Andreas Krause

Market crashes

- We will provide an explanation why occasionally stock markets might crash, while on other occasions in a similar situation no crash occurs.
- We will firstly look at why investors might still invest into stocks even if they know that a crash might occur and then look a mechanism that could trigger such a crash.

Sudden unexplained loss in asset values

- We observe occasionally stock markets loose value significantly within a very short period of time.
- The loss in value cannot be attributed to new information emerging.
- There is also no sudden change in the investment behaviour of investors.
- Such a situation is known as a market crash.
- It is mostly observed in stock markets but it also occurs in other financial instruments.

Sudden unexplained loss in asset values

→ While many movements in asset prices can at least be explained ex-post, there are significant events, such as sudden large price drops, that cannot be explained easily, even retrospectively.

- Stock markets are sometimes observed to loose a substantial fraction of their value
- and this loss happens in a very short period of time. The time frame may range from a few minutes or hours to a few days. In any case, for the scale of the loss in value, the movement of price is very fast.

- Of course, if new information arrives or becomes more widely known that suggests stocks are worth less than their current price, then such movements are easily explained. It is however, events in which no information arrives that could justify the price movement we are interested in.
- We can also exclude a change in the preferences of investors that lead to a change in demand, or other changes in their behaviour.
- If there are no apparent reasons for the sudden price drop, we speak of a 'crash'.

- Crashes are most prominently discussed in the context of stock markets,
- but we see similar developments in real estate, although given the nature of transactions the crash usually plays out over months.
- Exchange rates occasionally also see crashes of a currency,
- as do some commodities.

→ We will seek to explain these developments here.

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Overvaluations and crashes

- Market crashes are often difficult to explain
- At other times, markets are significantly overvalued and everyone is aware of this, but no crash occurs
- We will look at models that explain such overvaluations
- We will also will seek to explain the emergence of a crash without much new information arriving in the market

Overvaluations and crashes

→ One common way to explain crashes is that stocks were overvalued and the crash is a correction of the price towards its fundamental value.

- Explanations of crashes are often difficult, especially with the benefit of hindsight.
- One explanation often used is that stocks were overvalued at the time and hence the crash a correction. While such an explanation might sound appropriate well after the event, at the time of the crash there might not have been a consensus of stocks being overvalued and even if there was a consensus to this effect, it might have been held for a long period of time prior to the crash. The reason for the crash to occur that particular moment remains undiscovered.

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- We will in the first model look at why overvaluations can be sustained for long periods of time,
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- We will then in a second model explain the occurrence of crashes in some situations more carefully, avoiding the randomness of crashes in the previous model. We will look ata situation in which no(t much) information is responsible for the crash.

→ We will thus firstly looking at how overvaluations can be sustained and then will look at why sometimes the market crashes to correct these high prices.

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Rationality and overvaluation

- Many assets are frequently overvalued.
- We will see why it is rational to invest into an overvalued asset.
- Overvalued assets will eventually lead to a crash.

Rationality and overvaluation

→ We will firstly look at overvaluations and the reasons why they might be able to persist, even if all market participants agree that assets are overvalued.

- We often find that assets in financial markets are overvalued. Such overvaluations are not the result of asymmetric information between market participants or the lack of information, but they are often commonly known and openly acknowledged. Such overvaluations often persist for prolonged periods of time.
- While overvaluations are often observed, the same cannot be said of undervaluations. In most markets, undervlautions are rarely observed and if they are occurring, are short-lived only.

- We will discuss a model that shows it can be rational to invest into assets that an investor knows to be overvalued.
-
  - The overvaluation will at some point lead to a sudden price correction, a crash.
  - The explanation given in this model is highly unsatisfactory and we will discuss the mechanism of the crash in more detail in the second model.

→ We can now develop a model of bubbles, that is long periods of prices exceeding the fundamental value, that can be used to explain the willingness of investors to purchase overvalued assets.

Rationality and overvaluation

- Many assets are frequently overvalued, while under-valuations are rarely found
- We will see why it is rational to invest into an overvalued asset
- Overvalued assets will eventually lead to a crash, but rarely [illegible]

Rationality and overvaluation

→ We will firstly look at overvaluations and the reasons why they might be able to persist, even if all market participants agree that assets are overvalued.

