The Simple Economics of White Elephants

Juan-José Ganuza[1] Gerard Llobet[2]

[1]Universitat Pompeu Fabra and Barcelona GSE

[2]CEMFI and CEPR

PPPs in Cities
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What is a White Elephant?

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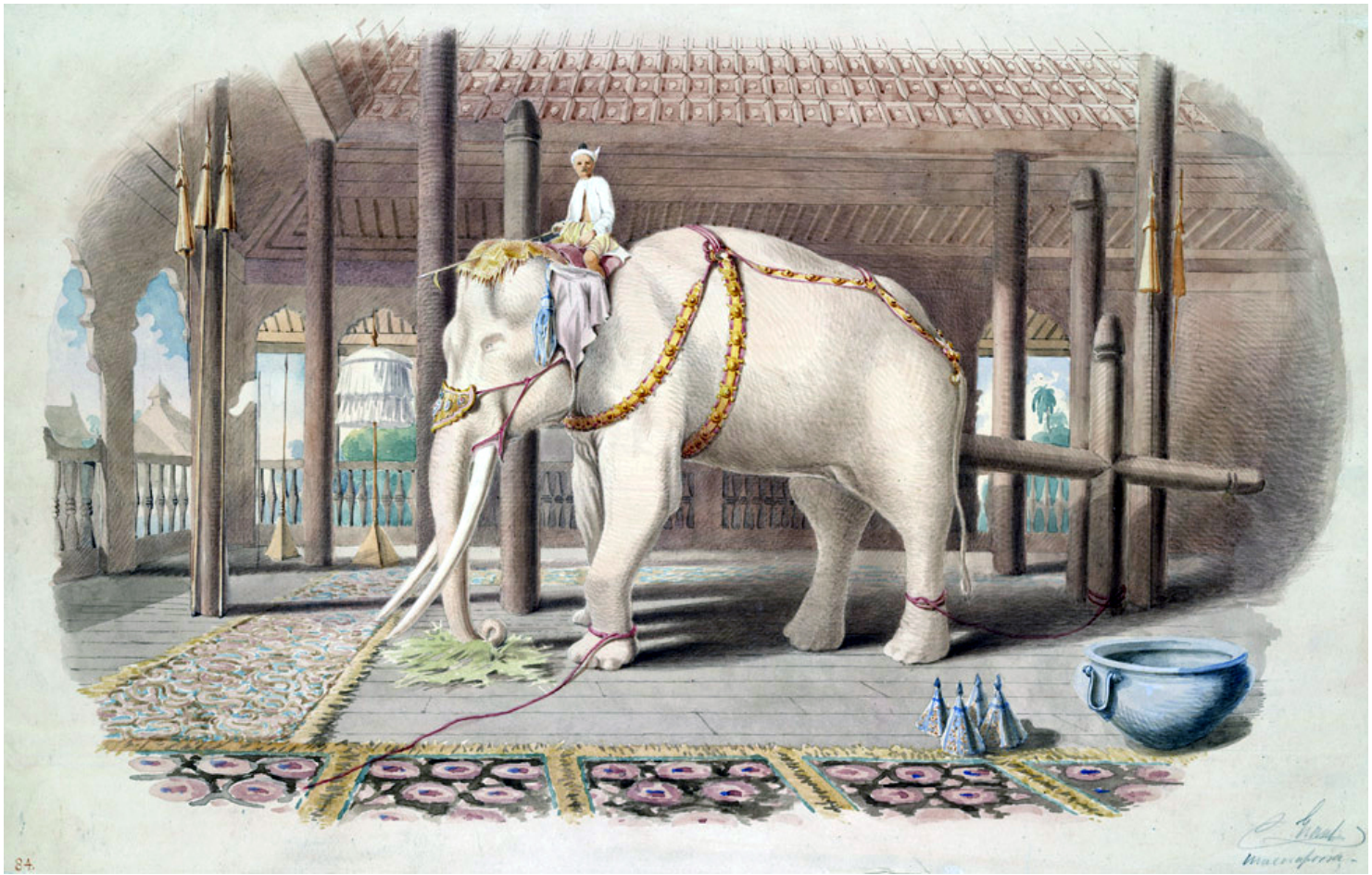

When a Siamese despot takes a grudge against one of his poorer subjects, and determines on his ruin, he does not cut off the delinquent's head and confiscate his property. On the contrary, he makes him a present – he sends him the handsomest and healthiest white elephant he can find. The luckless recipient knows at once that his fate is sealed. He knows that the beast will eat him out of house and home without the possibility, on his part, of resistance. He cannot sell or give away the fatal gift, for no one would accept it, and the attempt to get rid of it even would be direct treason and sacrilege. He sits down with Oriental resignation to submit to the inevitable, and the white elephant devours his substance (NYT May 28, 1873).

- Bullen (2011) claims that the NYT made up that story.
- White Elephants are now used to indicate **infrastructures that are too costly to build and maintain in relation to their usefulness** (see Robinson and Torvik (2005))

Illustrious White Elephants

- The *Montréal-Mirabel International Airport* was once the largest in the world in terms of surface. It was designed for 50 million passengers a year when it opened in 1975 but in 2004 it barely handled 2.8 million.
- The *New South China Mall* is the largest mall in the world but it has sat mostly vacant.
- the Brisbane's *Clem Jones Tunnel* that had less than 50% of the projected traffic even after tolls were slashed by half.
- Any high-speed train line or airport built in Spain in the last 15 years.

Figure: A toll highway around Madrid... on a busy day.

Deviation in traffic with respect to estimation					
Highway and year of tender	Year after inauguration				
	1	2	3	4	5
Tarragona-Valencia (1971)	-38	-45	-46	-48	-52
Valencia-Alicante (1972)	-75	-76	-69	-64	-66
Málaga-Estepona-Guadiaro (1996)	-45	-28	-18	4	18
Alicante-Cartagena (1998)	-24	-21	-10	-4	-4
R-3 Madrid-Arganda (1999)	-57	-47	-41	-44	-51
R-5 Madrid-Navalcarnero (1999)	-58	-55	-47	-43	-50
Santiago-Alto de Santo Domingo (1999)	-43	-33	-34	-32	-26
Ávila-Villacastín (1999)	-34	-25	-19	-20	-19
Segovia-El Espinar (1999)	-28	-31	-30	-25	-19
León-Astorga (2000)	-28	-44	-46	-45	-37
R-2 Madrid-Guadalajara (2000)	-63	-58	-58	-47	-43
R-4 Madrid-Ocaña (2000)	-56	-57	-45	-36	-45
M-12 Airport Madrid (2002)	-79	-65	-61	-65	-71
Ocaña-La Roda (2004)	-49	-55	-56		
Madrid-Toledo (2004)	-82	-74	-83		
Cartagena-Vera(2004)	-70	-65			
Alicante's ring road (2004)	-40	-37			

Table: Source: Baeza and Vassallo (2011).

PPPs, White Elephants, and Traffic risk

- The previous data was about toll highways built and managed as infrastructure concessions (PPPs).
- Infrastructure concessions are long-term contracts designed for investors (the *concessionaire*) to recover large investments carried out upfront, typically through user fees.
- But the profitability of the concession depends on variables (traffic, costs, etc.) that are difficult to forecast for such a long horizon.
- In particular, uncertainty over the demand (the *traffic risk*) is a central problem of concession contracts and one of the origins of the White Elephants.

