Access Pricing and Investment: A Real Options Approach

Fernando Camacho (PhD Student – University of Queensland)

Professor Flavio Menezes (University of Queensland)

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Motivation

- Price regulation was designed to promote static efficiency in an environment where capacity constraints were lax in many industries.
  - In practice, prices have been set such that NPV=0.
- However, due to sustained economic growth and technological change significant amounts of investment are necessary to provide new services or update existing ones.
- A second wave of regulatory reform has shifted the focus of price regulation from promoting static efficiency towards promoting dynamic efficiency and providing appropriate investment incentives.

Motivation

- A regulatory framework should correctly account for the risks faced by firms when investing in a new network facility.
- These risks are related to the combination of two characteristics: demand uncertainty and irreversibility.
- The combination of uncertainty, irreversibility and investment timing flexibility provides the building blocks of the option to delay theory.

Motivation

- Under the option to delay theory, a firm will invest in a project today if its NPV is higher or equal then the payoff of investing at anytime in the future. Therefore, profit-maximising firms might choose not to undertake an investment even though its NPV>0.

- Traditional regulation, which focuses on setting the price such that the NPV=0, might not provide the correct investment incentives.

Objective

This paper examines a three-period model of an investment decision in a network industry characterized by demand uncertainty, economies of scale and sunk costs.

- In the absence of regulation we identify the market conditions under which a monopolist decides to invest early as well as the underlying overall welfare output, which is set as the benchmark that the regulator will try to improve upon.

- In a regulated environment, we consider a monopolist facing no downstream competition but subject to a price cap on the downstream retail market. We identify the welfare-maximising retail prices.

- We also consider a vertically integrated network provider that is required to provide access to downstream competitors and compare the welfare generated by two access pricing methodologies: ECPR and ODPR.

Literature Review

- Teisberg (1993 and 1994) focus on a firm's decision to delay investment when this firm is faced with uncertain and asymmetric profit and loss restrictions due to regulation.
- The author shows that the project's value under regulation is lower than in an unregulated market and the greater the uncertainty, the more regulation reduces the project's value.
- Thus, the firm may choose to delay the investment under regulation whereas in an unregulated market the firm would invest in the project.
- Teisberg, however, does not explicitly consider a regulatory method that accounts for the option to delay value.

Literature Review

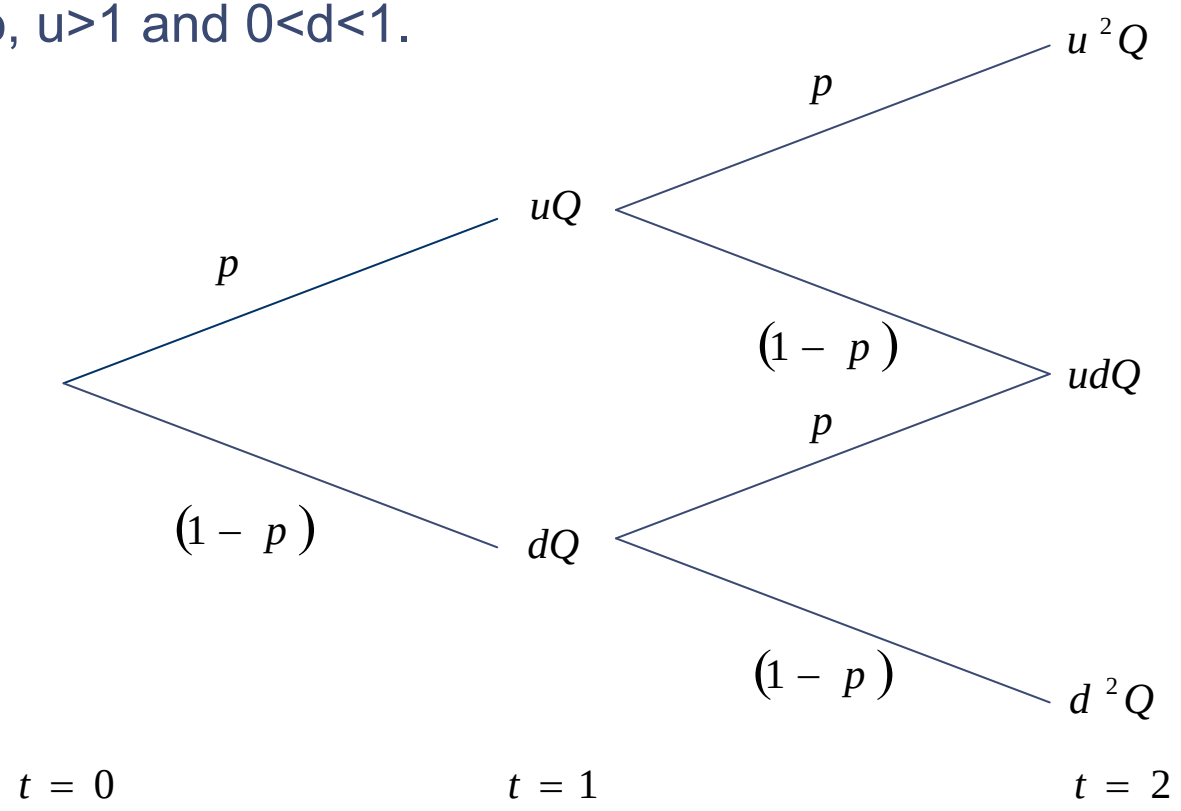
- Hausman (1999), Hausman and Myers (2002) and Pindyck (2004) focus on access pricing and asymmetric rights between incumbent and entrants in infrastructure industries.
- These authors point out that incumbent providers are forced to grant to new entrants a free option, where such option is the right but not the obligation to purchase the use of the incumbent's network.
- They conclude that a mark-up factor must be applied to the investment cost component of current methods to compensate incumbents for this option value.
- Again, these authors have not explicitly considered a regulatory method that accounts for the option to delay value.