- We often find that assets in financial markets are overvalued. Such overvaluations are not the result of asymmetric information between market participants or the lack of information, but they are often commonly known and openly acknowledged. Such overvaluations often persist for prolonged periods of time.
- While overvaluations are often observed, the same cannot be said of undervaluations. In most markets, undervlautions are rarely observed and if they are occurring, are short-lived only.

- We will discuss a model that shows it can be rational to invest into assets that an investor knows to be overvalued.
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Andreas Krause
Rational bubbles
LIVERMORE
NEW YORK STOCK EXCHANGE

→ The model developed here is highly stylised and shows how the expectation of selling an overvalued asset at an even higher price drives the investment into such assets.

Bursting bubbles

- Investors purchase overvalued assets in the anticipation of selling it at an even higher price.
- Overvalued assets will sooner or later crash and return to their fundamental value.

? You observe that based on your analysis, rental properties are significantly undervalued and the undervaluation seems to increase, as negative bubbles cannot occur, how can this be explained?

? Your assessment must be agreed with by the market overall for a deviation from the fundamental to be classified as a bubble, in this instance your assessment might not be shared by the wider market, whether you are correct or not.

Bursting bubbles

→ We have established that investing into stock that are overvalued can be rational.

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- We have seen that investors 'ride the bubble' and purchase an asset and hope to sell it at an even higher price, before the bubble bursts.
- The bubble, and hence the price of the asset, increase faster than the fundamental value and allow investors to make high profits. This higher return, however, compensates for the risk of the bubble bursting and leading to a crash.

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Modelling demand for assets

- Stochastic bursting of bubbles is unsatisfactory as an explanation of such significant events
- As prices are driven by demand and supply in the market, we should investigate these factors for an explanation
- Dividing investors into informed investors and uninformed investors allows us to introduce hedging by investors
- We will see how hedging by uninformed investors can lead to market crashes

Modelling demand for assets

→ We will now focus on modelling the actual causes of crashes, a sudden change in the demand.

- It is very unsatisfactory to explain rare and significant events with the random bursting of a bubble. To aid our understanding of crashes, we would want to demonstrate mechanism that will cause such a crash and investigate the conditions required to trigger it.
- Prices are equilibrium prices, thus points at which demand and supply meet. It would therefore be appropriate to asses the demand and supply as the driving force behind these equilibrium prices. We will take the supply of assets as given, such as the number of shares issued, the number of properties available and will focus ont he demand for holding such assets.
- We will consider informed and uninformed investors and consider that uninformed investors will want to hedge against any losses from assets being overvalued, which they would not be able to identify due to their lack of information.
- We will see how this hedging of uninformed investors can give rise to market crashes.

→ We will provide a model that explains how a small change in information about an asset can result in a large price change, a crash.

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Andreas Krause
Hedging and market crashes
LIVERMORE
NEW YORK STOCK EXCHANGE

→ We will now develop intuitively a model of market crashes that is based on the demand for hedging. In order to determine the implications of hedging, knowledge of option pricing is required, especially Δ-hedging.

Hedging can cause crashes

- If hedging is widespread after a prolonged market rise, the demand for assets is non-monotonous
- Small negative information can cause a large drop in asset prices

? Markets rise and fall over time, but not every time a crash occurs, why would markets most of times move slowly?

! We need a large amount of hedging and this hedging has to be at roughly the same strike price, only then do we observe a crash, if either conditions is not fulfilled, markets move smoothly, which is the case most of times.

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Summary of key results

- Asset prices will increase rapidly during a bubble
- Such bubbles might be bursting based on minor events
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- We have seen that bubbles are increasing over time, disconnecting prices and fundamental values ever more. This creates high returns while the bubble persists.
  - These high returns are compensation for the risk of the bubble bursting. It is this compensation that making investing into assets during a bubble rational.
- We have seen that such bubbles can burst on even small negative events affecting the asset price. A small event (information) has alarge impact (price drop).
  - These relationships are common where relationships between the demand of investors and prices are non-monotonous.
- Hedging can induce such non-monotonous relationship between the demand for assets and the equilibrium price.
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- In the right circumstances, this then results in a crash if a small amount of negative information becomes available.
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→ We can thus conclude that assets can be overvalued for prolonged times and that crashes eliminating such bubbles can occur on receiving even minor negative information.

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