- Very few studies have measured the traffic risk associated with the construction of large infrastructures.
  - Bain and Polakovic (2005) report, using a sample of toll highway concession projects collected by Standard and Poors (S&P), that first-year traffic volumes averaged about 76% of their predicted values and the error had a standard deviation of 0.26. A similar error persisted in the years 2 to 5.
  - Flyvbjerg et al. (2005) analyze 214 road projects in 14 countries – mainly free roads –, and they find almost no overestimation bias. However, forecasting errors are even larger (a standard deviation 0.44).
  - Flyvbjerg et al. (2005) find overestimation, however, in the construction of railways projects.

Demand Underestimation and PPPs

- This anecdotal evidence suggests that large estimation errors may arise even in private concession contracts.
- This is particularly striking since one of the main advantages of the concession model is that a firm can better assess the demand since its own money is at stake.

> *When high roads are ... made and supported by the commerce which is carried on by means of them, they can be made only where that commerce requires them (Adam Smith).*

Our paper explains this result through the interaction between the (asymmetric) consequences of the unpredictability of revenue (or costs) and the incentives for firms to acquire information.

Renegotiation Problem: Private Profits but Social Loses

- What are these (asymmetric) consequences of the unpredictability of traffic risk over the concession contracts?
  - If traffic is lower than expected, concessionaires will force a renegotiation of the contract.
    - ALL toll highways in Spain have been renegotiated in the first 20 years, typically by increasing the duration of the concession.
    - According to Guasch (2004), 54.7% of the projects in the transportation sector in Latinamerica were renegotiated.

    The alternative is a costly bailout.
  - If traffic is higher than expected, concessionaires will cash the profits (e.g. the M45 ring road around Madrid).
- If the potential losses of the concessions are limited by a future renegotiation (while the firm appropriates the upside) the incentives to acquire information are reduced, negatively affecting project selection.

TP Ferro

- The Government of Spain and France procured the tunnel to link both countries and set it up as a PPP in 2003.
- 60% of the cost was paid directly and the rest was incurred by a concessionary, entitled to receive tolls paid by the trains using the infrastructure during 50 years.
- The first train operated in 2010. In 2014, the duration of the concession was renegotiated to 75 years and in 2016 the concessionary has filed for bankruptcy.
- The concessionary has requested to be bailed out by the government according to the domestic RPA (Responsabilidad Patrimonial de la Administración).
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- The problem was that current traffic was lower than anticipated. In the case of freight trains, 4 a day as opposed to the estimated 24.
- Was this low traffic so difficult to anticipate?

- The reason for the low traffic is that the infrastructure combines three different voltages (1500V cc, 3000V cc, 25000V ac) and there is no train that is certified to use them.
- Only two adapted trains (used for passengers) operate under a temporary license. Certified trains will take at least five years to be operational.

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- Only the sure bailout may explain why the firm did not anticipate this problem.

Flexible-Term Concessions

- Some mechanisms have been proposed to mitigate traffic risk in order to solve the "renegotiation problem."
- Since highway traffic is exogenous to the behavior of the firm (quality is easy to monitor) papers like Engel et al. (1997) and Engel et al. (2001) suggest to protect firms from that risk.
- They propose the usage of the *Least Present Value of the Revenues* (LPVR) mechanism: To award the concession contract to the bidder offering to receive the lowest discounted amount. Over time, toll revenues are deducted from this amount and the contract expires when the LPVR is reached.
- In this paper we show that mitigation-risk mechanisms like the LPVR may reduce the problem of contract renegotiation but they do not deal with the resources wasted in white elephants.
- The LPVR would not help in cases like TPFerro.

This Paper

- We characterize the concession contract that results in the optimal allocation of traffic risk, reducing the likehood that white elephants are built.
- We assume that the concessionary
  1. is in better position to learn about the future profitability of the project than public agencies (since public agencies provide access to their public information),
  2. does not internalize the opportunity cost of the concession contract, and
  3. is protected by limited liability and other public guarantees.
- We start with a situation of bilateral negotiation but we also study the case of competition.
- The benchmark model deals with fixed-term concession contracts but we expand the analysis to flexible-term concession contracts like the LPVR mechanism.

The Basic Model

The Project:

- A project of cost c can be undertaken.
- It has a social opportunity cost $d > 0$.
- The value θ is uncertain. It is only known that it comes from a distribution $G(\theta)$ where we normalize $\theta \in [0, 1]$.
- The realized value θ is revealed if the firm pays a cost $k \geq 0$.

The Firm:

- Only one firm can carry out this project.
- It receives a proportion $\beta \in [0, 1]$ of the value of the project (through the duration of the concession, the toll price, etc).
- It incurs in the construction cost c.
- Whether the firm has acquired the information and paid k is not contractible.

The First Best

- If the firm acquires information it should invest if and only if the value of the project is higher, θ, than the cost $c + d$. That is, if

$$\theta \geq \underline{\theta}^s = c + d.$$

- If the firm does not acquire information it will carry out (by assumption) all projects.
- Thus, information should be acquired only if its cost is below a threshold K^s.

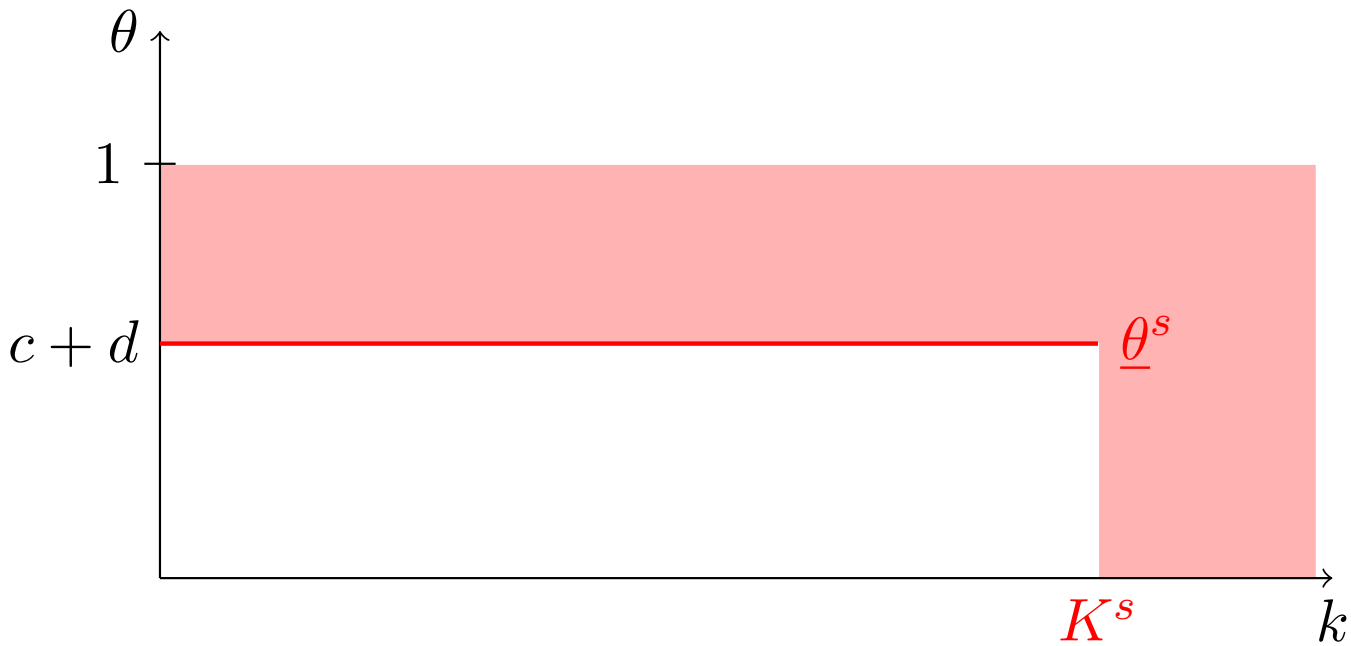


Figure: The red area denotes the projects that **should** be built.

