

Real Estate Crashes and Bank Lending

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Abstract

This paper analyzes the role that non-recourse bank lending plays in generating boom and bust cycles in real estate. The ability to default on a loan represents a put option written by the lender and owned by the borrower. Rational economic behavior typically dictates that lenders charge the borrower for the imbedded put option through higher interest rates, origination fees, or mortgage insurance. In this paper, we discuss the conditions that lead lenders to rationally underprice the put option imbedded in non-recourse lending and analyze the impact of put option underpricing on asset prices. We find an underpricing equilibrium in which all lenders rationally choose to underprice the put option. This underpricing results in inflated asset prices, compression in the spread between lending and deposit rates, lending booms and real estate crashes.

We apply this model to the real estate bubble in five Asian countries during the 1990s. Macroeconomic instability and higher interest rates both worked to induce price declines. Nonetheless, while countries in which underpricing was curtailed through government policy or institutional improvements experienced a decline of 30 to 40% in real estate prices, countries that experienced the symptoms of underpricing suffered a far greater drop in real estate values of 80% or more.

Introduction

A put option on the underlying asset is imbedded in every non-recourse, asset-backed loan. If the value of the underlying asset falls below the outstanding balance of the loan (less any transaction costs), then the borrower may simply “put” the asset to the lender, and walk away from any future payments of principal or interest on the loan. While it may seem that the lender is “giving away” this put option, it is important to note that the lender is compensated for the imbedded option through a higher interest rate on the loan.

Interestingly, Pavlov and Wachter (2004a, 2004b) show that completely rational lenders may choose to underprice the put option imbedded in a non-recourse loan. By doing so they maximize their performance based compensation, as long as the demand for the collateral assets is stable. Standard economic theory predicts that the losses following a market crash would preclude such underpricing behavior. However, due to agency frictions, deposit insurance covering potential losses, and limited liability, the losses to the bank managers and/or their shareholders are limited. Therefore, short-term oriented lenders may find it rational to extend risky loans without an adequate interest rate spread and ignore the potential consequences of a market crash.

Importantly, the presence of short-term oriented lenders that underprice the put option makes it impossible for correctly pricing banks to compete. Thus, as we show below, all lenders are forced into underpricing, regardless of whether they are focused on short-term profits or on the long-term performance of the bank. Ironically, under these circumstances the downside risk for bank managers even in the event of a market crash is limited. As Herring and Wachter (2002) point out, if all lenders face sudden large losses, both the regulators and the public will likely blame the general economic conditions, not the underpricing behavior of the managers.

Several outcomes are likely to accompany this systemic underpricing. First, the underpricing is accompanied by a narrowing in the spread of lending over deposit rates. In addition, asset prices rise above fundamental levels and lenders’ expected profits decline. Of these effects, the increase in asset prices is perhaps the most troubling because of the implications for macroeconomic instability. Inflated real estate prices cause a construction boom and an inefficient allocation of resources within the economy.

Furthermore, a market with inflated asset prices is exceedingly vulnerable to negative demand shocks. When a “healthy” market is struck by a negative demand shock, asset prices decline to reflect the new supply and demand conditions. Inflated asset prices, however, magnify this decline as prices drop not only to adjust to the new demand but also to eliminate the price inflation.

With levered real estate, asset price declines beneath mortgage value will induce defaults. At the same time, the loss in asset value will decrease the value of bank collateral. Both effects have the potential to undermine the banking system’s financial soundness, as has been seen in numerous banking crises that have followed real estate crashes (Herring and Wachter, 2002). Here, we explain why bank lending incentives lead to such crises.

