So be deviating Firm 1’s profits are:

\[ V = \pi^M \]

So for the proposed strategies to form an equilibrium it has to be the case that

\[ \frac{1}{2} \pi^M \frac{1}{1 - \delta} \geq \pi^M \]

which is equivalent to

\[ \delta > \frac{1}{2} \]

So the question then becomes what determines \( \delta \)?
- It is directly related to the interest rate, or the rate of return on some low risk asset.
- If the interest rate is $r$, $1$ today is worth $(1+r)$ in the next period, so

\[ \delta = \frac{1}{1+r} \]
There are other factors that also determine the discount rate. As we’ll see these factors will help explain why some industries engage in price wars, or other forms of noncollusive behavior.

One such factor is the frequency at which firms change their prices.

So if \( r \) denotes the annual interest rate and \( f \) denotes the frequency of price changes per year.

Then we have

\[
\delta = \frac{1}{1 + \frac{r}{f}}
\]

Another important factor is the probability any payment will be received in the future.
Collusion

- This will be of concern if a third firm enters the industry in the future and can produce at lower costs.
- We’ll denote this by $h$, the probability that the industry exists in the future, with $h \leq 1$.
- Still taking into account the frequency of meetings, we compute the discount factor as:

$$\delta = \frac{1}{1 + \frac{r}{f}h}$$

- Another factor to be taken into account is the growth rate of the industry.
- For example if the growth rate of demand is denoted by $g$, then profits will grow such that $\$1$ in the next period is worth more than a dollar in the current period, by a factor of $1 + g$. 
Collusion

- This implies that the discount factor is

\[ \delta = \frac{1}{1 + \frac{r}{f}} h(1 + g) \]

- Note the discount factor is increasing in \( f, g, h \).
- Thus we can conclude that the collusion pricing is more likely in industries the greater the frequency firms interact (nearby gas stations), the greater the probability of continuation, and the greater the growth rate.
- This, along with other reasons explain why firms don’t collude more often.
- Two prominent other reasons are 1) the law- antitrust policy. 2) not all prices are observed. So secret price cuts are hard to distinguish form a drop in market demand.
- Such conditions will lead to price wars.
Price Wars

- One common observation in industries is the oscillation in prices between high (e.g. monopoly, duopoly) and low (competitive).
- We’ll have to extend previous models to help explain this.
- One such extension would be to allow demand to fluctuate across periods and such fluctuations cannot be perfectly observed.
- In this model all that a firm observes is the price that it sets, and the demand that it receives.
- So if it receives low demand, this can be for one of two reasons.
- Either there is low market demand or its competitor is undercutting.
Price Wars

- Given the uncertainty, should a firm punish its rival if demand is low?
- Not punishing would not be an equilibrium.
- This is because the other firm would be better off by always undercutting and blaming the first firm's low demand on market conditions.
- Alternatively, the firm could revert to an infinite price war, which would result in zero profits for either firm.
- An alternative strategy would be to respond to a low demand with engaging in a price war for, say, \( T \) periods, and then revert to collusive pricing.
- We thus have an equilibrium with collusion phases alternating with price wars.
Price Wars

- In this setting of uncertainty price wars are necessary to sustain the collusion.
- Another way to model price wars is asymmetric shocks.
- Specifically, we’ll assume that the discount factor of one of the firms becomes lower than the rest.
- Such firms will then deviate from the collusive price and initiate a price war.
- In the airline industry, this is usually the case with the weaker firms, where the probability of exiting the industry becomes higher.
- Situations where a strong firm initiates a price war can often be explained by an attempt to drive out competitors from the industry.
Facilitating Collusion

- Fewer firms in the industry.
- Firms are similar in terms of cost structures.
- Multimarkets, where each firm has a cost advantage in one of the markets.
- Institutional factors: rules or regulations imposed by the firms or the government.
- One such example is most favored customer clauses.
- These clauses bind firms not offer a discount to a particular customer without offering the same discount to every other customer within a specified period of time.
Facilitating Collusion

- While this appears to be protecting consumers, it is actually a collusive device.
- This is because it lowers the incentive of the firm to price aggressively.
- This is because if it does although a price cut may enable a firm to capture its rivals customers it also implies the penalty of refunding previous customers, lowering the incentive to undercut and making the collusive arrangement more stable.
- So such a regulation actually makes consumers worse off even though it appears its intent is to protect them.
In most countries most of the public policy is directed precisely toward fighting the tendency for firms to “conspire” against consumers.

One reason why price fixing is (often but not always) illegal is it results in allocative inefficiency.

The optimal solution from a total welfare point of view is for firms to set prices equal to marginal costs.

Which supposedly is the motivation behind The Treaty of Rome and the Sherman Act.