The Optimal Concession when k is very large

- In this case the firm will never get informed.
- The duration of the contract must guarantee that the firm covers costs in expected terms. Thus

$$\beta^* = \frac{c}{E(\theta)}.$$

The Optimal Concession when $k = 0$

- Since the cost of information is 0, the firm will always get informed.
- The firm will only carry out projects if during a concession of duration β profits exceed its own costs,

$$\beta\theta > c.$$

- Thus, we need to guarantee that the duration is such that when traffic is $\underline{\theta}^s$, profits are equal to costs. Thus, the duration must be

$$\beta^* = \frac{c}{c+d} < 1.$$

Since the firm does not internalize the cost d, it has excessive incentives to invest. So $\beta^* < 1$.

The Optimal Concession when k takes an intermediate value

- We show that there is a trade-off when choosing the duration of the concession
  - When β is high, the firm has **incentives to undertake most projects**. But in this case, firm makes big profits when θ is high and small losses when θ is small. Thus, the firm has few incentives to get informed.
  - When β is low, the firm **has more incentives to get informed** as, otherwise, it is likely to make large losses. However, it might only carry out projects when θ is very high.

When k takes an intermediate value β must trade-off both effects.

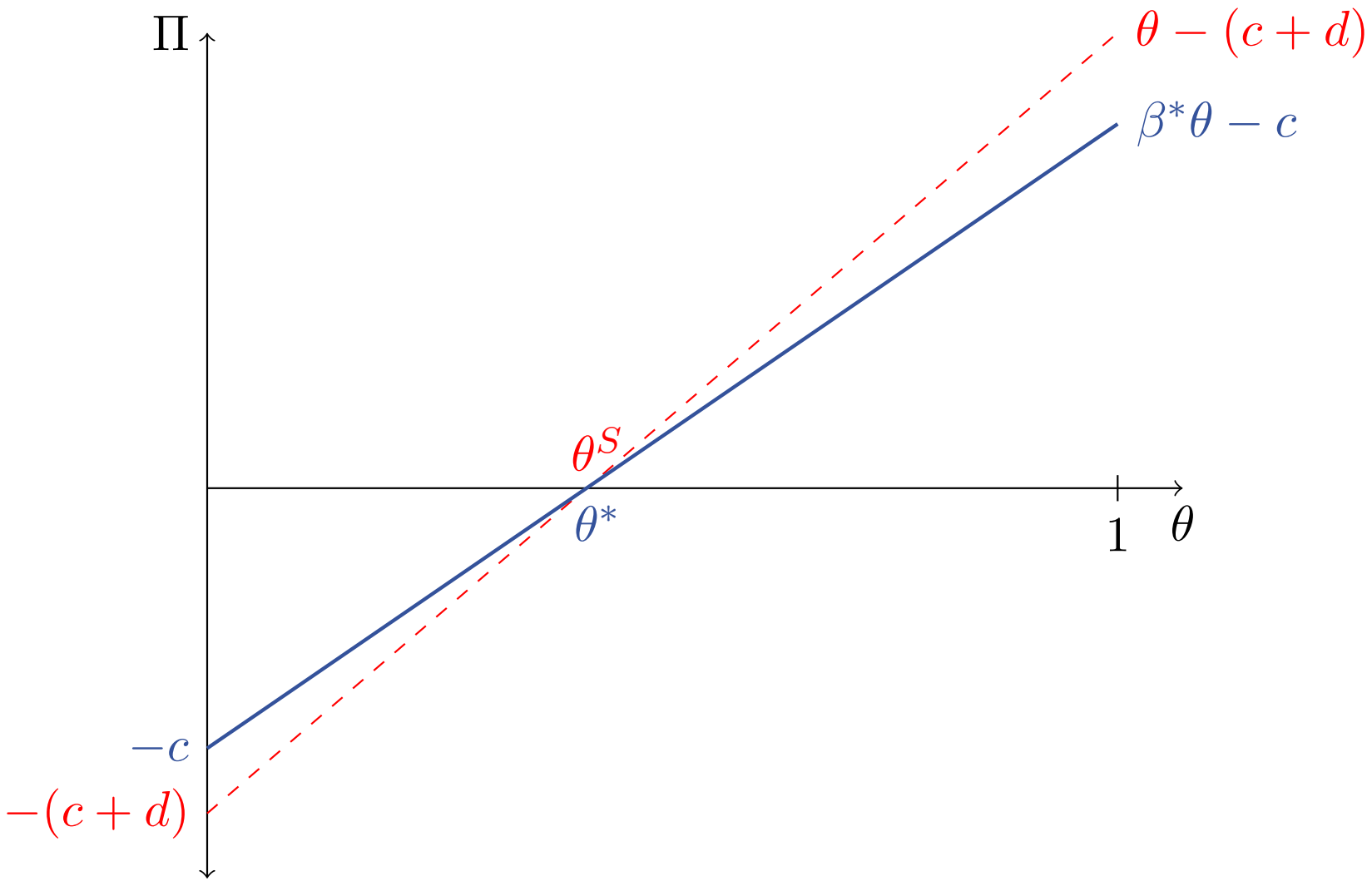


Figure: Losses and profits depending on θ.

