gamma = 0. \quad (7)$$

Focusing on real eigenvalues, i.e. where  $r^2 > 4\mu\gamma$ , the dynamic equation for  $q_t$  in terms of the key financial frictions,  $\mu$  and  $\gamma$  is simply

$$q_t = Ae^{\mu t} + Be^{\gamma t}, \quad (8)$$

where  $A$  and  $B$  are arbitrary constants. Clearly, as  $\gamma, \mu \rightarrow 0$ ,  $q_t \rightarrow A + B$ , or equivalently,  $q_t \rightarrow \bar{v}/r$ . The stronger the financial frictions, the further they take asset prices away from fundamental valuations.

From the arbitrage condition between short- and long-bonds (4), we know that

$$\dot{R}_t = R_t^2 - rR_t,$$

and to solve for equations of the form  $\dot{R}_t = f(R_t)$ , we use the fixed point of the differential equation, which occurs when  $\dot{R}_t = 0$ .

Setting  $R_t^2 - rR_t = 0$ , it is clear that  $R^* = r$  is the fixed point of the differential equation. Taylor series expansion of  $f(R_t)$  around  $R^*$  allows  $f(R_t)$  to be approximated as  $f(R_t) = m(R - R^*)$ , where  $m = \frac{df}{dR} |_{R=R^*} = r$ . Defining a new variable  $g = R - R^*$ , allows us to write the differential equation as  $\dot{g}_t = mg_t$ . The dynamic

equation for the long-term real interest rate can then be expressed as

$$R_t = r + Ce^{rt}. \quad (9)$$

where  $C$  is another arbitrary constant. Note that equations (2) and (8) can be substituted into the expression for equation (9) to allow long-term interest rates to be expressed in terms of the frictions  $\gamma$  and  $\mu$ .

### 3. Excess liquidity or saving glut?

The hypotheses highlighted by King (2006) and other policymakers can now be cast into this simple framework. Whether the asset price boom of recent years is a result of speculative investments in activities, such as the carry trade, or a rational response to fundamental macroeconomic factors is a key question for policymakers, particularly following the reappraisal of the pricing of risk by financial market participants during 2007.

Consider the equation for steady state asset prices,

$$q^* = \frac{\bar{v} + \gamma(k_t - k^*)}{r}, \quad (10)$$

where  $q^*$  can be regarded as the ratio of asset prices relative to a constant level of unit goods prices.

This ratio is determined by the fundamental value of the asset, the rate of interest, and the strength of funding externalities in key asset markets. In the nomenclature of current policy debate, the ratio could be high because of "excess savings" or improvements in the quality of risky credit ( $\bar{v}$ ); low interest rates or "excess global liquidity" ( $r$ ); or if prices are more sensitive to flows of hot money into "carry-trade assets" ( $\gamma$ ).

King (2006) observes that the current ratio of asset prices to goods prices may be abnormally high and that a reversal of "the search for yield" could trigger a reversion of the ratio to "normal" levels. Our model implies that the impact of sudden shifts in sentiment is much greater if excess monetary growth underpins asset price behaviour and if prices are sensitive to funding externalities.

Figures 4, 5 and 6 illustrate. Accommodative monetary policy (Figure 4) and stronger funding externalities,  $\gamma$ , (Figure 5) effectively shift the "probabilities" that investors attach to their investment strategies, influencing the range of macroeconomic fundamentals over which the search for yield takes place. Asset prices are more volatile, responding to shifts in sentiment by switching between  $q'_H$  and  $q'_L$  rather than  $q_H$  and  $q_L$ . By contrast, with an increase in  $\bar{v}$  (Figure 6), both the  $\dot{k}_t = 0$  and  $\dot{q}_t = 0$  loci shift upwards so that there is an increase in the steady-state value of  $q^*$ . But there is no increase in asset price volatility and the range over which investors search for yield is unchanged.

Monetary accomodation and significant funding externalities also hold out the possibility of self-fulfilling dynamics in our model. Complex roots may arise if  $r$  is sufficiently low and/or  $\gamma$  is sufficiently large. In both cases, it implies increased interdependency amongst the actions of investors as they seek out the high-yield asset. Rapid asset transformation (high  $\mu$ ) also contributes to speculative dynamics, pointing to the potential dark side of financial innovation. But it is important to note that when financial frictions exacerbate strategic complementarities in this fashion, we cannot reach clear conclusions about the resulting complex dynamics without imposing further structure on the problem.

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**Notes**

<sup>1</sup>The rise in asset prices over this period also coincided with a steady decline in the volatility of asset prices. This secular decline is likely to have reflected the greater perceived resilience of economies to macroeconomic shocks and to the greater credibility of policymakers. A detailed analysis of the reasons for the decline of asset price volatility is beyond the scope of our model.

<sup>2</sup>In recent work, Hattori and Shin (2007) document a broader notion of the carry trade in terms of shifts in the balance sheet composition of major international banks.

