# Inflation Targeting and Financial Stability*

Franklin Allen Jae Hyoung Kim Ansgar Walther

Imperial College London

17 May 2024

**Abstract**

There has been a long running debate on how central banks should deal with financial instability and particularly whether monetary policy should be used to "lean against the wind" by raising interest rates when asset prices seem too high. However, Svensson (2017) has argued the costs from raising interest rates in terms of the likelihood of a slowdown or recession are larger than the benefits in terms of a reduced probability of a crisis. Another possibility is to use macroprudential tools to control asset prices, but this approach has not proved very effective. This paper makes two points. The first is that it is necessary to look at the whole financial system to understand why real estate prices can increase so much. The case of China is given where one of the main reasons that real estate prices have risen so much is that the stock market does not provide a reasonable alternative investment. The second is that an alternative monetary policy to leaning against the wind to deal with financial instability is to pursue an accommodative monetary policy. A simple model is presented where this is optimal. The key insight is that both inflation and financial instability can be costly, and these costs must be traded off.

* Prepared for the conference on "The Quest for Nominal Stability: Lessons from Three Decades with Inflation Targeting" held at the Sveriges Riksbank, 23-24 May 2024.

## 1. Introduction

The traditional view before the 2007-09 Global Financial Crisis was that regulation of individual banks would prevent systemic risk and monetary policy could focus on inflation targeting. For example, Schwartz (1998) argued that price stability, maintained by setting an inflation target, should be the main objective of central banks. Anchored inflationary expectations would be achieved by inflation targeting and lead to predictable returns on investment and improved financial stability. Also, enhanced transparency and accountability of central banks, bolstered by inflation targeting, would have positive spillover effects on financial stability.

The 1997 Asian and other crises were difficult to reconcile with this view but were regarded by many as emerging country problems. In an important paper, Borio and Lowe (2002) documented a relationship between credit growth, real estate/asset price increases and subsequent collapses and financial instability and suggested central banks should "lean against the wind" by raising rates to prevent future instability. This perspective was not widely accepted. However, the 2007-09 Global Financial Crisis led to a re-evaluation of the traditional view. The question became how should governments and central banks maintain financial stability and price stability?

Smets (2014) divided the literature resulting from this debate into three categories.

<u>(i) Leaning against the wind vindicated</u>

Borio and Lowe (2002) showed that credit expansion with increased asset prices leads to an increase in the likelihood of financial instability even within a low inflation setting. Borio and White (2004) argued that monetary policy (e.g., inflation targeting) should consider financial stability by leaning against the wind, to prevent the build-up of financial imbalances. White (2006) also argues that price stability alone is not enough, advocating for the inclusion of financial stability considerations within monetary policy.

Woodford (2012) provides a simplified version of the Curdia and Woodford (2009) model, a New Keynesian model, advocating for the implementation of leaning against the wind monetary policy. Woodford (2012) shows monetary policy responds to financial imbalances while simultaneously maintaining price stability, following the integration of financial stability measures into the model.

In an influential contribution, Svensson (2017) considers whether the costs of leaning against the wind exceeds its benefits. He provides evidence that the costs of raising interest rates from to contain an asset price boom arising from a slowdown in growth or a recession are considerably higher than the benefits of reducing the probability of a financial crisis.

Very few central banks have actually tried to lean against the wind. None has used it as a regular and repeated policy.

(ii) Financial stability is price stability

Another view is that financial stability and price stability are closely intertwined and inseparable. According to this view, monetary policy should prioritize financial stability since price stability relies on it. Brunnermeier and Sannikov (2014) build on Kiyotaki and Moore (1997) and Bernanke, Gertler, and Gilchrist (1999). In their model, Brunnermeier and Sannikov (2014) put financial frictions at the centre of the monetary policy transmission mechanism. Their view is that monetary policy should unblock balance sheet impairments and allow funds to flow to the productive parts of the economy.

(iii) Modified Jackson Hole Consensus

This view supports a separation of policies to achieve financial stability and price stability. Financial stability is the responsibility of macroprudential policies. These had two types of components. The first involves policies that prevent asset prices growing dramatically through direct intervention in real estate and other asset markets. For example, there could be restrictions on the number and size of mortgages, and the introduction of various types of real estate taxes such as transfer taxes, annual property taxes and so on. The second set of components are those designed to make the banking system more resilient. Examples of these are regulations on capital buffers, introduction of contingent bonds that turn into equity should a bank run become financially distressed, liquidity regulations and so on.

Once financial stability is taken care of by macroprudential policy, then price stability can be the responsibility of monetary policy. To some extent this view became the conventional wisdom among many central bankers and policymakers.

One example of a model that captures the ideas behind the Modified Jackson Hole Consensus is contained in Collard, Dellas, Diba, and Loisel (2017). They build a New Keynesian model with banks to examine the optimal interactions between monetary and macroprudential policy instruments. In their benchmark model, with perfectly competitive banks and constant marginal costs, it's optimal that monetary and macroprudential policy instruments serve distinct duties.

Most countries have adopted macroprudential regulations and have inflation targeting as their basic method of interest rate setting. The formal legal structures governing the central banks do differ to some degree. Two interesting examples are Sweden and Norway. In Sweden the overriding objective of the 2023 Sveriges Riksbank Act is to ensure low and stable inflation. Without neglecting price stability, monetary policy should also consider the real economy. The build-up of financial imbalances should be counteracted and the time to return to the inflation target should be adjusted if necessary. In contrast, in Norway the 2020 Central Bank Act has as a primary objective maintaining monetary stability, promoting the stability of the financial system, and an efficient and secure payment system. The secondary objective is to contribute to high and stable output and employment. So, while in Norway financial stability is explicitly ranked equally with monetary policy, in Sweden it is not.

In this paper, we revisit the conventional wisdom incorporated in the Modified Jackson Hole Consensus. In Section 2, we consider the effectiveness of macroprudential policies. The main example involves documenting the extreme case of China. Here, the first type of macroprudential policy, namely direct intervention in the real estate market has been extensively used. Nevertheless, the policy has not been that successful as real estate prices have risen considerably. While there are certainly difficulties with enforcing such policies, we argue that this is not the major issue. It is necessary to look at the financial system as a whole. In particular, the alternatives available to investors are very limited in China. The main one, other than low yielding deposit accounts and fixed income wealth management products, is the stock market. Allen, Qian, Shan, and Zhu (2024) show that the average real return on the Chinese A-share over the last two decades has been around zero in real terms. It is then not surprising that people overwhelmingly invest their wealth in real estate and macroprudential polices have little effect.

In addition to the large potential costs from financial instability, there is also a large misallocation of resources. High property prices are to a large extent transfers rather than leading to an increase in the productive capacity of the economy. The lack of savings going into the stock market leads to low growth because it limits the investment in firms and their productive capacity. The section briefly explains the theoretical model of Allen, Barlevy, and Gale (2022) that models this market failure.

Most theories of financial stability assume contracts are written in real terms (e.g., Diamond and Dybvig (1983), Allen and Gale (1998, 2000a) and Diamond and Rajan (2001, 2005)). With real contracts crises arise because banks may be unable to make the promised payments on their deposits because the returns on their assets are lower than these. However, in practice, contracts used in banking are in nominal terms. This potentially means financial crises can be avoided because the central bank can create enough liquidity to allow banks to fulfil their contracts. This point is well put by Buiter (2007).

*"Liquidity is a public good. It can be managed privately (by hoarding inherently liquid assets), but it would be socially inefficient for private banks and other financial institutions to hold liquid assets on their balance sheets in amounts sufficient to tide them over when markets become disorderly. They are meant to intermediate short maturity liabilities into long maturity assets and (normally) liquid liabilities into illiquid assets. Since central banks can create unquestioned liquidity at the drop of a hat, in any amount and at zero cost, they should be the liquidity providers of last resort both as lender of last resort and as market maker of last resort....*

Section 3 explains the model of financial stability and price stability that Allen, Carletti and Gale (2014) develop to consider this type of policy. In this, the central bank provides liquidity to commercial banks that raise funds through deposits and make loans to firms. In the simplest case, there is aggregate risk from loan returns and the liquidity needs of depositors. The main result is to show that if the central bank provides liquidity to the commercial banks and that enables them to meet the commitments to their depositors, then there is no financial instability. This institutional structure implements the first best allocation. There is inflation in this case, but this is desirable because it allows the risk sharing that is necessary in this economy that results from the aggregate risk from loan returns and liquidity needs of depositors. Because the risk is aggregate and therefore observable, the central bank policy of providing the liquidity that commercial banks need is not subject to moral hazard. If there is idiosyncratic liquidity risk so that individual banks differ in the liquidity demands of their depositors, then interbank markets can effectively deal with these shocks, so the efficiency result is maintained. Allowing for idiosyncratic loan risk requires institutions or markets allowing real transfers between banks for the efficiency result to hold. However, these are subject to problems of moral hazard and other incentive problems. The model potentially provides insights into the inflation that occurred after the Covid-19 pandemic.

Finally, Section 4 contains conclusions and directions for future research.

## 2. Problems with Macroprudential Regulation

As mentioned above, Borio and Lowe (2002) documented a relationship between credit growth, asset price increases and collapses (bubbles), particularly in real estate and financial instability – verified in subsequent work such as Jorda, Schularick and Taylor (2015) and Mian, Sufi and Vernier (2017). The global financial crisis that struck in 2007 illustrates this relationship. In countries such as the U.S., Ireland and Spain, significant run ups in property prices were followed by collapses, bank runs and bail outs both of banks and, in the case of Ireland and Spain, of countries.

A large part of the discussion in the macroprudential literature has been on how to prevent these changes in real estate prices. In this section, we will focus primarily on the effectiveness of these kinds of regulations. They consist of a variety of measures such as caps on loan-to-value ratios when purchasing with mortgages, restrictions on the number of properties that can be bought using mortgages, and various types of real estate taxes. We will focus on China as this provides an extreme example of the ineffectiveness of these kinds of measures.