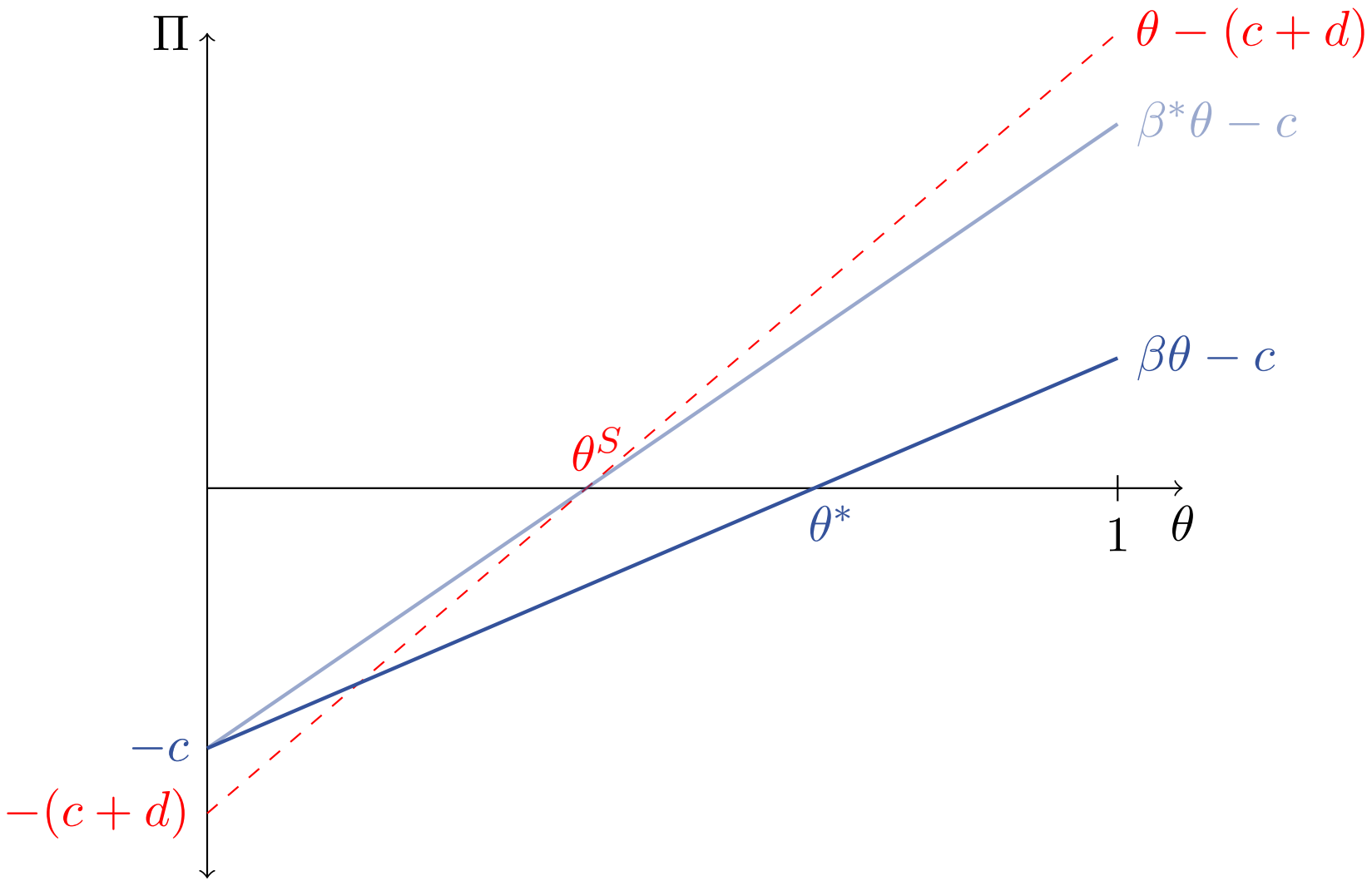
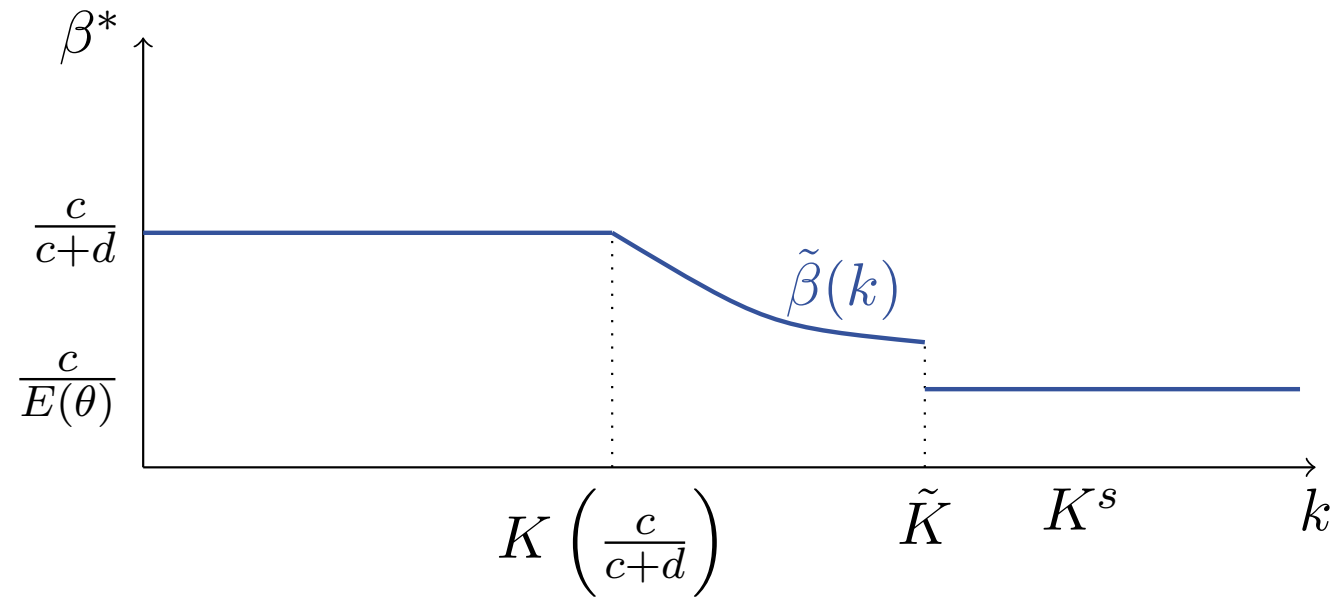
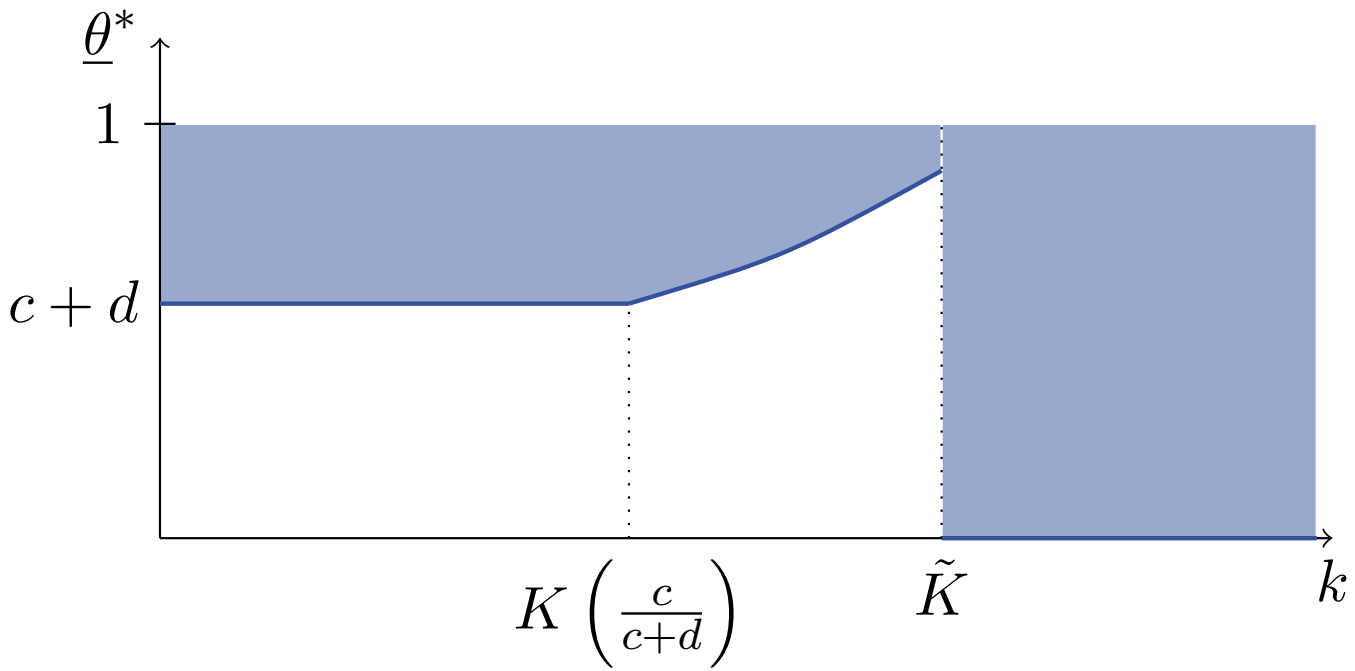
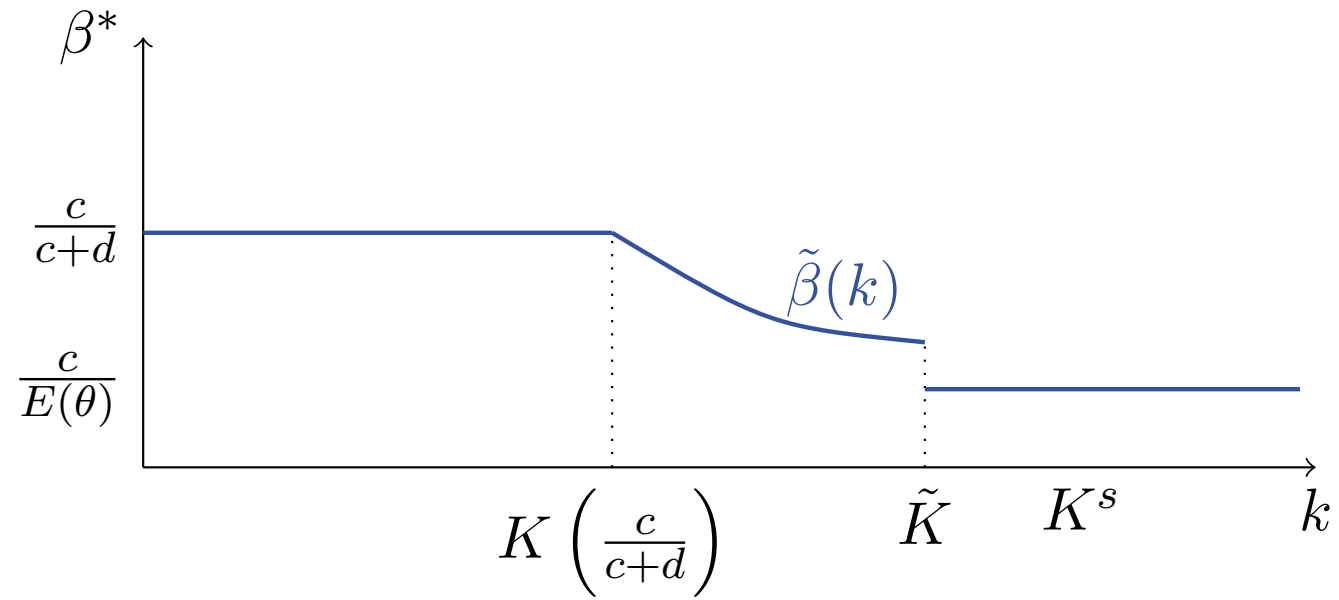


