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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 real estate, exchange rates, and commodities

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.

Overvaluations and crashes

- Market crashes are often difficult to explain and while it is often obvious ex-post that the assets were overvalued, this was not always seen at the time
- 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 and how these are corrected
- 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.

- Also, it other times, markets are overvalued, which seems to be common knowledge, and the stock prices either adjust slowly downwards towards the fundamental value or they remain stable until the fundamental value has increased to reach the price. In either case, no crash is observed.
- We will in the first model look at why overvaluations can be sustained for long periods of time,
- and also how a correction is affected in that model.

- 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.

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 this explanation is left to the second model

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.


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Rational bubbles
NEW YORK STOCK EXCHANGE
LIVERMORE

→ 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, making it a rational decision
- Overvalued assets will sooner or later crash and return to their fundamental value, but this risk is compensated

? 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.

▶
- 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.

▶
- Asset prices returning to their fundamental value is here modelled as being purely stochastic. Thus any overvaluation will eventually end in a crash.
- The risk of holding assets during a crash is compensated for by higher returns while the bubble persists.

▶ [?] You analyse the market for rental properties and your analysis suggests that there is a widespread undervaluation and looking back over time it seems that this undervaluation is increasing. How can this be if negative bubbles cannot occur?

▶ [!] This is your analysis and the market overall might not agree. the model required the overall market assessment to be that the price deviates from the fundamental value; it would allow for deviations in the assessment by individuals, like in this case.

→ In this model, bubbles are rational, but the mechanism with which they generate crashes is highly unsatisfactory. For this reason we will now focus our attention on modelling the crash itself.

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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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

Hedging can cause crashes

→ We have seen that the origin of crashes lies in the hedging of investors.

- If we have a rise in the price of an asset, uninformed investors might want to hedge their demand as they cannot know if this rise is due to the fundamental value increasing or a bubble having emerged. To protect themselves against any losses they will increasingly hedge their investment and this hedging demand causes the demand for the asset to become non-monotonous.
- Due to this non-monotonicity we can have a situation where a small piece of negative information instigates a large drop in the price of the asset. the information itself does not justify this price drop.
- [?] Markets are moving up and down a lot and crashes are a rare occurrence, for entire markets as well as individual assets. Hence most of times the prices move smoothly rather than crash. Why?
- [!] For crashes to occur hedging must be widespread and the strike prices need to be similar, otherwise the non-monotonicity of the demand does not emerge and hence we cannot observe a crash. Thus is will be that most of times either of these two conditions is not fulfilled, so either investors are not much concerned about losses from overvalued assets and therefore do not hedge, or they are concerned, but employ widely differing strike prices for their protection.

→ We see that we need quite specific conditions for crashes to occur and these conditions will not be fulfilled frequently; thus crashes are rare events.

Summary of key results

- Asset prices will increase rapidly during a bubble to compensate investors for the risk of the bubble bursting
- Such bubbles might be bursting based on minor events if the demand is non-monotonous in the price
- Hedging can cause such non-monotonous demand, provided it is a significant fraction of the market
- Market crashes can be caused by minor informational events that would not affect the fundamental value of the asset significantly

Summary of key results

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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.
  - This, however, requires that hedging demand is relatively high to make this change to the otherwise monotonous demand.
- In the right circumstances, this then results in a crash if a small amount of negative information becomes available.
  - The information itself would not affect the fundamental value significantly, but its impact on the price is much larger due to the non-monotonicity of the demand.

→ 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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