Figures 1-5 show the path of real estate prices from 2002-2023 for China as a whole and for the four major (tier 1) cities of Beijing, Shanghai, Guangzhou, and Shenzhen. These graphs normalise prices at the end of 2002 at 100 and then adjust for inflation. They also take six-month averages to smooth the data. It can be seen that for the country as a whole there has been a doubling of prices in this period. For the major cities, prices have been more volatile with much larger overall increases. In Beijing and Shanghai, prices are about four times what they were initially, while in Guangzhou and Shenzhen they are four and a half to five times larger than to start with. These figures do not take account of the flow of services or rents accruing from these properties and so are a lower bound on their attractiveness.

Not surprisingly, the authorities have been very concerned with these price rises and have used a whole set of macroprudential measures such as restrictions on mortgages to control them and reduce them. Nevertheless, they have been very successful long-term investments for those undertaking them.

Alternative ways for households to save in China are limited. There are fixed income alternatives like deposit accounts and various wealth management products but the real returns on these are much lower than on real estate, typically just above zero. This leaves the other major investment possibility, which is the stock market. Allen, Qian, Shan, and Zhu (2024) considers the long run performance of the domestic Chinese stock markets with those of Brazil, India, Japan, and the U.S. and externally listed Chinese (but domestically operating) firms. Figure 6 shows the real performance of these countries' stock markets from the end of 2000 until the end of 2023. A weighted average of listed stock prices in each country are normalised to one in domestic currency at the start date. Any dividends paid are reinvested and adjustments are made for domestic inflation, so the returns measured are real. Externally listed Chinese firms are mostly listed in Hong Kong, where the currency is pegged to the U.S. dollar and the U.S. so the performance of these is measured in U.S. dollars and adjusted for the U.S. inflation rate.

Several things stand out from the figure. The first is that despite China being the fastest growing large economy in the world for the period considered, China's domestic stock markets are, together with Japan's, the worst performing in real terms. The overall real return for the 23 years considered is around zero. This contrasts sharply with the two large emerging economies of Brazil and India, and the U.S., the other major developed economy.

All of these countries' stock markets far outperform China's domestic (A-share) markets. The second thing that stands out is that China's externally listed firms have done much better than the domestically listed firms despite the fact both sets operate mainly in mainland China and are subject to the same laws and regulations.

Why are there these stark differences? Allen et al. (2024) point to three major factors for the poor performance of the domestic Chinese stock markets.

1. Behavioural factors
2. Poor corporate governance
3. Institutional factors, particularly listing and delisting requirements

One of the features of China's stock markets is that they are dominated by retail investors. Although institutional investors have become more important in recent years, individuals are still responsible for a large proportion of the trading and have an important influence on prices. In terms of corporate governance, domestically listed Chinese firms, particularly large ones and those that are state owned enterprises are not very interested in wealth creation for shareholders. Other objectives such as maintaining employment are important for them. The overall effect is that companies invest large amounts at low returns. Finally, the traditional listing process required two to three years of positive profits before listing was possible. In other countries, many newly listed firms are at an early stage and are making losses for some time after they are listed as they grow their businesses and develop new products. The regulatory authorities have made large improvements in recent years in reforming these listing rules so this problem is no longer as great as it was previously. Delisting is also problematic and is very rare in China. Instead failed companies become shells and are then acquired by other companies that use this as a backdoor way of listing.

Interestingly, these factors are not as important for externally listed firms and they are able to perform much better.

A comparison of the returns from investing in real estate and the stock market in China is stark. There is an overwhelming incentive to buy real estate rather than stocks. This is what Chinese households do. China's main household survey shows that Chinese household portfolios have, on average, 1% in equity and 59% in real estate. Faced with the large differences in returns, macroprudential regulations trying to limit real estate price increases have little chance of overcoming the attractiveness of property as an investment. It is only in recent years with the widespread financial problems of real estate developers and the prospect of bankruptcy of these, that real estate in China has started to be widely questioned as a desirable investment.

The problem in China's housing sector is not just one of rapid price increases. It has consumed an immense amount of resources. Rogoff and Yang (2021, 2022) provide evidence that the direct value added of activities in real estate are about 11-12% of GDP in recent years. The demand for construction generates demand for materials and services of many kinds. If these upstream activities are taken into account, the share of GDP going to real estate activities is around 25%. The outcome of devoting these large resources to construction is that average residential space per person is similar to Germany, France, and the UK.

The large proportion of GDP going to real estate suggests there may be a misallocation of resources in China. Allen, Barlevy and Gale (2022) develop a model based on risk-shifting incentives that can be used to consider how large price increases in real estate prices can occur and how this leads to misallocation of resources with too much going to real estate and not enough being invested in other economic activities.

The initial version of the model has no risk but has credit, production, and a fixed asset that can be interpreted as real estate. We consider an infinite horizon OLG model where the fixed pays off $d_t = d > 0$ per period and agents live for two periods. Agents only care about consumption when old: $u(c_t, c_{t+1}) = c_{t+1}$. At $t = 0$ the old own all the fixed supply of the asset of one unit.

A new cohort is born at each date $t = 0, 1, 2, \ldots$ consisting of two types of agents

- **Savers** who are endowed with an aggregate e units of the good when young who can buy the asset or trade intertemporally to allow them to consume when old
- **Entrepreneurs** with ability y who can convert the good at date t into 1+ y goods when old where $y > 0$ but only up to a finite capacity of one unit of input. They have an initial endowment of $w = 0$.

Trade between savers and entrepreneurs is subject to the following frictions:

1. Savers cannot monitor whether those they finance produce or buy assets. They also cannot observe any of the agent's wealth beyond the particular project the lender finances, so loans are effectively *non-recourse*.
2. Trade is restricted to debt contracts so that for each unit of funding agents receive at date t, they must promise to pay a fixed amount $1 + R_t$ at date $t + 1$
3. If borrowers fail to pay their obligation, lenders can get a court to transfer any proceeds from the project agents invested in, but there is a deadweight bankruptcy cost of $\Phi$ per unit invested in the project.

The equilibrium for the economy with credit that we consider involves the following.

- Some savers putting their money in the asset and some lending to entrepreneurs as shown in Figure 7.

- A constant asset price $p_t = p^d$.
- A constant return on the asset $r_t = d/p^d$ for all t
- An equal interest rate in the credit market and on the asset: $R^d = d/p^d = r_t$ for all t
- The fundamental of the asset $f_t = p^d$ so there is no bubble

To introduce **risk,** we use a regime switching process similar to that in Zeira (1999). The asset initially pays a dividend $d_t = D > 0$. There is a probability $\pi > 0$ each period that the dividend falls to d where $0 < d < D$. Once the dividend is d it stays there forever. The informational friction is as in Allen and Gorton (1993), Allen and Gale (2000b), Barlevy (2014) and others that lenders can't observe an entrepreneur's productivity or what the borrower does with the funds. This friction means that the low ability entrepreneurs who cannot make a profit at the rate $R^d$ by producing can now borrow and invest in the asset. They bid up the price of the asset until they can just repay the loan if the dividend turns out to be D but default if it switches to d. This borrowing to invest in the asset means less is available for production by entrepreneurs so *the interest rate rises*. It can be seen from Figure 8 that this rise in interest rates means that fewer entrepreneurs produce. This is the mechanism that crowds out production and leads to a less productive economy.

If the asset is interpreted as real estate what is happening is that the price of the real estate is higher and less is being produced. The increase in the price of the real estate leads to a bigger transfer from the old to the young but the output of the economy goes down. This is obviously an extremely simple model, but it can be extended in a number of ways. Allen, Barlevy, and Gale show that the equilibrium with risky assets in this model can capture many of the episodes documented by Borio and Lowe (2002), Jorda, Schularick, and Taylor (2015), and Mian, Sufi, and Verner (2017). There can be asset price booms, credit booms, asset bubbles, and large negative fallouts from the crash.

Although the model is very simple, it can provide some insight into how to design policies to prevent the misallocation of resources from real estate booms. The stock market in the China example is like the entrepreneurs in the model. If they are unproductive then the risk shifting is greater and the amount the real estate is bid up is larger. The problem is therefore to change the financial system to make it more balanced. Rather than direct intervention in the real estate market, intervention to improve returns in the stock market by, for example, improving corporate governance may be more effective in preventing the misallocation.

While we have focussed on China as an extreme example, a number of countries also arguably have imbalances between the real estate sector and the productive economy. For example, the UK and a number of other European countries such as France and Italy have similar features.

So far, we have focussed on the first type of macroprudential policy. It was mentioned in the introduction that the second type of macroprudential policy involves taking measures to make the banking system more resilient such as increasing capital ratios, introducing contingent bonds that switch from debt to equity should be bank get into trouble, and so forth. Suffice it to say there are issues about whether the policies that have been introduced in this area will work in the ways those designing them predicted. The two recent examples that suggest they will not are the collapses of Silicon Valley Bank and Credit Suisse. With Silicon Valley Bank the regulators ended up bailing out all the depositors, even those with very large deposits well above the $250,000 deposit insurance limit. With Credit Suisse a whole tranche of bondholders received nothing while the shareholders did receive something.