Figure: Losses and profits depending on θ.

- In this case we show that there are two regions:
  - If k takes an intermediate value it is better to foster information acquisition and sacrifice some good projects.
  - If k takes a higher value it is better to give up on providing incentives to invest in information.


β^*
$\frac{c}{c+d}$
$\frac{c}{E(\theta)}$
$\tilde{\beta}(k)$
$K\left(\frac{c}{c+d}\right)$
$\tilde{K}$
K^s
k


$\underline{\theta}^*$
1
$c+d$
$K\left(\frac{c}{c+d}\right)$
$\tilde{K}$
k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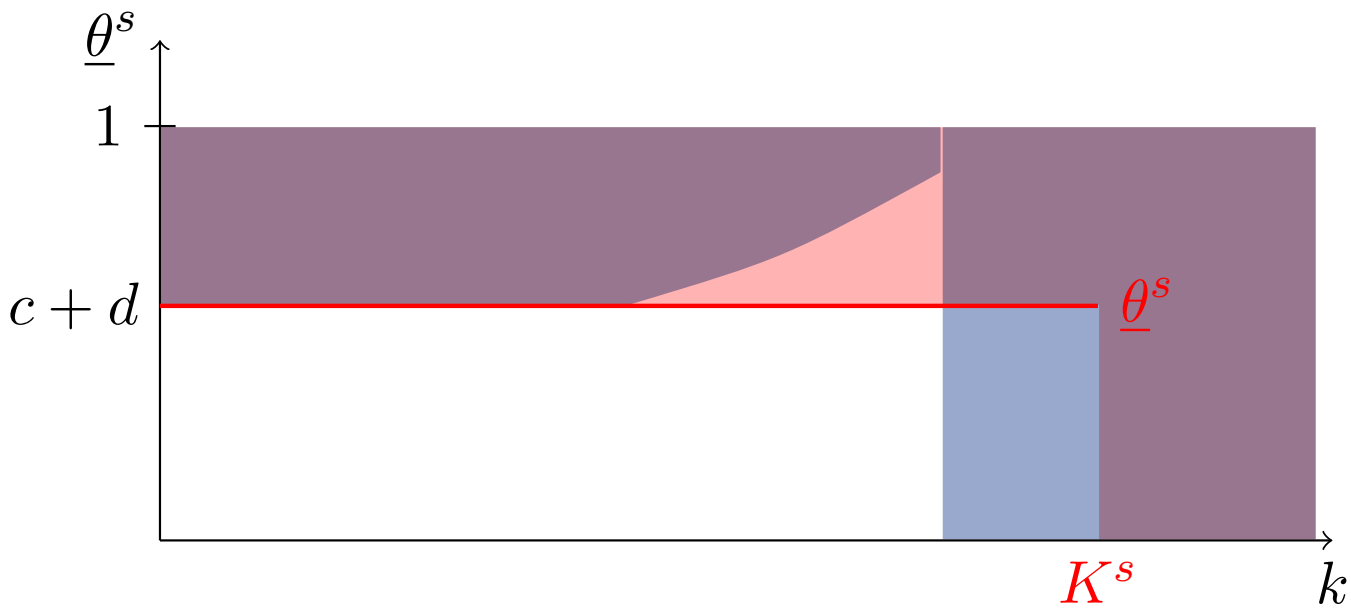
K^s
k


$\underline{\theta}^s$
1
$c+d$
$\underline{\theta}^s$
K^s
k

What is a White Elephant? (II)

- White elephants like the ones discussed in the introduction are interpreted from the ex-post evaluation of projects.
- However, when k is large the presence of uncertainty is efficient and this implies that ex-post for some projects the costs will never be recovered. But this does not imply an upfront bad project selection.
- For this reason, we should reserve the term *white elephants* for those bad projects that ex-ante could have been efficiently screened out by investing in information but they were built anyway.

Limited Losses (and/or Renegotiation)

- Suppose that the firm can only incur in losses up to $L \in [0, c]$.
- In the benchmark case $L = c$.
- This limit on losses "insures" the firm against low demand realizations and it implies fewer incentives to get informed.
- As a result it is optimal to lower the duration of the concession.