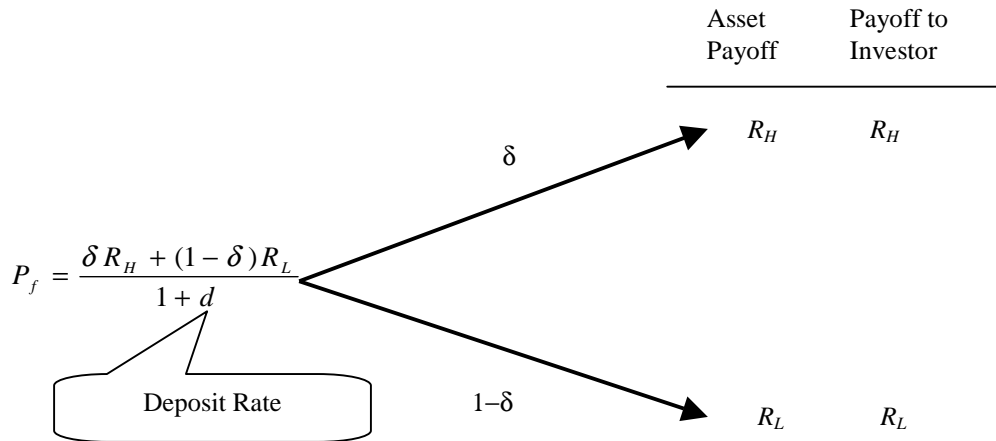
In this paper, we also describe results from an analysis of the Asian financial crisis using our models’ predictions (Koh, 2003). With country-specific lending and real estate price data, we find that Thailand, Malasia, and Indonesia exhibited symptoms of underpricing before the crisis, while Singapore and Hong Kong did not. Consistent with our theory, the real estate values in the first three countries dropped by more than 80% relative to their peak, while Singapore and Hong Kong experienced sizable but far smaller declines of less than 40%.

Asset Pricing

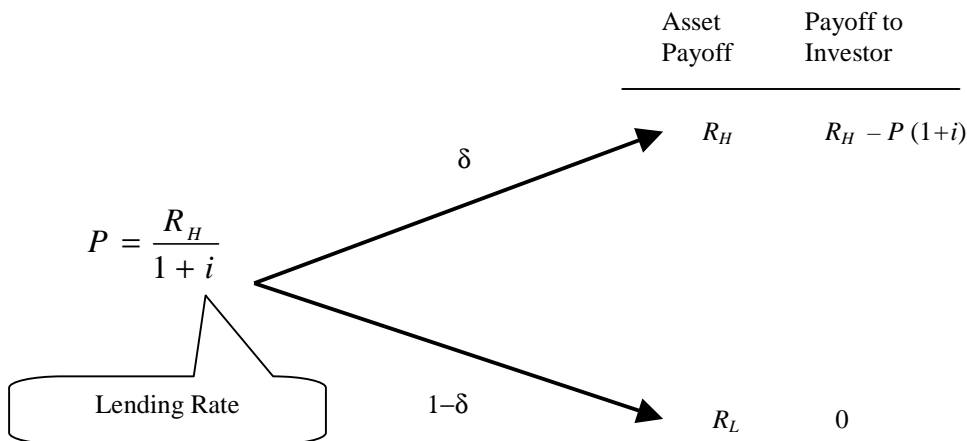
Following Pavlov and Wachter (2004a, 2004b), we define banks as financial intermediaries that accept deposits and make loans to investors (borrowers) who purchase risky asset (properties) with zero equity. All agents are risk-neutral. In this setting, we show that bank managers are incentivized to underprice the put option, and that this results in an inflated asset price above its fundamental value, even when rational lenders correctly estimate its value.

Pavlov and Wachter (2004a) describe the fundamental price as the expected discounted value of the asset over all possible future states of the economy. A rational investor would pay this price in the absence of lending or if lending is full recourse. Consider a simple model with two states in which the asset has high payoff (R_H) or low

payoff (R_L). The probability of the high payoff is δ . The fundamental price of the asset, P_f , is:



In the presence of non-recourse lending, an investor who purchases the asset with zero equity either receives the price appreciation (minus interest payment) in the good state or defaults and receives zero in the bad state:



In the above figure, P denotes the current market price of the asset, and i denotes the lending rate. The price an investor would pay is simply the high payoff discounted at the lending rate. In other words, the return in the high-payoff state equals the interest

rate. When the payoff is low, borrowers exercise their put option and put their property back to the bank.

Thus, Pavlov and Wachter (2004a) show that if the interest rate correctly incorporates the value of the put option, then the market price equals the fundamental price. If, however, the lending rate is too low relative to the deposit rate and does not fully incorporate the value of the put option, investors incorporate this mistake into the market price of the asset, which then exceeds its fundamental value. Consider, for instance, the extreme event in which the interest rate only reflects the deposit rate and does not include the value of the put option, i.e. $i = d$. Competition bids up the market price to $P = \frac{R_H}{1+d}$, which is clearly greater than the fundamental price, P_f , as long as there is some probability the low outcome may occur. We show below that this troubling scenario of asset price inflation is not just a theoretical possibility but will likely occur under certain economic conditions. Underpricing the put option imbedded in a non-recourse loan results in inflated asset prices.