## 3. Financial Stability and Price Stability with Central Bank Liquidity Provision

As discussed in the introduction, most models of financial crises assume that contracts between banks and depositors are written in real terms. If the amount that a bank receives from its loans is less than the amount promised to depositors, there will a bank run and it will fail. If the same is true for many banks, there will be a financial crisis. However, it is not the case that contracts are written in real terms. Almost all banking contracts are written in nominal terms. As the quote from Buiter (2007) in the introduction indicated, this creates the possibility that central banks can create money and ensure that no bank fails because money can be created by central banks very easily. To illustrate, if there is a recession output will be low and firms will be unable to repay their loans. With a real contract the bank would fail. However, if contracts are nominal, the central bank can print money and provide it to the bank so that it can repay its depositors. The price level in the economy will be high in this case because the ratio of money to output will be high because output is low. In other words, there is inflation relative to states where output is high. This inflation is desirable though because it allows the risk of low output to be shared. A similar argument holds when in instead of there being a return shock, depositors suffer a liquidity shock.

Allen, Carletti, and Gale (2014) develop a simple banking model to develop these ideas. We will illustrate their results by focusing on the simple case of aggregate return risk.

The first step is to describe the structure of the economy. The second describes how a planner subject to the same constraints as the market would allocate resources. The third is to lay out the institutional arrangements of the decentralised market economy. Finally, it is shown this market economy leads to the same allocation as that of the planner.

There are three dates t = 0, 1, 2. A single good is used for consumption and investment at each date.

Consumers have an endowment of one unit at $t = 0$ and no units at $t = 1, 2$. With probability $\lambda$ they wish to consume at date 1 (early consumers) and with probability $(1 - \lambda)$ they wish to consume at date 2 (late consumers). At date 0 they don't know whether they are an early or late consumer. They find this out privately at date 1. Denoting the consumption of early consumers as $c_1$ and the consumption of late consumers as $c_2$, their expected utility at date 0 is

$$EU = \lambda u(c_1) + (1 - \lambda)u(c_2)$$

There are two assets. The short asset is storage so 1 unit invested at date 0 produces 1 unit at date 1 or 2. The long asset produces a random return $R > 0$ at date 2 for every unit invested at date 0. The realisation of R is discovered by everybody at date 1.

The efficient allocation offers each consumer a consumption profile $(c_1(R), c_2(R))$. A necessary condition for maximizing the expected utility of the representative consumer is that given the portfolio y invested in the short asset and $(1 - y)$ invested in the long asset at date 0, $c_1(R)$ and $c_2(R)$ are chosen in each aggregate state to

$$\text{Max} \quad EU = \lambda u(c_1) + (1 - \lambda)u(c_2)$$

$$\text{subject to} \quad \lambda c_1 \leq y$$

$$\text{and} \quad \lambda c_1 + (1 - \lambda)c_2 = y + (1 - y)R$$

The utility function $u(c_t)$ satisfies the standard properties that $u' > 0$ and $u'' < 0$. The first constraint says that the early consumers cannot consume more than the amount of output that is available at date 1 that is provided by the short asset. The second constraint is that total consumption must be equal to total output.

The solution to this problem is that when R is low the consumption of the early and late consumers is equal and there is storage so that

$$c_1 = c_2 = y + (1 - y)R$$

As R increases the early consumers receive all the output from the short-term asset. The late consumers then receive the output at date 2 so we have

$$\lambda c_1 = y \quad \text{and} \quad (1 - \lambda)c_2 = (1 - y)R$$

This solution is illustrated in Figure 9.

It can be seen that $c_1$ and $c_2$ are determined by the choice of y, so the planner's problem can be reduced to maximising the expected utility of the representative consumer with respect to y.

$$\text{Max} \quad E\,[\,\lambda u(\min\{y/\lambda, y + (1 - y)R\}) + (1 - \lambda)u(\max\{(1\text{-}y)R/(1\text{-}\lambda), y + (1\text{-}y)R\})]$$

Since the function u is strictly concave, the maximiser y* is unique and this uniquely determines $c_1^*(R)$ and $c_2^*(R)$. This is the solution to the planner's problem.

We next introduce an institutional structure to implement a market solution. There are four groups of agents.

1. A central bank that lends money to the banking sector.
2. A commercial banking sector that borrows from the central bank, that takes deposits from consumers and makes loans to firms.
3. A productive sector consisting of firms that borrow from the banking sector in order to invest in the short and long assets.
4. A sector of consumers that sells their initial endowment to firms and has the proceeds deposited in its accounts in the banking sector to provide for future consumption.

Figures 10 and 11 illustrate the sequence of events at the three dates. Figure 10 shows the flow of funds at date 0.

1. Banks borrow cash from the central bank.
2. Firms borrow cash from the banks.
3. Firms purchase goods from the consumers.
4. Consumers deposit cash with the banks.
5. Banks repay their intraday loans to the central bank.

Figure 11 shows the flow of funds at dates 1 and 2.

1. Banks borrow cash from the central bank.
2. Early consumers (date 1)/late consumers (date 2) withdraw cash from the banks.
3. Consumers purchase goods from the firms.
4. Firms repay part of their loans to the banks.
5. Banks repay their intraday loans to the central bank.

There are a number of additional notations and assumptions.

- The nominal interest rate on loans between periods t and t + 1 is denoted by $r_t$.
- Initially nominal interest rates are set to zero: $r_0 = r_1 = 0$ but this is relaxed in the extensions.
- $M_0$ = money supply at date 0.
- $P_0 = 1$ is the price level at date 0.
- $M_t(R)$ = money supply at date t = 1, 2 in state R
- $P_t(R)$ = price level at date t = 1, 2 in state R
- $D_t$ = money value of deposit at date t = 1, 2 promised by the banks at date 0.

We next turn to the main decentralization result that shows the existence of a first best efficient equilibrium that implements the planner's solution. This is done using a constructive approach.

(i) $y^*$ and $(c_1^*(R), c_2^*(R))$ are from the planner's solution.

(ii) The money supply, prices, and deposit contracts can be defined to satisfy the usual equilibrium conditions.

(iii) Then goods market-clearing conditions are satisfied by construction.

(iv) All agents are optimizing.

(v) The exchange of money for goods determines their price at both dates.

$$P_1^*(R) = 1/c_1^*(R)$$

$$P_2^*(R) = 1/c_2^*(R)$$

(vi) Competition among banks will ensure they make zero profits and offer depositors the most attractive deposit contracts.

$$\lambda D_1 + (1 - \lambda)D_2 = 1$$

(vii) This is satisfied if we set

$$D_1^* = D_2^* = 1$$

(viii) The central bank accommodates the banks demand for money.

$$M_0^* = P_0^* = 1$$

$$M_1^*(R) = \lambda D_1^* = \lambda$$

$$M_2^*(R) = (1 - \lambda)D_2^* = 1 - \lambda$$

(ix) The representative firm borrows one unit of the good at date 0 and chooses a portfolio $y^*$ such that

$$P_1^*(R)y^* + P_2^*(R)(1 - y^*)R = 1 \text{ for every } R,$$

makes zero profits and there is no more profitable choice.

We then have the efficiency result that an equilibrium consisting of the price functions $(P_0^*, P_1^*(R), P_2^*(R))$, the money supply functions $(M_0^*, M_1^*(R), M_2^*(R))$, the portfolio choice $y^*$, the consumption functions ($c_1^*(R)$, $c_2^*(R)$) and the deposit contract ($D_1^*$, $D_2^*$) such that the equilibrium conditions are satisfied is first best efficient.

The model can be extended in several ways.

**Aggregate liquidity shocks** $\lambda$ can be introduced in addition to aggregate return shocks R.

**Public observability of the outcomes of R and $\lambda$** eliminates moral hazard problems with regard to these.

**Nominal interest rates** can be set at any level. The real rates of interest, which are all that matter when money is not held as a store of value outside the banking system between periods, are independent of the nominal rate as long as the price levels are adjusted appropriately.

**Idiosyncratic liquidity risk for the banks and the interbank market** Bank specific shocks can be dealt with using the interbank market in the usual way.

**Multi-period model** The analysis can be extended to the multi-period case.

**Idiosyncratic return risk** This cannot be dealt with by monetary policy alone. Institutions or markets allowing real transfers from those with high returns to those with low returns are necessary, but these are fraught with problems of moral hazard and other incentive problems.

The model developed above has banking with nominal contracts and money. A wide range of different types of uncertainty, including aggregate return uncertainty, aggregate liquidity shocks and idiosyncratic bank-specific liquidity shocks can be incorporated. With nominal contracts and a central bank, it is possible to eliminate financial instability and achieve the first best allocation through the central bank following an accommodative monetary policy. The one type of risk that cannot easily be dealt with is idiosyncratic return shocks. This requires that the government or a private institution make transfers between banks with high and low returns to achieve the first best. Implementing this type of scheme is problematic as it creates moral hazard and other incentive problems. Having large banks with many loans potentially overcomes these incentive problems but at the cost of introducing oligopoly power.

The way that risk sharing is achieved in this model is through variations in the price level, so price stability is not achieved. However, this is desirable since the first best is implemented even though there are non-contingent deposit contracts used in the banking system. The model is without any frictions that occur with inflation and without any frictions that occur with financial stability. If these were introduced the policy issue would be to trade off the two types of cost.

The financial crisis of 2007-09 illustrates a case where many policymakers were unwilling to print money to solve the problem. Instead, in many countries austerity policies were introduced and price stability was maintained. The financial crisis was contained to some extent, but the fiscal costs of this strategy were large. Ex post views on whether these kinds of policies were successful are mixed.

The Covid-19 pandemic illustrates a situation where policymakers effectively chose to print money to fund large subsidies to see people through the lockdowns and other problems that were created by the disease. At the time, overall inflation was subdued because of the limited range of goods that people purchased. Instead, many households built up large savings. When subsequent shocks of various kinds such as the Ukraine war and the resulting energy shortages hit, these balances were run down, and inflation occurred. Forecasting this inflation has proved particularly problematic for central banks. As a result, implementing policies to restore price stability has also been difficult. Developing more realistic models of accommodative central bank monetary policy may be helpful in this regard.