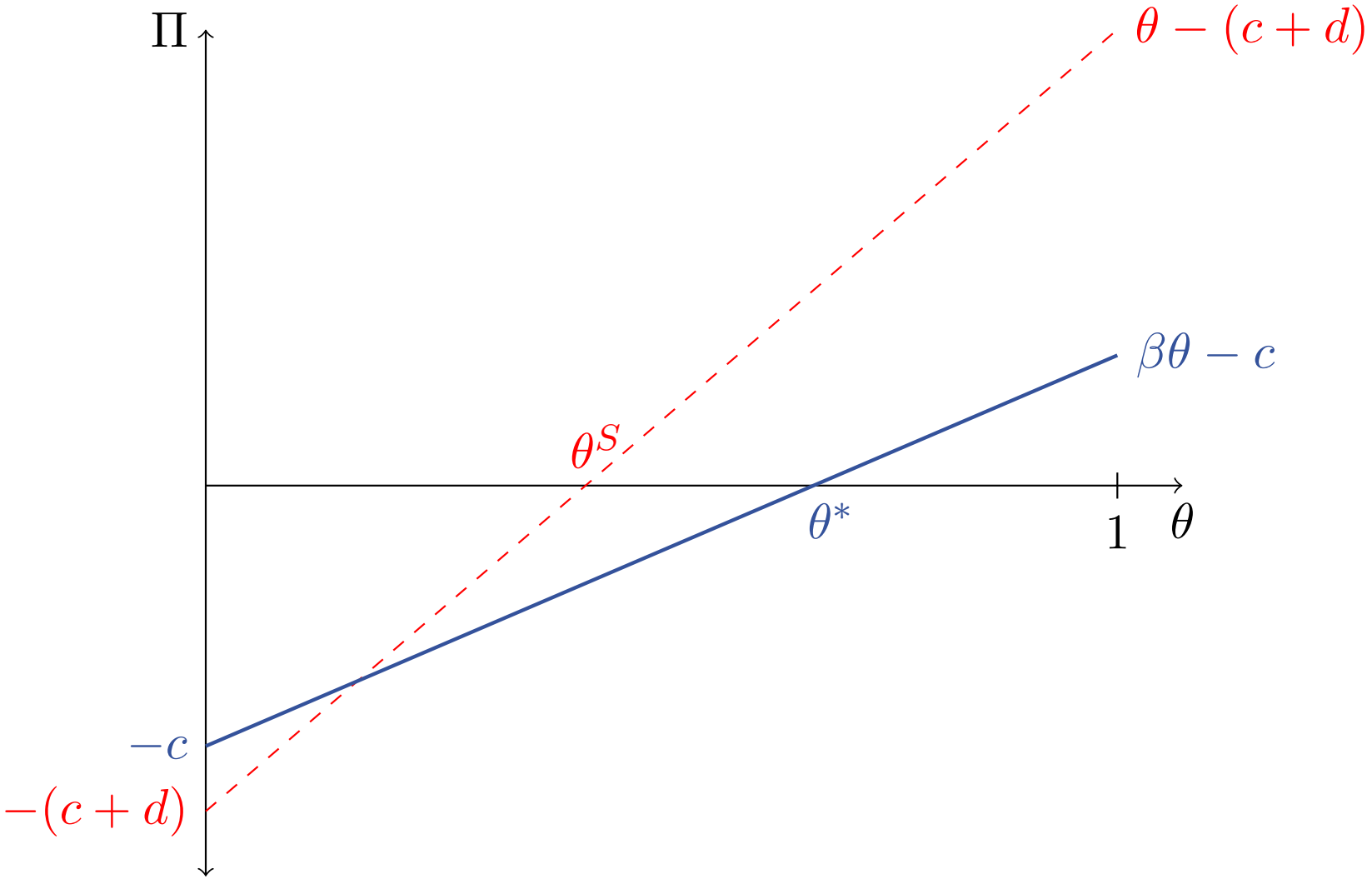
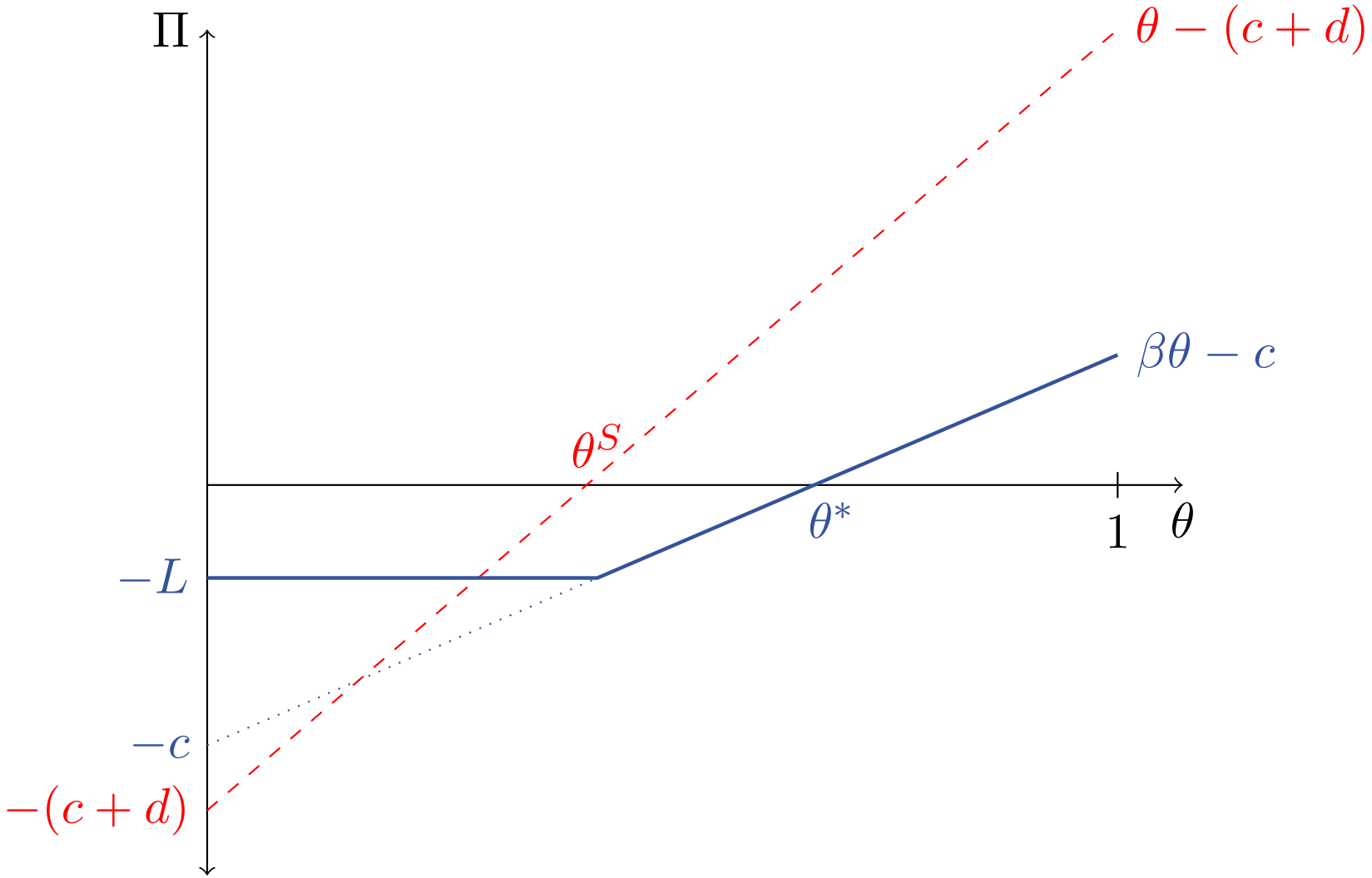


Figure: The effect of limited losses.