Lending Markets

We now turn to the issue of why rational lenders might choose to underprice the put option even if they correctly estimate its value. Pavlov and Wachter (2004a) assume risk-neutral lenders whose only marginal cost of producing loans is the deposit rate. Thus, the value of the put option becomes part of the cost of capital for the borrowers and the expected profit to the bank is zero. The profit in the good state is the value of the option. Therefore, lenders have an incentive to increase market share as much as possible and collect the value of the option as profit in the good state. When all lenders price the put option correctly, asset prices reflect fundamental values.

Similarly to Pavlov and Wachter (2004a), conditional on the bank being in business, we assume the manager's compensation to have two components—salary and bonus—that depend on the realized bank profits. If bank managers price the put option correctly, they receive the salary component regardless of the state of the world. In the good state, the bank realizes positive profits and managers receive bonuses, which are an

increasing function of the realized profits. Further, if bank managers underprice the put option, they expand their market share and maximize their bonus in the good state.

Critical to our model is the assumption that when underpricing occurs it is detected only in the bad state. Pavlov and Wachter motivate this assumption by appealing to the fact that absent a negative outcome the bank operations are not subject to serious scrutiny from regulators and/or shareholders. Thus, managers receive their salary in the good state, regardless of whether they price the option correctly or not. Furthermore, if managers underprice the put option they are able to increase profits in the good state. This results in a higher bonus in the good state. If, however, an underpricing is discovered, i.e. the manager underprices the put and the bad state occurs, the manager is fired and they receive zero compensation thereafter. The following table summarizes the management compensation we consider, where salary is denoted by S , and the bonus, which is a function of the profits in the good state, is denoted by B :

Payoff	High	Low
Price correctly	$S+B(\)$	S
Underprice	$S+B(\)$	0

A manager with short time horizon has relatively little to lose if they underprice and are discovered. Therefore, such a manager may very likely decide to increase the immediate profits (and bonus) and risk the small probability that a bad state will occur and their underpricing will be discovered.

Pavlov and Wachter (2004a, b) show that if underpricing increases profits in the good state, there exists a time horizon such that managers with shorter horizons will underprice the put option. The intuition behind this result is based on the tradeoff between increased profits in the good state and potential discovery of underpricing in the bad state. Managers have a great deal to lose if they underprice and are discovered. Nonetheless managers who ignore the long term have relatively little to lose if their underpricing is discovered. For them the benefit of increased profits in the good state is sufficient to underprice and risk discovery.

Due to limited liability and/or deposit insurance, the above compensation scheme is consistent with maximizing shareholder value. Thus, shareholders with limited liability may not provide incentives for the managers to prevent underpricing. This possibility is strongest for shareholders who have little equity compared to the payoff from underpricing in the good state. This finding suggests that efficient markets alone may not be able to eliminate underpricing without regulatory intervention.

The above analysis yields a second worrisome implication. The bank that underprices steals market share from the correctly pricing banks. Thus, the correctly pricing banks, while still having zero expected profit, have lower profits in the good state. Managers who underprice maximize their compensation, but that comes at the expense of the correctly pricing managers.

Not surprisingly, even if one bank underprices, another bank can still increase profits in the good state if it too underprices the put option. Banks that correctly price the option receive even lower profits. Once again, given a certain time horizon, we can draw the similar results as in the case of the market with only one underpricer. The results in this case, however, are exacerbated by the presence of two underpricers.

To generalize this further, we also examine the case where many lenders underprice the put option. The central question is whether there is still incentive for yet another lender to start underpricing. If the correctly pricing lenders cannot break-even even in the good state due to competitive pressures from the underpricers, then all lenders will rationally switch to underpricing. This result holds even for bank managers who correctly estimate the value of the put option they are providing *and* have a long-term horizon. We call this the “underpricing” equilibrium. Such lender behavior has potential for devastating effects on the property markets, making it more vulnerable to negative demand shocks. In other words, when a negative demand shock occurs for reasons unrelated to the financing activity of lenders, the asset prices drop to compensate for the negative demand shock. Ultimately, because banks are not correctly pricing risk, they are producing risk. This decapitalizes the banking system and may cause an economy-wide decline.