The Model

- The firm can build the network at t=0 or at t=1, with services starting at t=1 or t=2, respectively.
- If the firm does not invest at t=0, it has the right but not the obligation to invest at t=1.
- The investment outlay at t=0 is I and at t=1 is (1+r)I in a risk-neutral world, where r is the risk-free interest rate.
- Cost of waiting – the first period cash flow.
- Cost of investing at t=0 – demand uncertainty.

The Model

- The inverse demand function is characterized by a choke price at each period ($\bar{P}_1$ and $\bar{P}_2$) and the expected demand at t=0 is Q. Also, u>1 and 0<d<1.



- The technology is such that the production of the final good requires one unit of the network service and one unit of a generic input with unit prices c_1 at t=1 and c_2 at t=2.

The NPV and OD in an Unregulated Market

- The NPV is the expected payoff of investing at t=0.

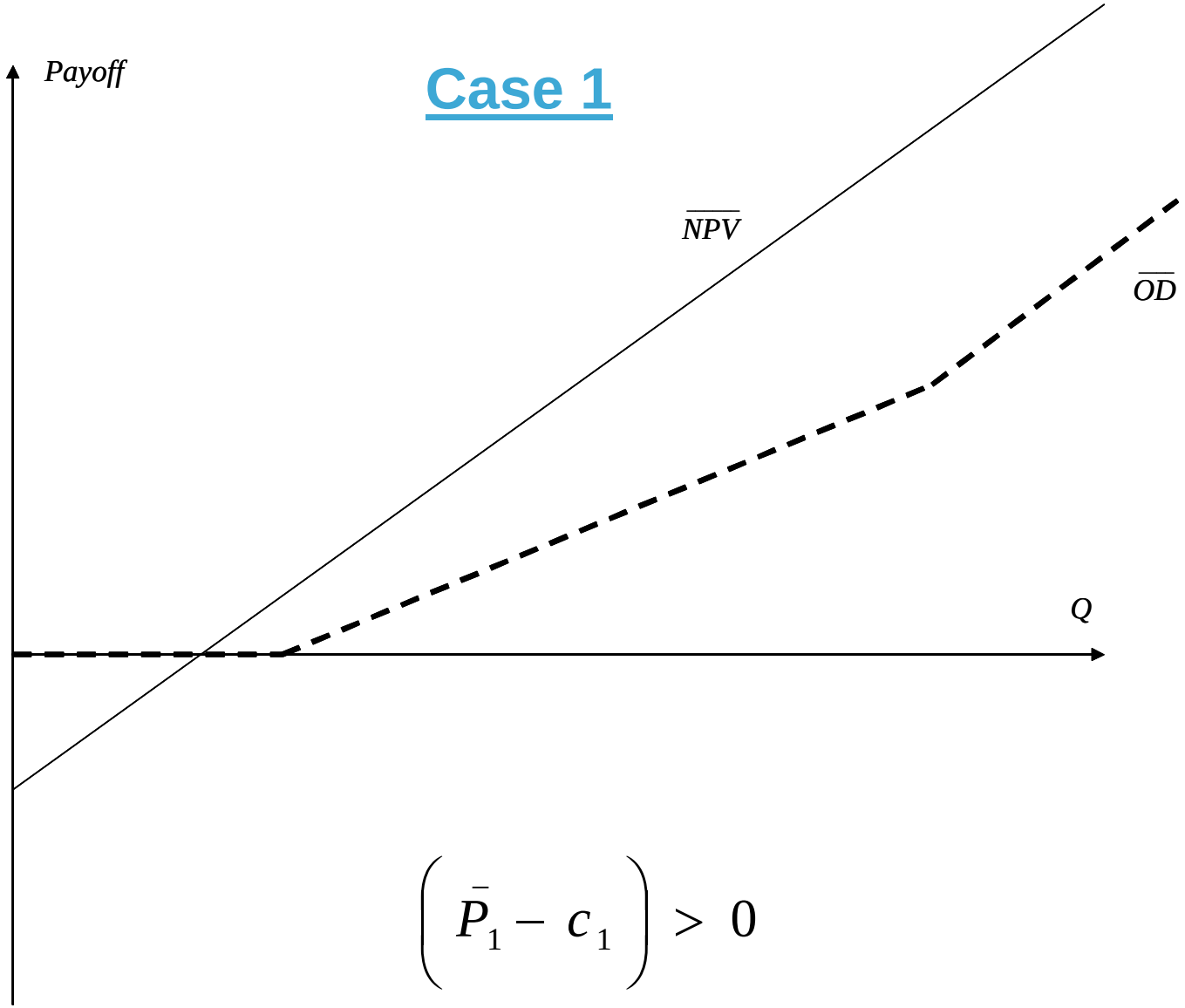
$$\overline{NPV} = \left[\left(\bar{P}_1 - c_1\right) + \left(\bar{P}_2 - c_2\right)\right]Q - I$$