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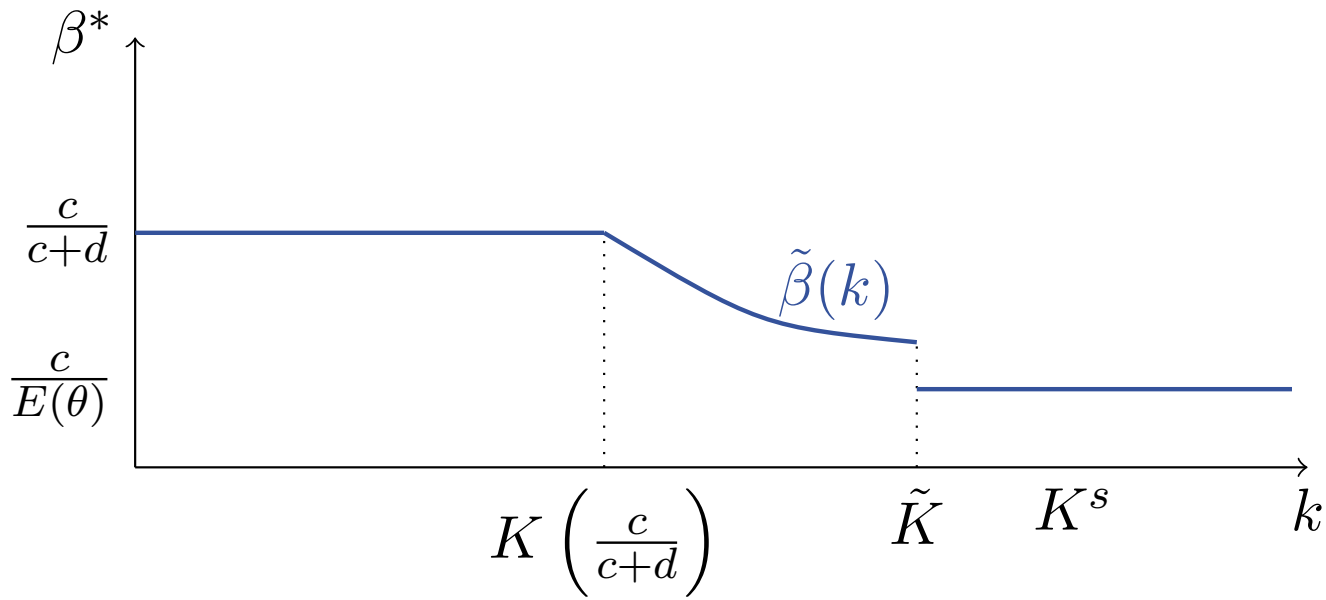
β^*
$\frac{c}{c+d}$
$\frac{c}{E(\theta)}$
$\tilde{\beta}(k)$
$K\left(\frac{c}{c+d}\right)$
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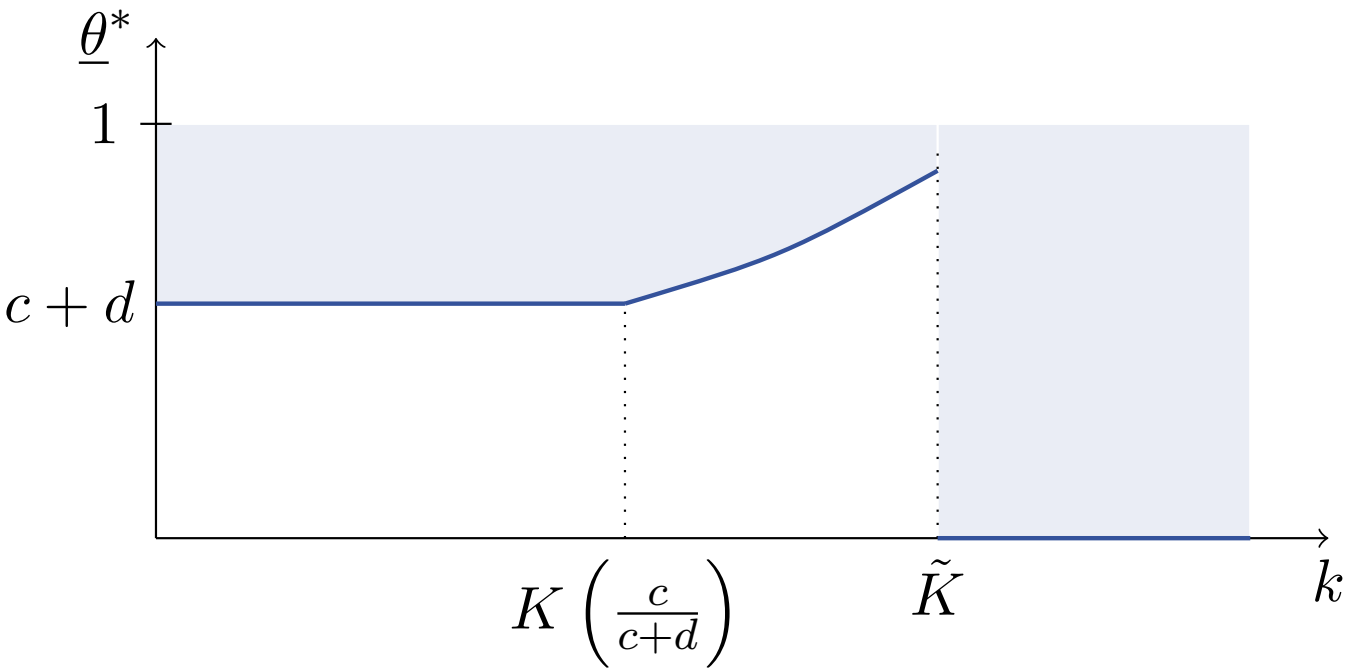
K^s
k