Effects on Asia

Herring and Wachter (1999, 2002) show that real estate markets are vulnerable to waves of optimism—reservation prices above the fundamental value—by lenders, investors, and borrowers. Optimists strongly influence asset prices and are also likely to remain in business so long as the upward trend in prices continues even if their optimism is unfounded by an analysis of fundamental value. Optimists are likely to be able to borrow against their capital gains so long as lenders rely on market prices above the fundamental price when determining the value of real estate as collateral. The primary difficulty in selling real estate short, given its heterogeneity, means that optimists exert significant influence in the setting of real estate property prices.

But where do funds come from to finance the optimists' investments? The above shows that bank managers with short-term horizons are incentivized to provide funds to support these waves of exuberant borrowing. The magnitude of the resultant rise in real estate property rise will be greater, and the duration longer, so long as banks continue to augment the financial resources of the optimists. Bank lenders will wish to maximize their short run pay, and lend at rates that are too low for the expected risk.

While the divergence between market and fundamental value of real estate assets is not directly testable, if the Pavlov-Wachter model holds, the spread of the loan rate over the deposit rate can be used as a proxy for the extent of underpricing. This spread compensates the lender for providing the put option embedded in non-recourse loans. During a bubble which is due to widespread lender underpricing, lenders require little or no compensation for the put option. Thus, the spread of lending rates over deposit rates is narrowed, and is correlated with higher prices of the underlying asset.

At the same time, periods of widespread underpricing are associated with increased lending activity. In order for lenders to support the increased lending, they must increase the deposit rates. This then leads to the testable implication that deposit rates are positively correlated with asset prices. Therefore we can test this hypothesis and the conjecture that the spread of lending versus deposit rates are negatively correlated with asset prices.

In the context of Asian markets in the 1990s, the high deposit rates served to attract further capital inflows, even as the spread between lending rates and deposit rates

narrowed. In light of the significant surge in foreign capital inflows, there may not be any noticeable surge in deposit rates, at least not till the eve of the financial crisis in mid-1997.

Koh et. al. (2004) test the Pavlov-Wachter hypothesis using real estate and interest rate data from five South-Asian countries: Hong Kong, Indonesia, Malaysia, Singapore and Thailand. They find that the correlation between the spread of lending over deposit rates and real estate values is highly negative for Thailand, Malaysia, and Indonesia. This finding is consistent with the Pavlov-Wachter hypothesis and is symptomatic of underpricing behavior. Interestingly, relative to their peak, the real estate markets in Thailand, Malaysia, and Indonesia declined by shocking 95, 86, and 81 percent, respectively

The correlation coefficient between the spread of lending over deposit rates and real estate prices for Hong Kong and Singapore is either close to zero or positive. Furthermore, both of these countries exercised strong government controls over the lending market before the crash. All this evidence suggests that underpricing was limited or non-existent in these two countries. Consequently, while Hong Kong and Singapore also experienced a substantial negative real estate demand shock, property values in these two countries declined by a lot smaller 33 and 38% respectively.

According to Pavlov and Wachter (2004a, b), underpricing results in inflated asset prices above their fundamental level. After a crash, underpricing is eliminated and prices return to their fundamental level. Thus, underpricing compounds the effect of a negative demand shock and produces massive price declines. Therefore, countries that experience severe underpricing in the landing market, such as Thailand, Malaysia, and Indonesia, experience otherwise unexplained excessive price drops following a negative demand shock. Countries that prevent underpricing during periods of economic growth tend to experience relatively smaller price declines during economic stagnation.

Conclusion

In this paper we discuss how underpricing of the put option imbedded in non-recourse lending leads to inflated asset prices even within efficient markets. We also identify why, under certain economic conditions, rational lenders choose to underprice

the put option. We further report on results utilizing real estate and interest rate data from five Asian countries that test our predictions. We find evidence that underpricing was relatively widespread in Thailand, Malaysia, and Indonesia, while it was limited in Hong Kong and Singapore. Consistent with our hypothesis, although Hong Kong and Singapore experienced real estate price declines, the three countries in which underpricing was strikingly evident experienced far greater losses in real estate values, with declines reaching levels of 80% or more in the aftermath of the Asian financial market crisis.

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