## 4. Concluding Remarks

There has been a long running debate on how central banks and regulators should attain price stability and financial stability. One policy suggested was to "lean against the wind" by raising interest rates to try and prevent bubbles in real estate and other asset prices and in particular subsequent crashes that would cause financial instability. However, as Svensson (2017) has convincingly argued the costs and benefits of these kinds of policy make them unattractive.

An alternative policy is macroprudential tools. The first type of these involves interventions in real estate and other markets to try to directly prevent rapid run-ups and subsequent collapses that cause financial instability. These have not been very successful. Our first main point is that it is not possible to focus just on the real estate market with these kinds of policies. It is necessary to create a balanced financial system where large amounts of resources do not flow into the real estate sector and drive prices up at the same time taking resources out of the productive sector. The example of China is given where the real estate sector has boomed but the stock market has been one of the worst performing in the world despite the overall economy being one of the best performing. Policies to provide a better balance between the sectors are necessary.

The second point we have made is to argue that an accommodative monetary policy is an alternative to leaning against the wind. Although such policies can lead to inflation, we have shown that this can be a good thing because it allows risk sharing. Of course, inflation has its own costs but so do financial crises. Monetary policy needs to take account of the balance between the costs of financial instability and the costs of inflation. In some cases, it may be best to avoid a financial crisis and have inflation while in others the reverse can be true.

In the introduction, we mentioned the difference in the mandates of the central banks in Sweden and Norway. The analysis above suggests to us that monetary policy should take into account both price stability and financial stability.

One final point is that we have taken financial structure and in particular the structure of the banking system as given. With innovations in payment systems, central bank digital currencies and so forth, it may be that alternative institutional structures that do not combine gathering of deposits with making loans can provide better trade-offs between price stability and financial stability (see, e.g., Allen and Walther (2021) and Allen, Kim, and Walther (2024)). This is an important area for future research.

## References


Allen, F., G. Barlevy, and D. Gale (2022). “Asset Price Booms and Macroeconomic Policy: A Risk-Shifting Approach,” *American Economic Journal: Macroeconomics* 14, 243-280.

Allen, F., E. Carletti, and D. Gale (2014). “Money, Financial Stability, and Efficiency,” *Journal of Economic Theory* 149, 100-127.

Allen, F., and D. Gale (1998). “Optimal Financial Crises,” *Journal of Finance* 53, 1245–1284.

Allen, F., and D. Gale, (2000a). “Financial Contagion,” *Journal of Political Economy* 108, 1–33.

Allen, F., and D. Gale (2000b). “Bubbles and Crises,” *Economic Journal* 110, 236–55.

Allen, F., and G. Gorton (1993). “Churning Bubbles,” *Review of Economic Studies* 60, 813–836.

Allen, F., J. H. Kim, and A. Walther (2024). “Money, Payments, Financial Architecture, and Financial Stability,” working paper, Imperial College London.

Allen, F., and A. Walther (2021). “Financial Architecture and Financial Stability,” *Annual Review of Financial Economics* 13, 129-151.

Allen, F., J. Qian, C. Shan, L. Zhu (2024). “Dissecting the Long-Term Performance of the Chinese Stock Market,” *Journal of Finance* 79, 993-1054.

Barlevy, G., (2014). “A Leverage-Based Model of Speculative Bubbles,” *Journal of Economic Theory* 153, 459–505.

Bernanke, B., M. Gertler, and S. Gilchrist. (1999). “The Financial Accelerator in a Quantitative Business Cycle Framework,” in Handbook of Macroeconomics. Vol. 1, edited by J. Taylor and M. Woodford, Elsevier Science, North-Holland: Amsterdam, 1341–93.

Borio, C., and P. Lowe (2002). “Asset Prices, Financial and Monetary Stability: Exploring the Nexus,” BIS Working Paper 114.

Borio, C., and W. White (2004). *“Whither monetary and financial stability? The implications of evolving policy regimes,”* BIS Working Paper 147.

Brunnermeier, M., and Y. Sannikov (2014). “A Macroeconomic Model with a Financial Sector,” *American Economic Review* 104, 379–421.

Buiter, W. (2007). Maverecon, Financial times, December 13, 2007, as quoted in Cao and Illing (2011).

Cao, J., and G. Illing (2011). “Endogenous Exposure to Systemic Liquidity Risk, *International Journal of Central Banking* 7, 173–216.

Collard, F., H. Dellas, B. Diba, and O. Loisel (2017). “Optimal Monetary and Prudential Policies,” *American Economic Journal: Macroeconomics 9*, 40–87.

Curdia, V., and M. Woodford (2009). “Credit Frictions and Optimal Monetary Policy,” working paper, Federal Reserve Bank of New York, August.

Diamond, D., and P. Dybvig (1983). “Bank Runs, Deposit Insurance, and Liquidity,” *Journal of Political Economy* 91, 401–419.

Diamond, D., and R. Rajan (2001). “Liquidity Risk, Liquidity Creation and Financial Fragility: A Theory of Banking,” *Journal of Political Economy* 109, 2431–2465.

Diamond, D. and R. Rajan (2005). “Liquidity Shortages and Banking Crises,” *Journal of Finance* 60, 615–647.

Jorda, O., M. Schularick and A. Taylor (2015). “Leveraged Bubbles,” *Journal of Monetary Economics* 76(S), S1–20.

Kiyotaki, N., and J. Moore. (1997). “Credit Cycles.” *Journal of Political Economy* 105, 211–48.

Mian, A., A. Sufi, and E. Verner (2017). “Household Debt and Business Cycles Worldwide,” *Quarterly Journal of Economics* 132, 1755–1817.

Rogoff, K., and Y. Yang (2021). “Has China’s Housing Production Peaked?” *China and the World Economy* 21, 1-31.

Rogoff, K., and Y. Yang (2022). “A Tale of Tier 3 Cities.” IMF Working Paper No. 2022/196.

Schwartz, A. (1998). “Why financial stability depends on price stability.” Chapter 3 in Money, Price, and the Real Economy, edited by G. Wood, Edward Elgar: Cheltenham, UK, 40-47.

Smets, F. (2014). “Financial Stability and Monetary Policy: How Closely Interlinked?” *International Journal of Central Banking* 10, 263-300.

Svensson, L. (2017). “Cost-Benefit Analysis of Leaning Against the Wind,” *Journal of Monetary Economics* 90, 193–213.

White, W. (2006). “Is price stability enough?” BIS Working Paper 205.

Woodford, M. (2012). “Inflation Targeting and Financial Stability,” *Sveriges Riksbank Economic Review* 1, 7–32.

Zeira, J. (1999). “Informational Overshooting, Booms, and Crashes,” *Journal of Monetary Economics* 43, 237–57.

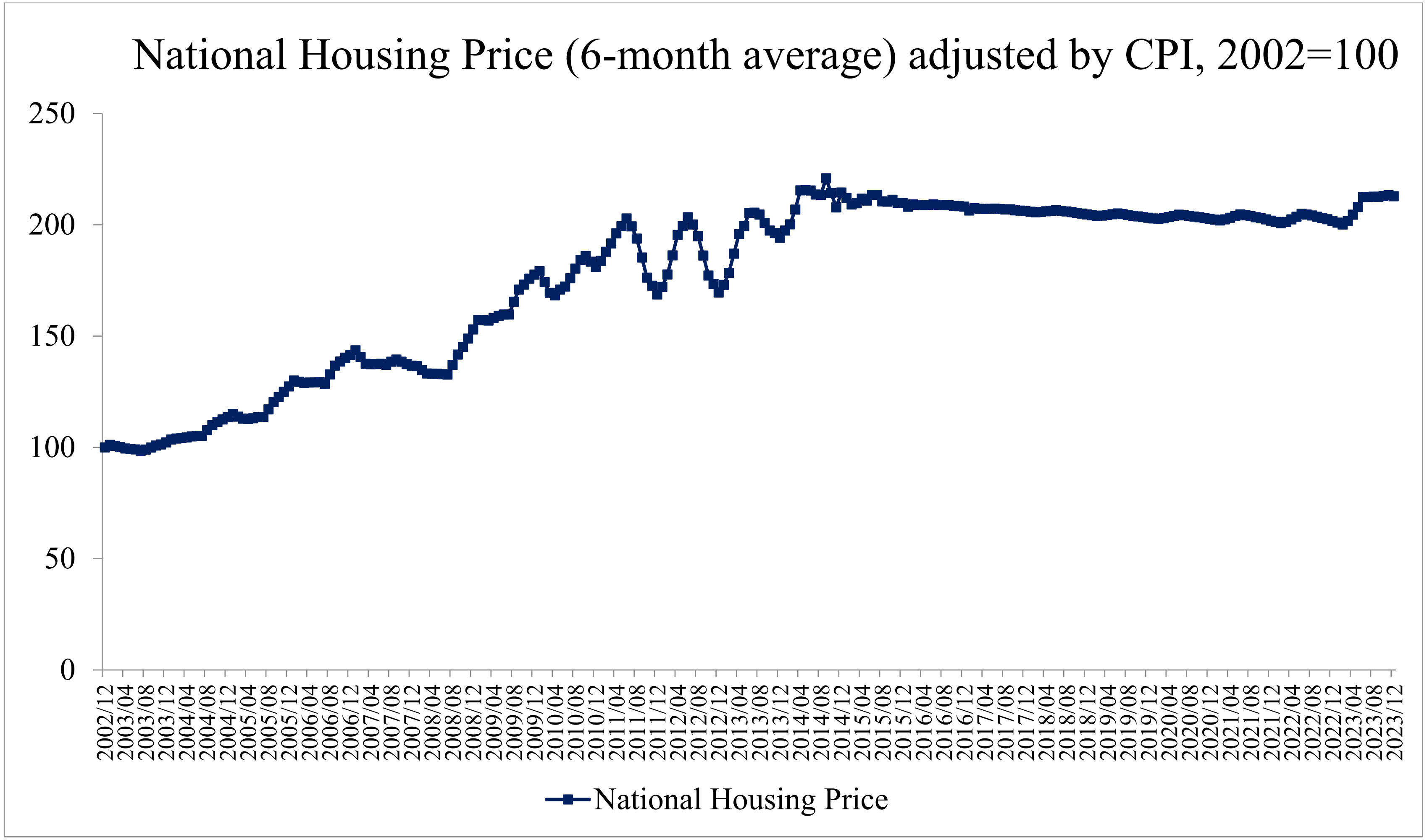


Figure 1
China's National Housing Price
(Adjusted by CPI)