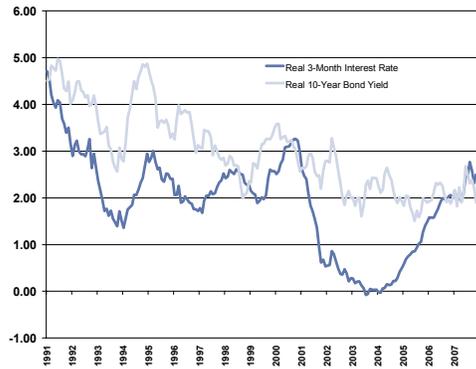
<sup>3</sup>The parameter  $\gamma$  may also be interpreted as "fundamental" source of positive network externalities, where individual desirability of adoption depends on what others do, thereby driving up asset prices. Examples include the internet and the railroad. We are grateful to a referee for suggesting this interpretation.

<sup>4</sup>When viewed as a carry trade activity, our reduced form representation implicitly allows for short sales and leverage by investors. Carry trades typically involve selling short funding currencies and buying target currencies, often by leveraging. The induced excess demand for target currencies leads to an appreciation which, in turn, encourages other investors to adopt the strategy. See Galati et.al (2007) for a description of carry trade strategies used in practice.

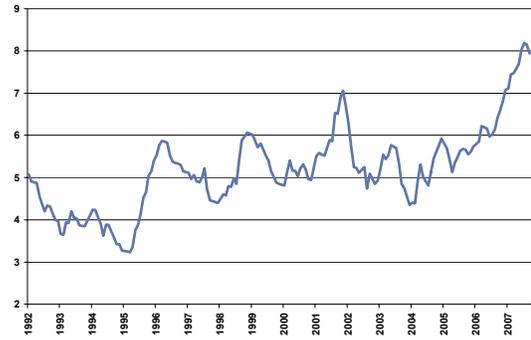
<sup>5</sup>Since, in what follows, the short-term rate does not vary with time, we drop the time subscript in subsequent discussion.

<sup>6</sup>See the Bank of England Financial Stability Report (November 2007) for a detailed discussion of information difficulties in global credit markets.

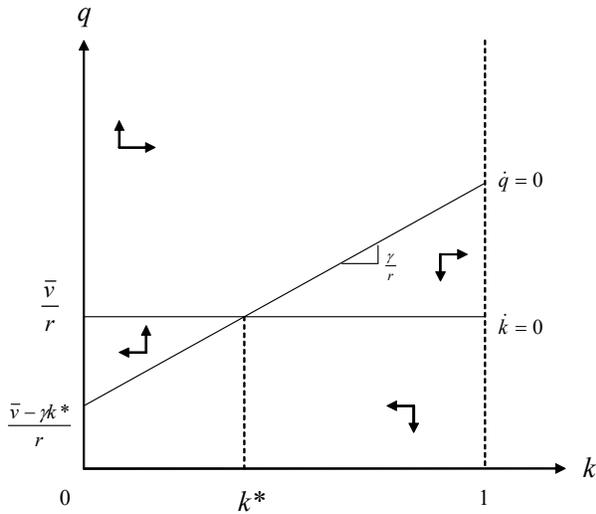
**Figure 1: OECD Long and Short rates**



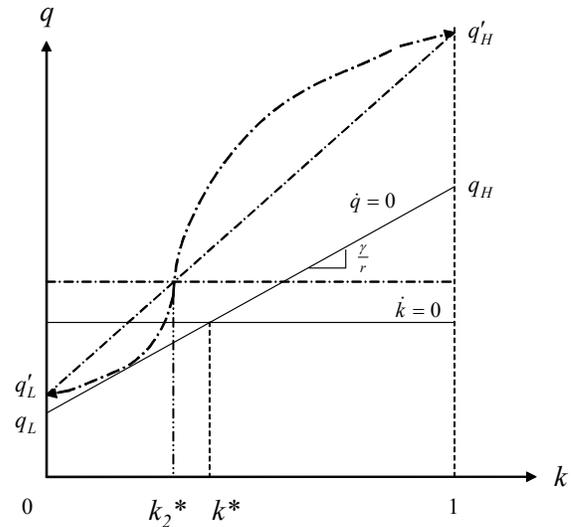
**Figure 2: Annual Growth rate of Broad money in OECD**



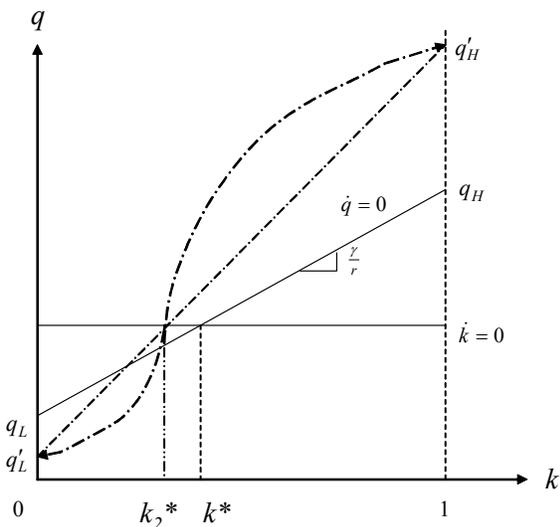
**Figure 3: Linear system in  $k$  and  $q$**



**Figure 4: "Excess Liquidity" and Search for Yield**



**Figure 5: Sensitivity of funding externality and Search for Yield**



**Figure 6: "Saving Glut" and Search for Yield**