$\underline{\theta}^*$
1
$c+d$
$K\left(\frac{c}{c+d}\right)$
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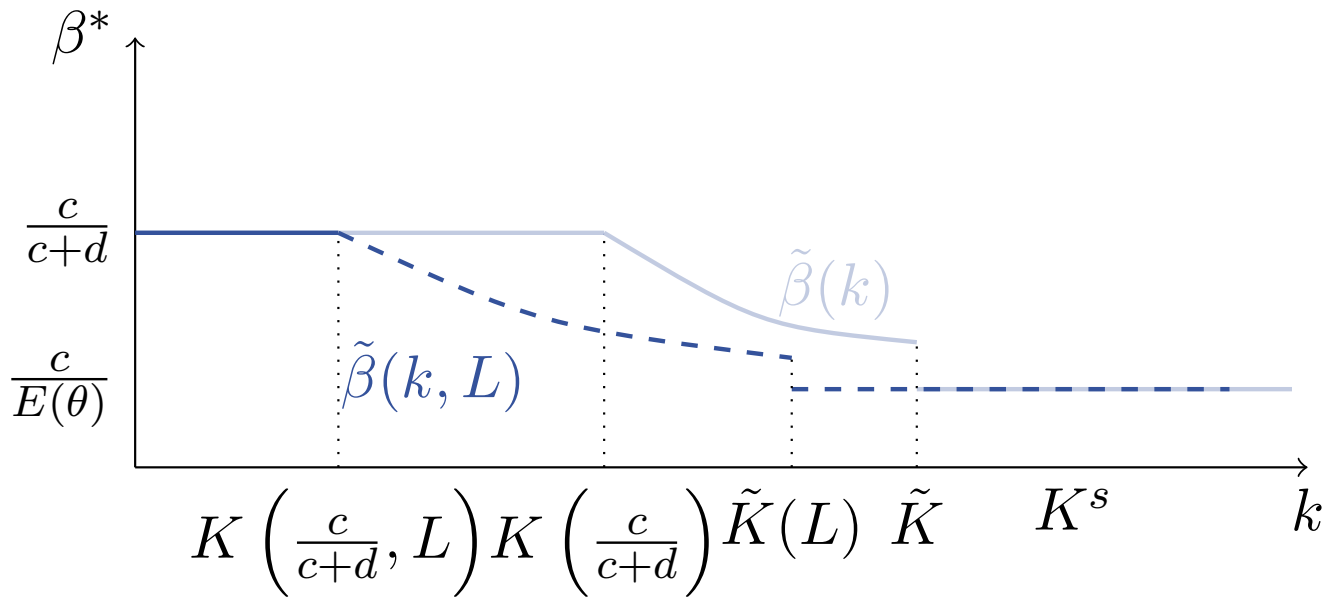
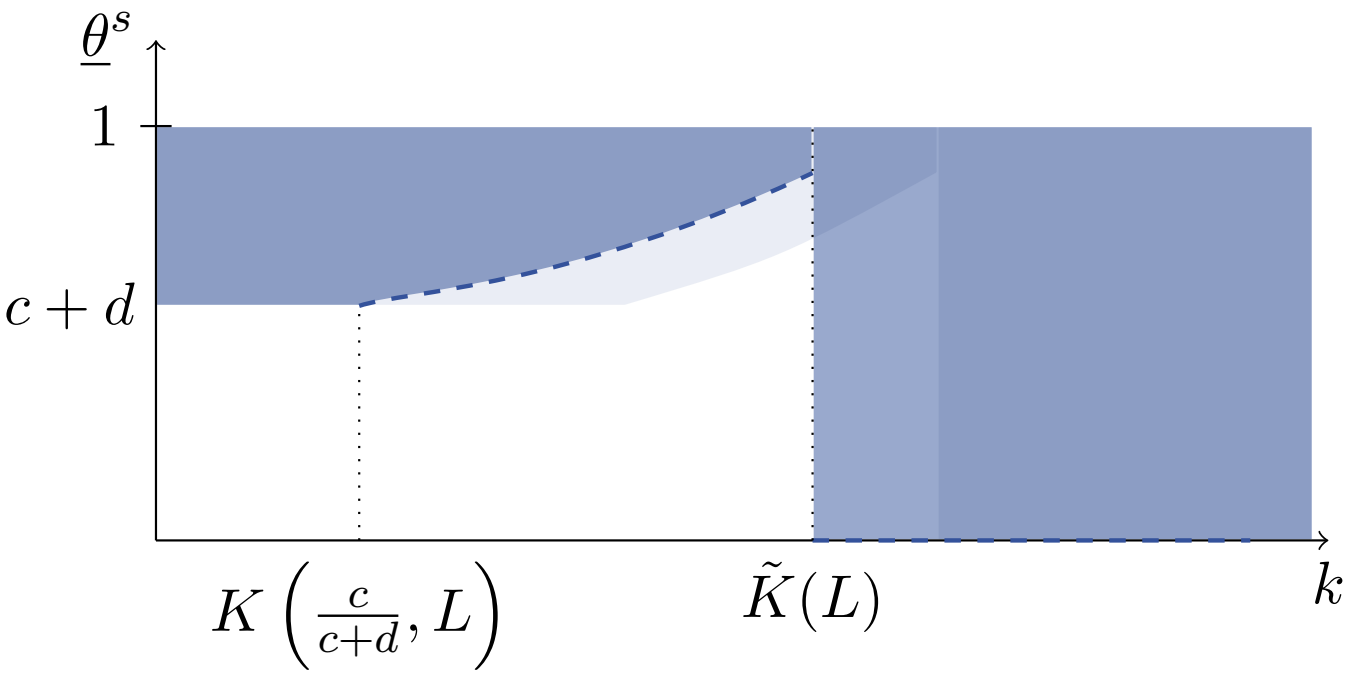

β^*
$\frac{c}{c+d}$
$\frac{c}{E(\theta)}$
$\tilde{\beta}(k)$
$\tilde{\beta}(k, L)$
$K\left(\frac{c}{c+d}, L\right)$
$K\left(\frac{c}{c+d}\right)$
$\tilde{K}(L)$
$\tilde{K}$
K^s
k


$\underline{\theta}^s$
1
$c + d$
$K\left(\frac{c}{c+d}, L\right)$
$\tilde{K}(L)$
k

Policy Implications

- When the losses that the firm can absorve, L, increase,
  1. Social welfare increases,
  2. White elephants are less likely, and
  3. Equilibrium decision errors are smaller.

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- In practice, when θ is sufficiently low the concessionaire might go bankrupt.
- The sponsor takes over the concession in order to keep its activity. The firm is compensated.
- As opposed to what it is often done, the compensation should be tailored to θ rather than to c.
- How can this be implemented? Through an auction.

Optimal Flexible-Term Contracts

- A useful property of the flexible-term contracts is that they condition the payoff on the realized traffic, $\beta(\theta)$.
- But a standard application of flexible-term contracts (the LPVR), leading to

$$\beta(\theta)\theta = c$$

  is inefficient because it removes all the risk from the firm and, hence, it provides no incentives for the firm to get informed.

- In the paper we extend our benchmark contract so that
  - we can condition β on θ and
  - we allow for cash payments when not undertaking the project.
- Under these assumptions we show that we can implement the first best.

Optimal Flexible-Term Contract

- Suppose that k is sufficiently small so that the government finds optimal to foster information acquisition, $k \leq K^S$. In that case the concessionaire will receive:
  - a fixed payment $\rho_N > 0$ if the project is not built,
  - a concession $\beta^{ft}(\theta) > \frac{c}{\theta}$ if the project is built and $\theta \geq \theta^S$,
  - 0 if the project is built and $\theta < \theta^S$.

  Providing a payment for not building the project is enough to induce the firm to acquire information.
- If k is very high it is optimal, as before, to choose $\beta^{ft} = \frac{c}{E(\theta)}$.
- This concession contract implies that, given k, only those projects that are optimal to build are carried out.

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- If payments for not undertaking the project are not possible, inefficiencies arise again, although they are smaller than in the benchmark case.

Competition

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- The benchmark model assumes that a unique firm can carry out the project. But concessions are typically allocated through an auction process. Do results change?
- In the last part of the paper we consider this case.
- Firms participating in the auction bid a β.
- A lower β might be understood not only as a shorter duration but also as lower tolls (in the case of a highway, for example).
- The firm with the lowest β wins.
- In that case we show that the same kind of results arise in this case and, in particular, the higher is k the lower is β.

How to avoid White Elephants

- White elephants should be evaluated from a ex-ante perspective: Just because a project is ruinous it does not mean that it was not ex-ante sound.
- A white elephant arises when the concessionaire did not acquire as much information as it should.
- Longer and more generous concessions might not lead to better and more informed decisions. It is sometimes worth to pass up some good projects if that leads firms to acquire more information.
- Government guarantees and the perspective of a generous renegotiation might foster the investment in white elephants. Bankrupt concessionaires should be compensated according to the value of the concession and not the incurred cost.
- When possible, mechanisms that compensate the potential concessionaire for acquiring information (even if this leads to not carrying out the project) are optimal.

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