Source: Wind

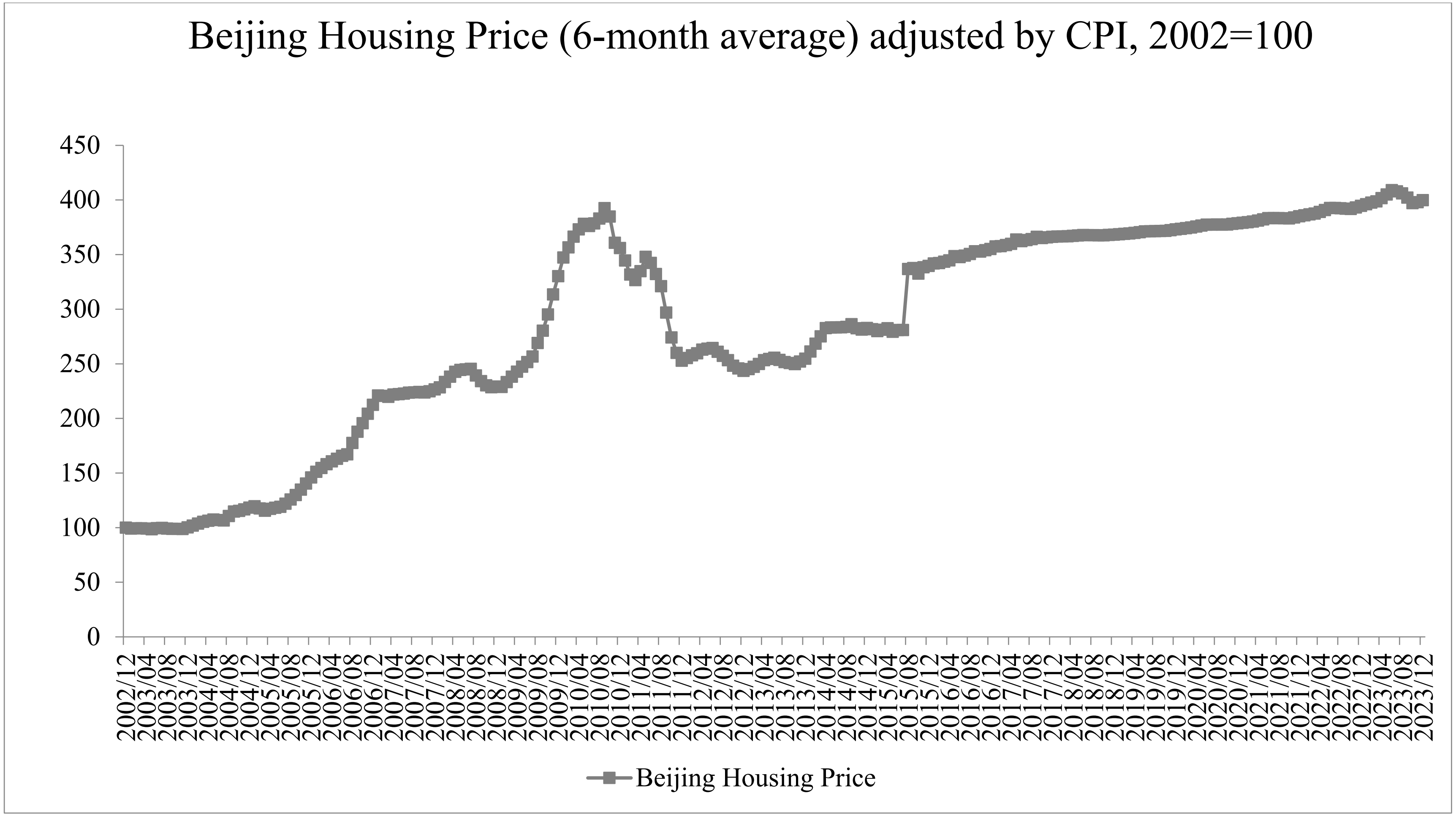


Figure 2
Beijing Housing Price
(Adjusted by CPI)

Source: Wind

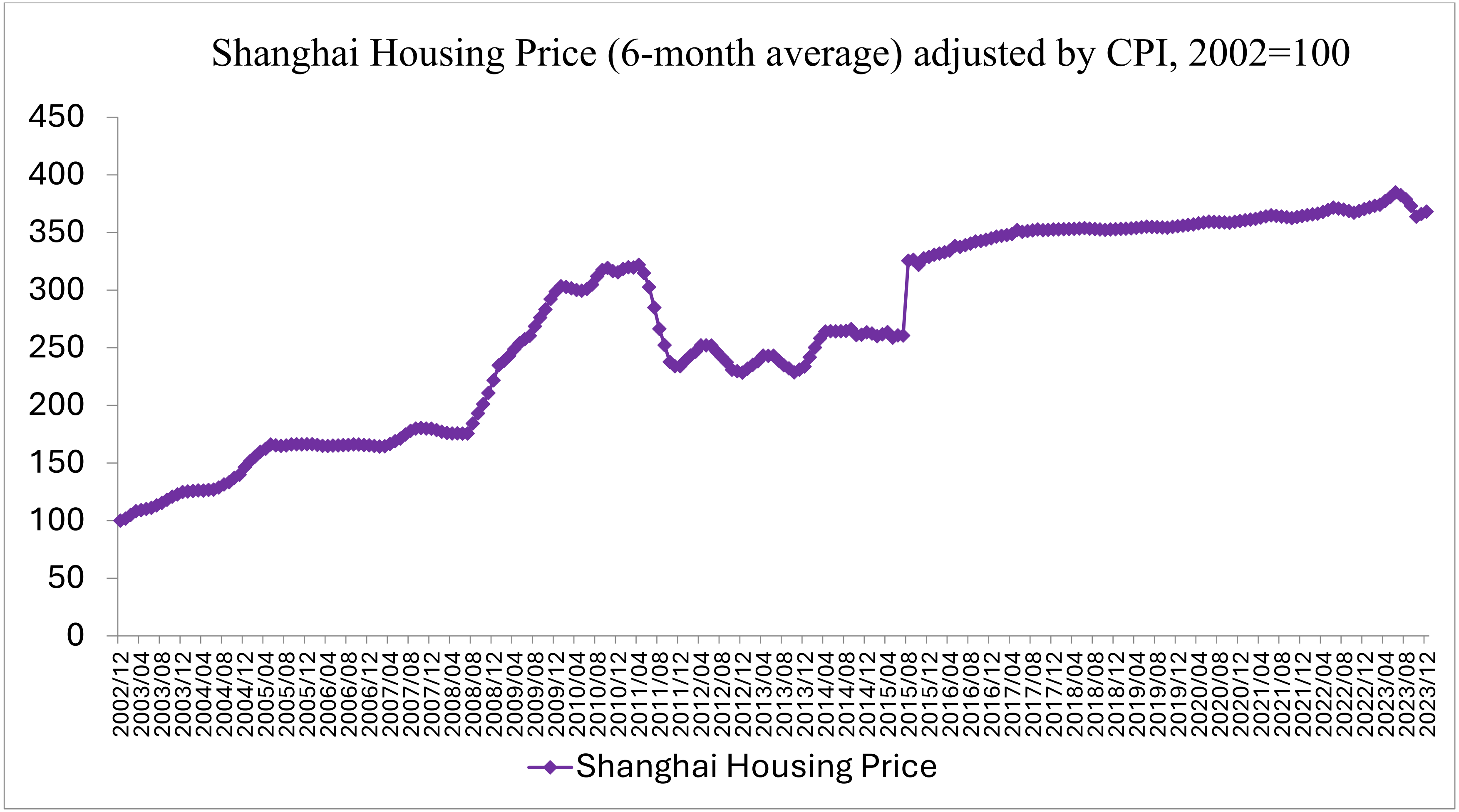


Figure 3
Shanghai Housing Price
(Adjusted by CPI)