- The OD is the payoff of investing at t=1 if the payoff is positive.

$$\overline{OD} = \frac{pMax\left[\left(\bar{P}_2 - c_2\right)uQ - (1+r)I;0\right] + (1-p)Max\left[\left(\bar{P}_2 - c_2\right)dQ - (1+r)I;0\right]}{1+r}$$

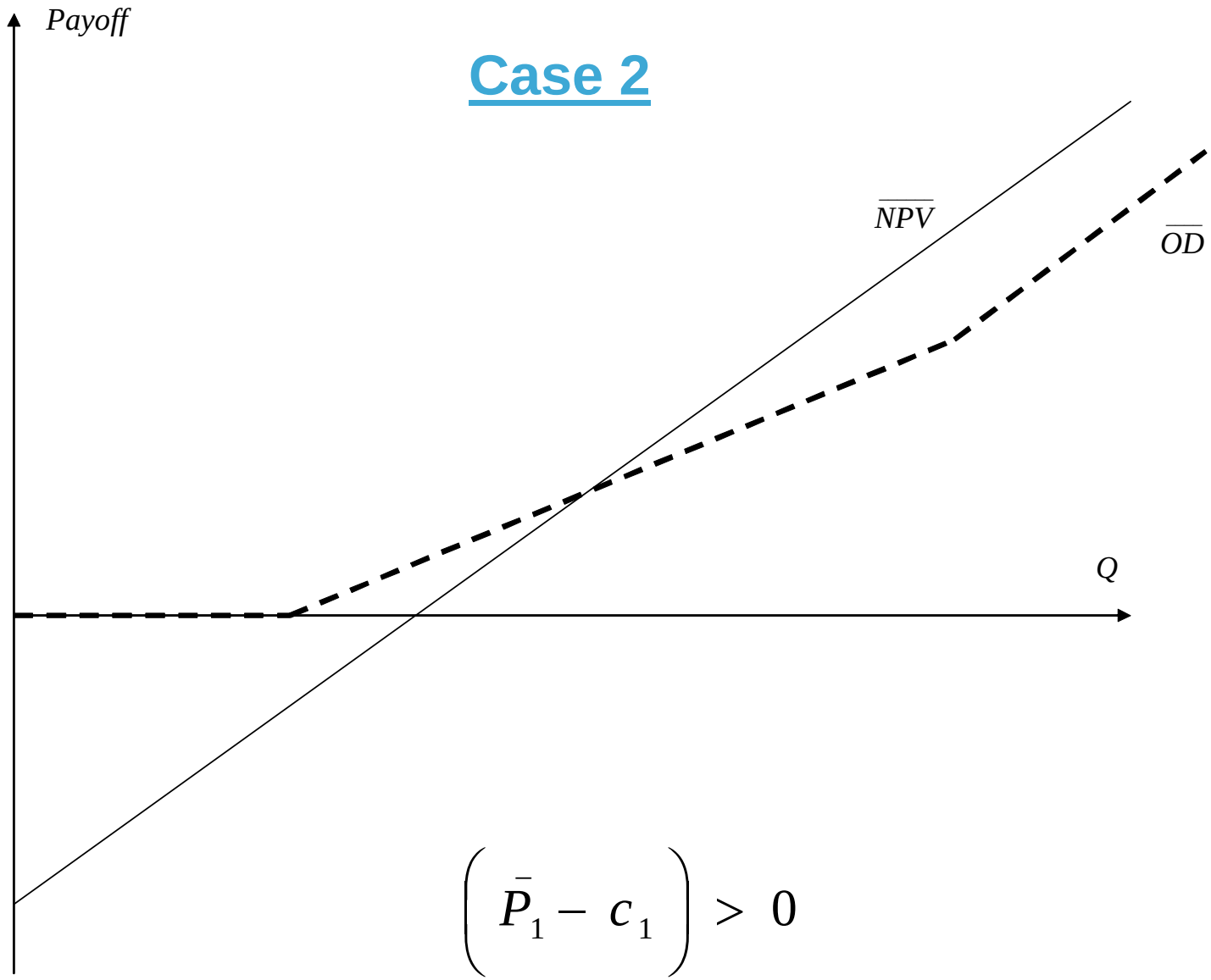
The NPV and OD in an Unregulated Market

Case 1



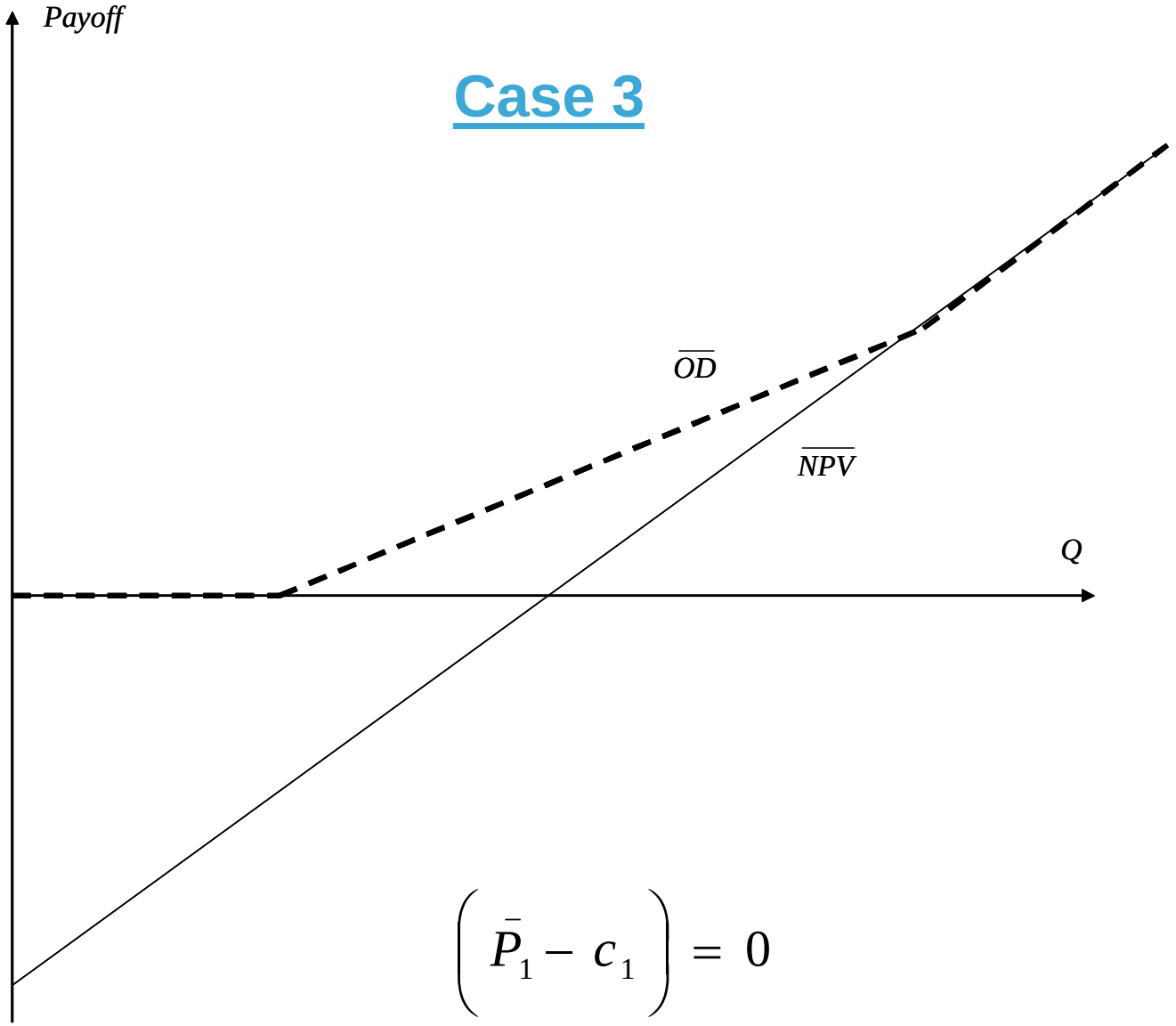
$$\left(\bar{P}_1 - c_1 \right) > 0$$

The NPV and OD in an Unregulated Market



$$\left(\bar{P}_1 - c_1 \right) > 0$$

The NPV and OD in an Unregulated Market



$$\left(\bar{P}_1 - c_1 \right) = 0$$

Retail Regulation

- The regulator and the firm both observe the choke prices and are fully informed about the nature of demand uncertainty and the cost function.

- The regulator sets *ex ante* regulated prices that will prevail at t=1 and at t=2 in order to maximize total welfare:

$$Max \quad W_R = CS + \alpha\pi$$

where CS is the consumer surplus, π is the firm's profit and α<1 is the weight assigned to the firm's profit.

Retail Regulation

- Optimal regulation depends on market conditions.
- **Case 1**: the regulator is able to set regulated prices such that the NPV=OD=0 and the firm invests at t=0.