Source: Wind

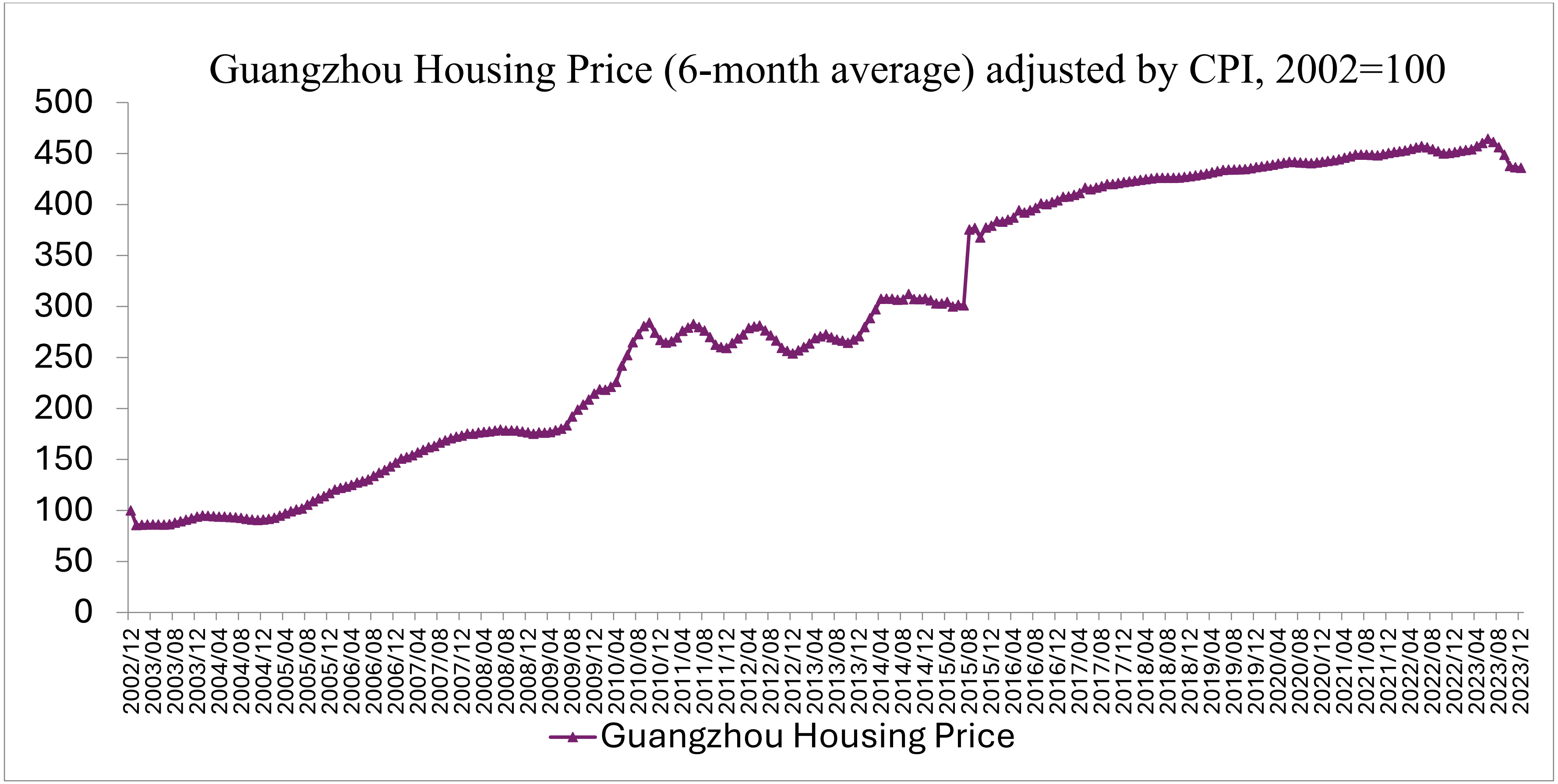


Figure 4
Guangzhou Housing Price
(Adjusted by CPI)

Source: Wind

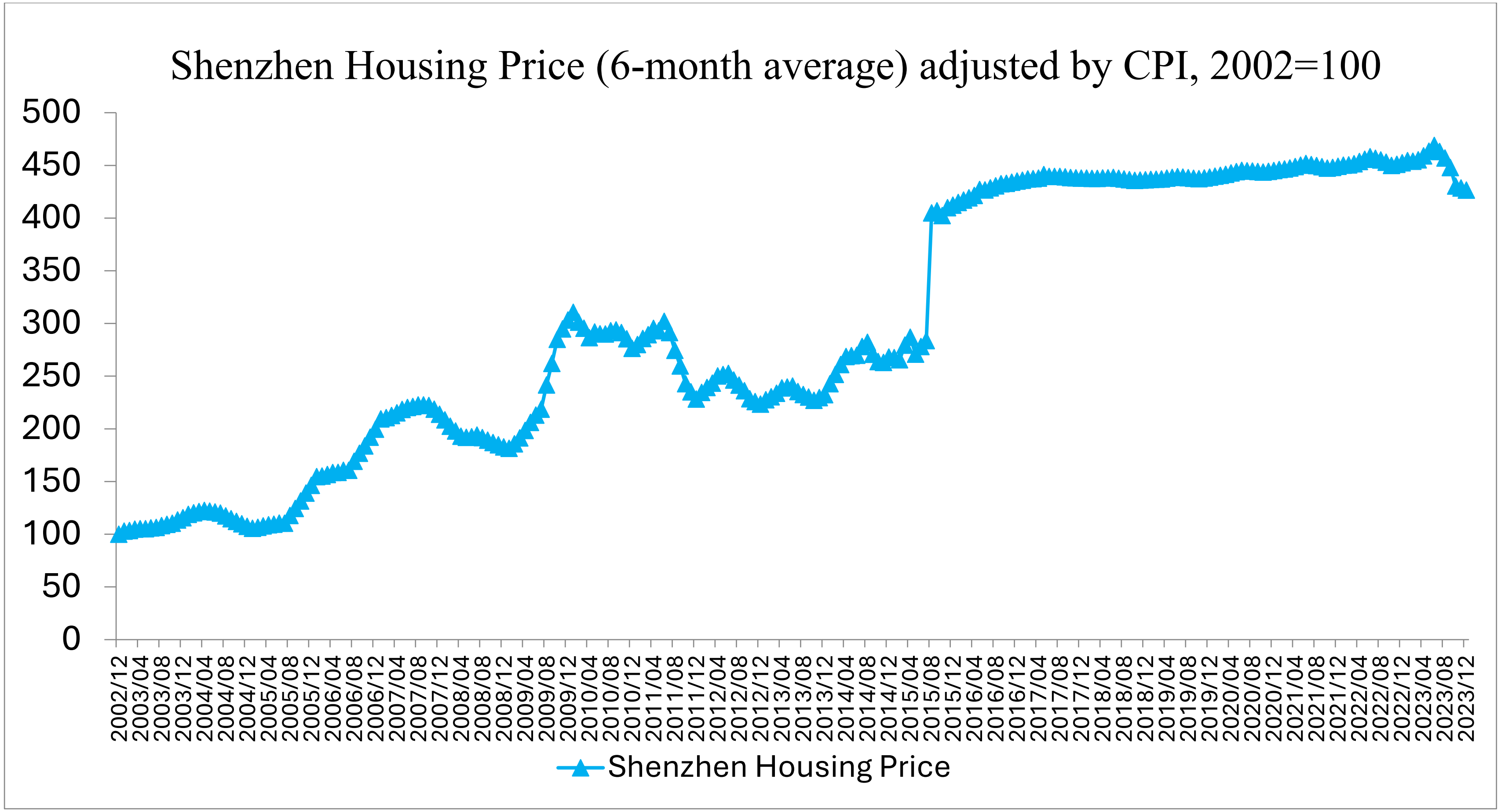


Figure 5
Shenzhen Housing Price
(Adjusted by CPI)

Source: Wind

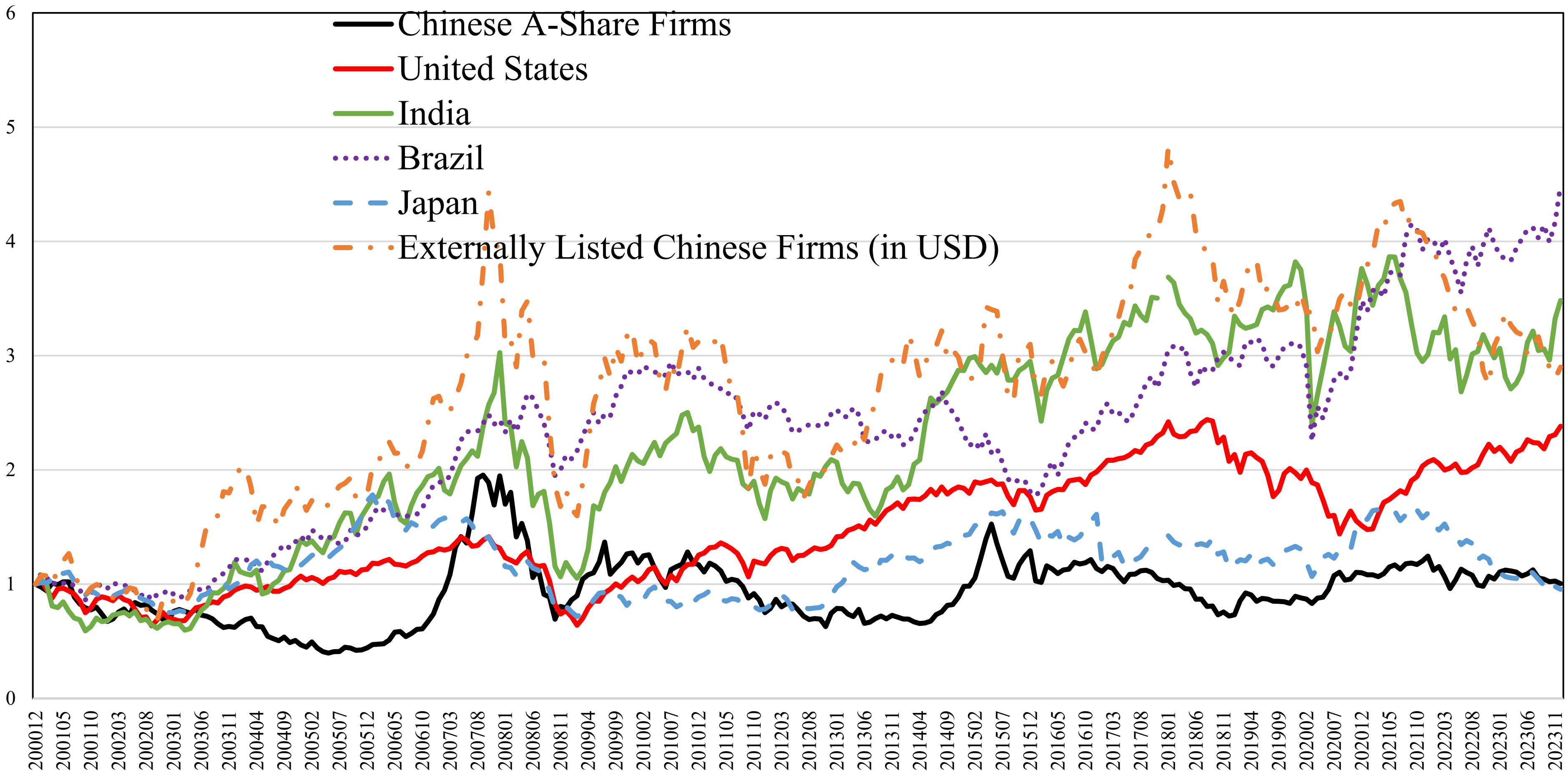


Figure 6

Chinese Stock Market: Buy-and-hold Returns of Listed Firms in Large Economies

（2000-2023; inflation adjusted; cash dividends included）

(Allen, Qian, Shan, and Zhu 2024)

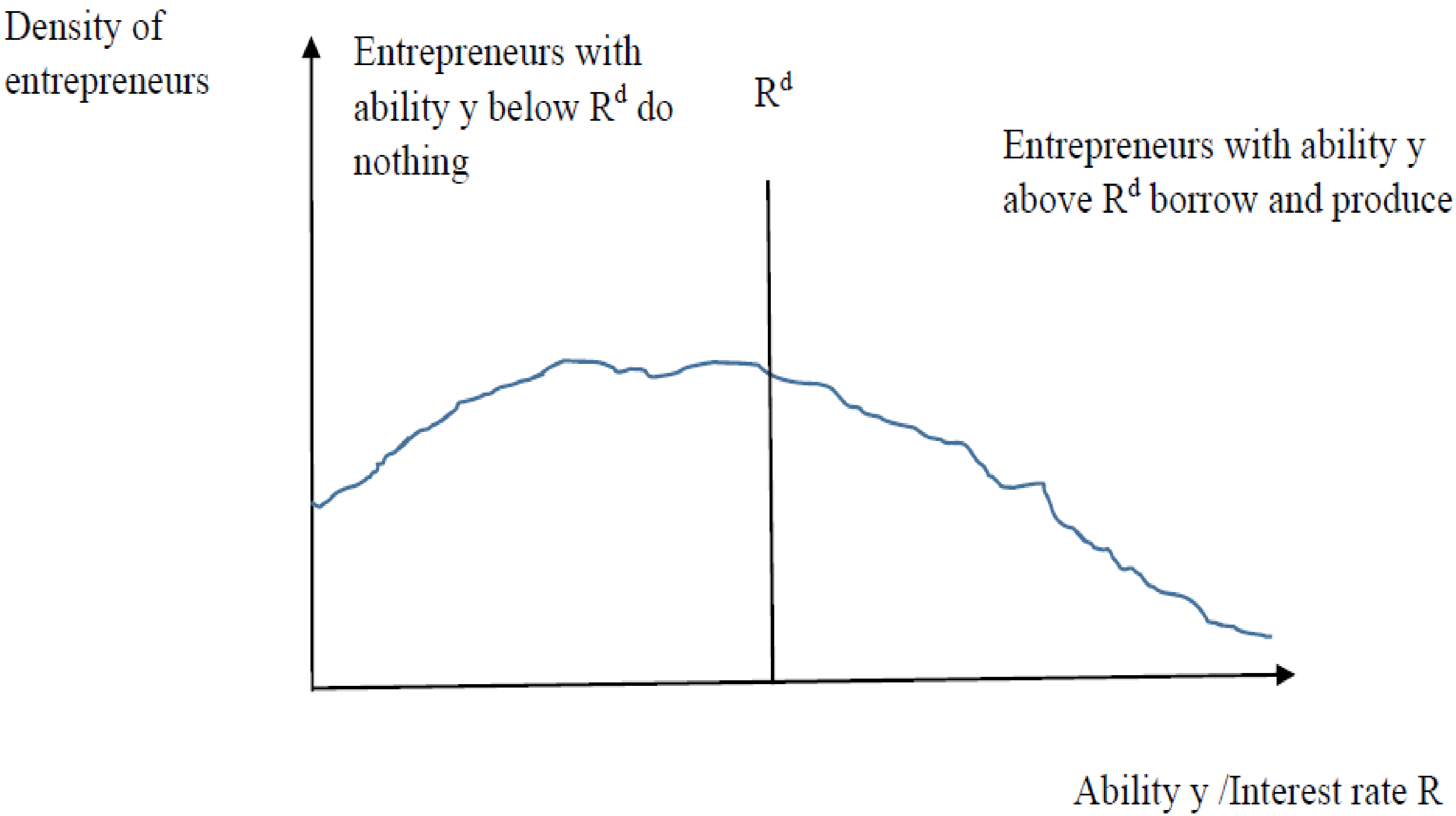


Figure 7

The Roles of Entrepreneurs According to Ability when there is no Risk

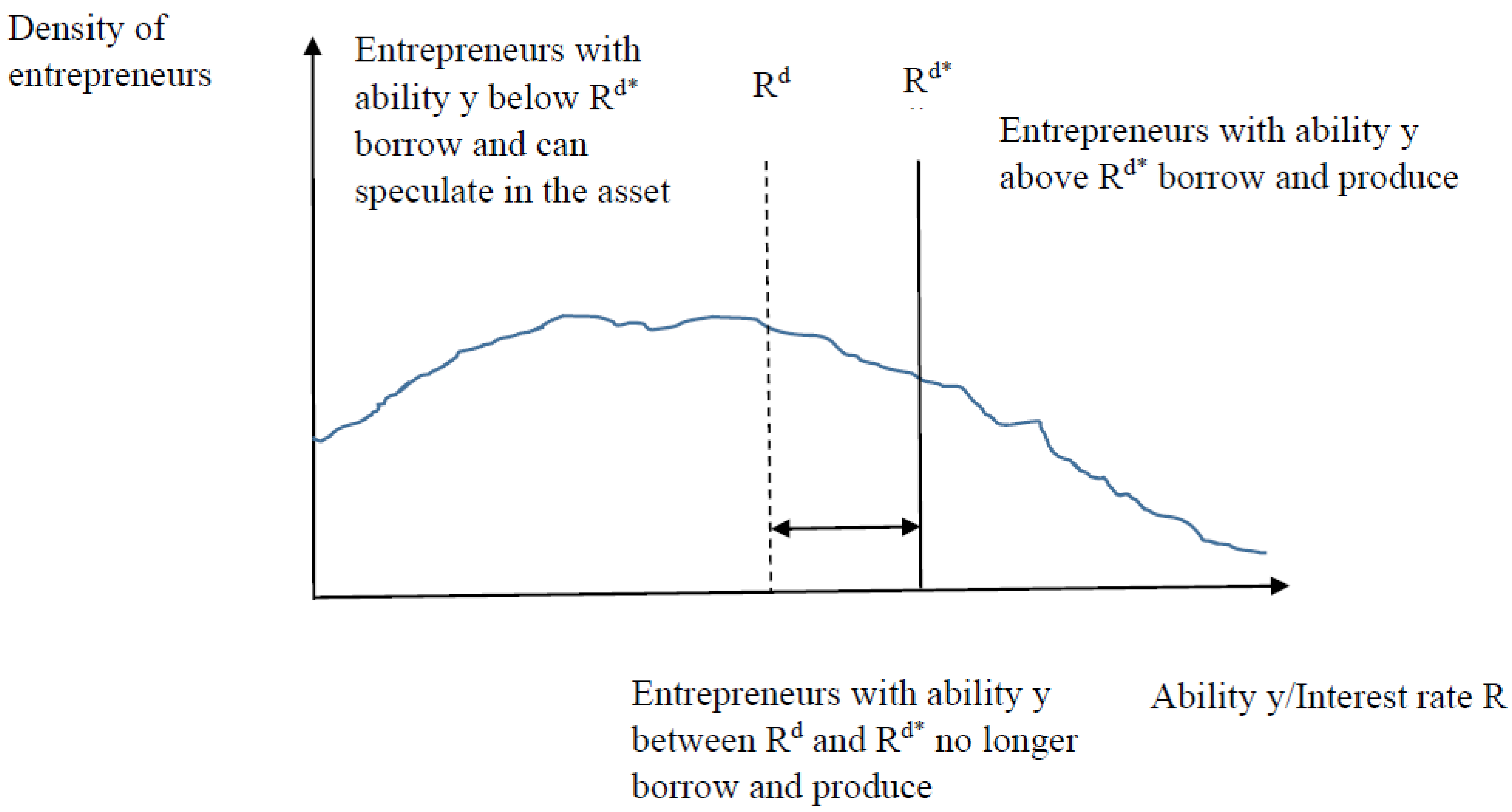


Figure 8

The Roles of Entrepreneurs According to Ability when there is Risk

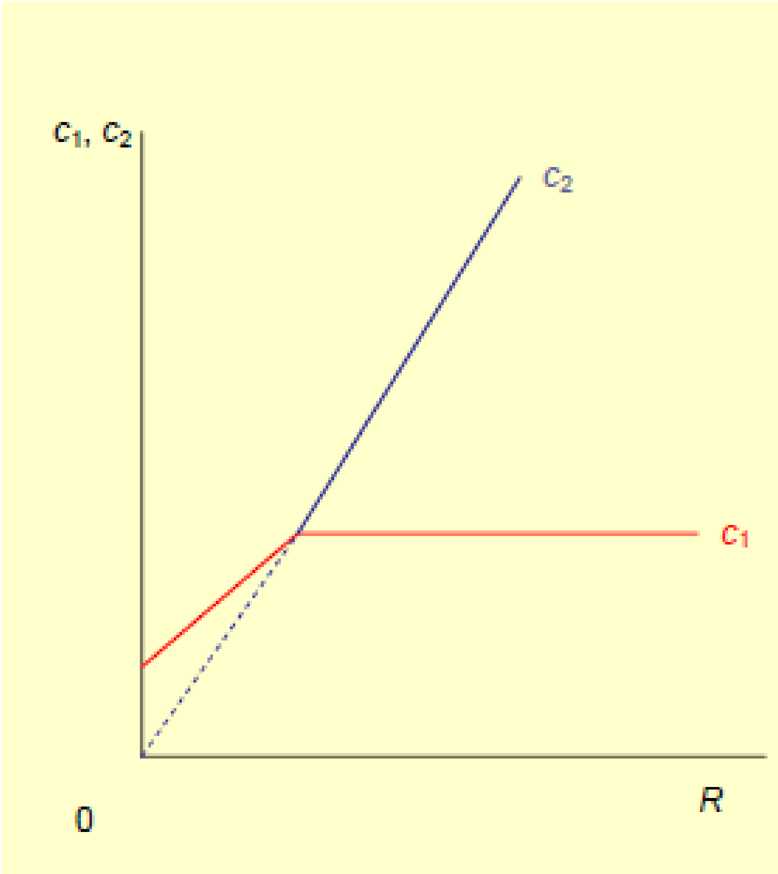


Figure 9

Consumption Functions at dates 1 and 2

The red is for early consumers and the blue is for late consumers

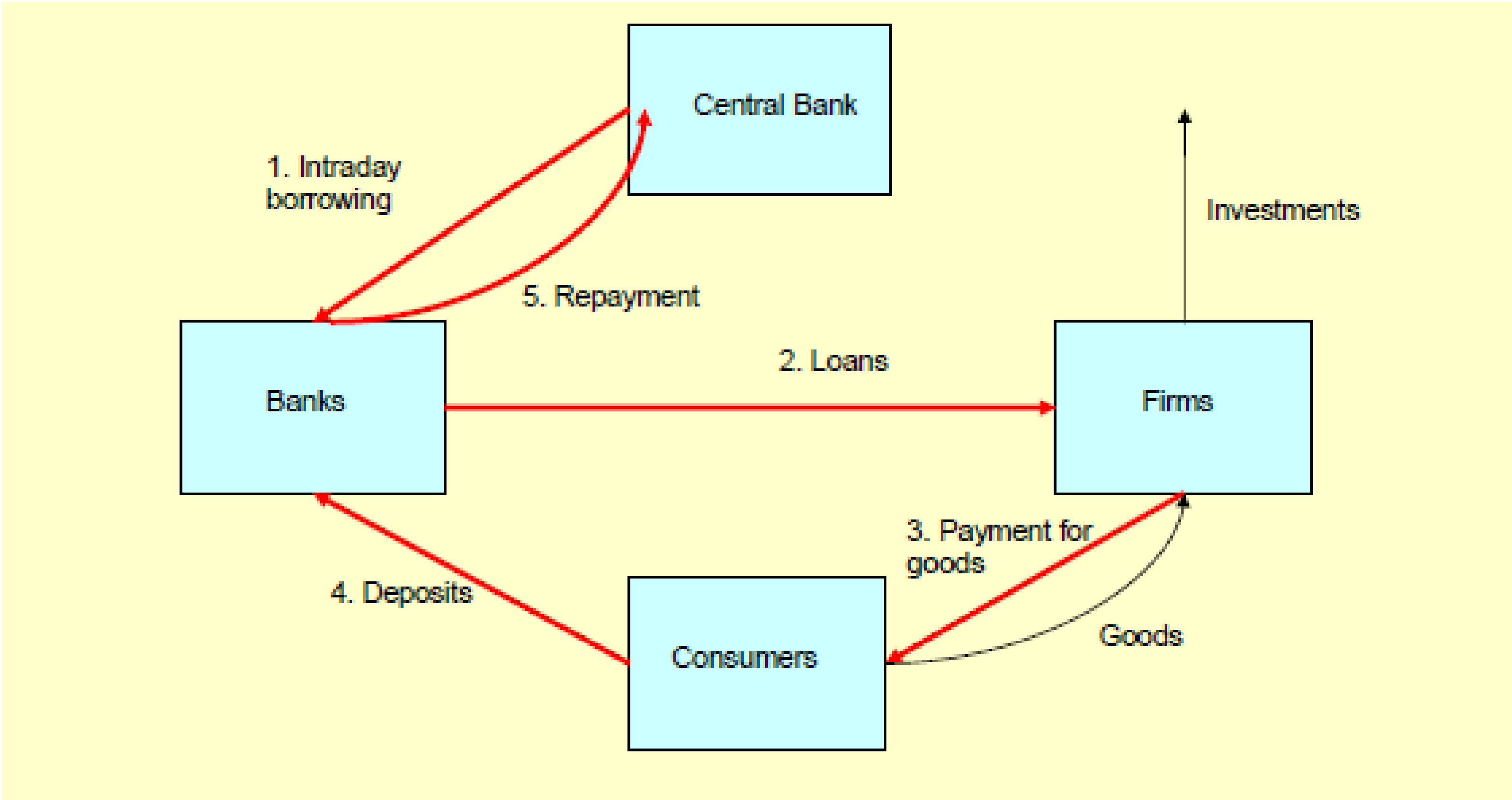


Figure 10

Flow of Funds at Date 0