- **Cases 2 or 3**: the optimal regulation depends on p and will be one of the two following price settings:

  - The minimum prices such that NPV=OD>0 and the firm invests at t=0.

  - The minimum prices such that the payoff is 0 and the firm invests at t=1 if the high demand eventuates.

Access Regulation

- The regulator requires the incumbent to provide access to its network and sets the access prices. There are infinitely many potential entrants with the same technology as the incumbent and retail unit costs equal to c_{1E} at t=1 and c_{2E} at t=2. Firms compete à la Bertrand and consumers prefer to buy from the incumbent when prices are identical.

- The access prices under the ECPR are

$$A_1^{ECPR} = \bar{P}_1 - c_1 \qquad A_2^{ECPR} = \bar{P}_2 - c_2$$

- The access prices under the ODPR are

$$A_1^{ODPR} = P_1^R - c_1 \qquad A_2^{ODPR} = P_2^R - c_2$$

Access Regulation

- When $(c_{1E} + c_{2E}) < (c_1 + c_2)$ the ECPR yields higher overall welfare than an unregulated industry that is not required to provide access.

- When the potential entrant is less efficient than the incumbent an ECPR-based access price yields the same outcome as an unregulated industry.

Access Regulation

- Prices under the ODPR are always lower or equal than under the ECPR. Thus, there is a Z≥0 such that

$$\left(A_1^{ECPR}+A_2^{ECPR}\right)-\left(A_1^{ODPR}+A_2^{ODPR}\right)=Z$$

- When Z=0 the ODPR generates the same welfare as the ECPR.

- When Z>0 and the ODPR is such that the firm invests at t=0 this price regulation generates at least the same welfare as under the ECPR. When $(c_1+c_2)\leq(c_{1E}+c_{2E})<(c_1+c_2)+Z$ the ODPR generates higher welfare than the ECPR.

- When Z>0 and the ODPR is such that the firm invests at t=1 the optimal regulation will depend on p.

Conclusion

- Optimal retail prices depend on demand conditions and basically there are two possible optimal scenarios: regulated prices that provide a zero payoff to the firm and regulated prices that include an option to delay value to the firm.
  - In the latter case, traditional regulation fails to maximize overall welfare.
- When retail competition is possible, the analysis shows that an access price that incorporates an option to delay value (ODPR) often yields higher welfare than the ECPR.