1. Banks borrow cash from the central bank. 2. Firms borrow cash from the banks. 3. Firms purchase goods from the consumers. 4. Consumers deposit cash with the banks. 5. Banks repay their intraday loans to the central bank.

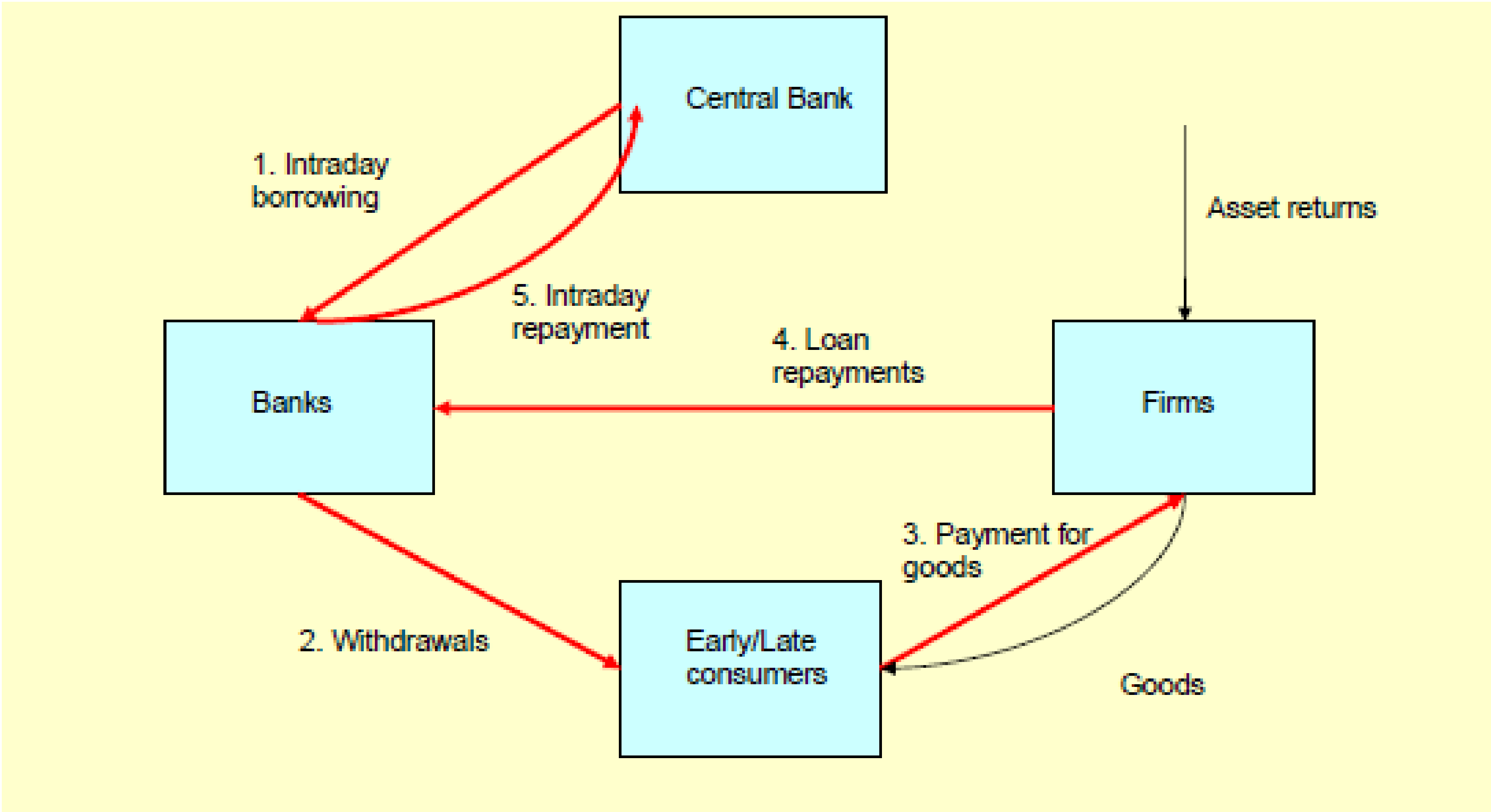


Figure 11

Flow of Funds at Dates 1 and 2

1. Banks borrow cash from the central bank. 2. Early consumers withdraw cash from the banks. 3. Consumers purchase goods from the firms. 4. Firms repay part of their loans to the banks. 5. Banks repay their intraday loans to the central bank.