Basic Economics of Fish Farming

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Briefly about myself

- PhD in Economics from Yale University, 1981
- Professor for 35 years at University of Alaska Anchorage Institute of Social and Economic Research (ISER)
- Spent most of my career studying:
  - Seafood markets
  - Fisheries management
  - Aquaculture
  - Seafood industry

My goal for this talk

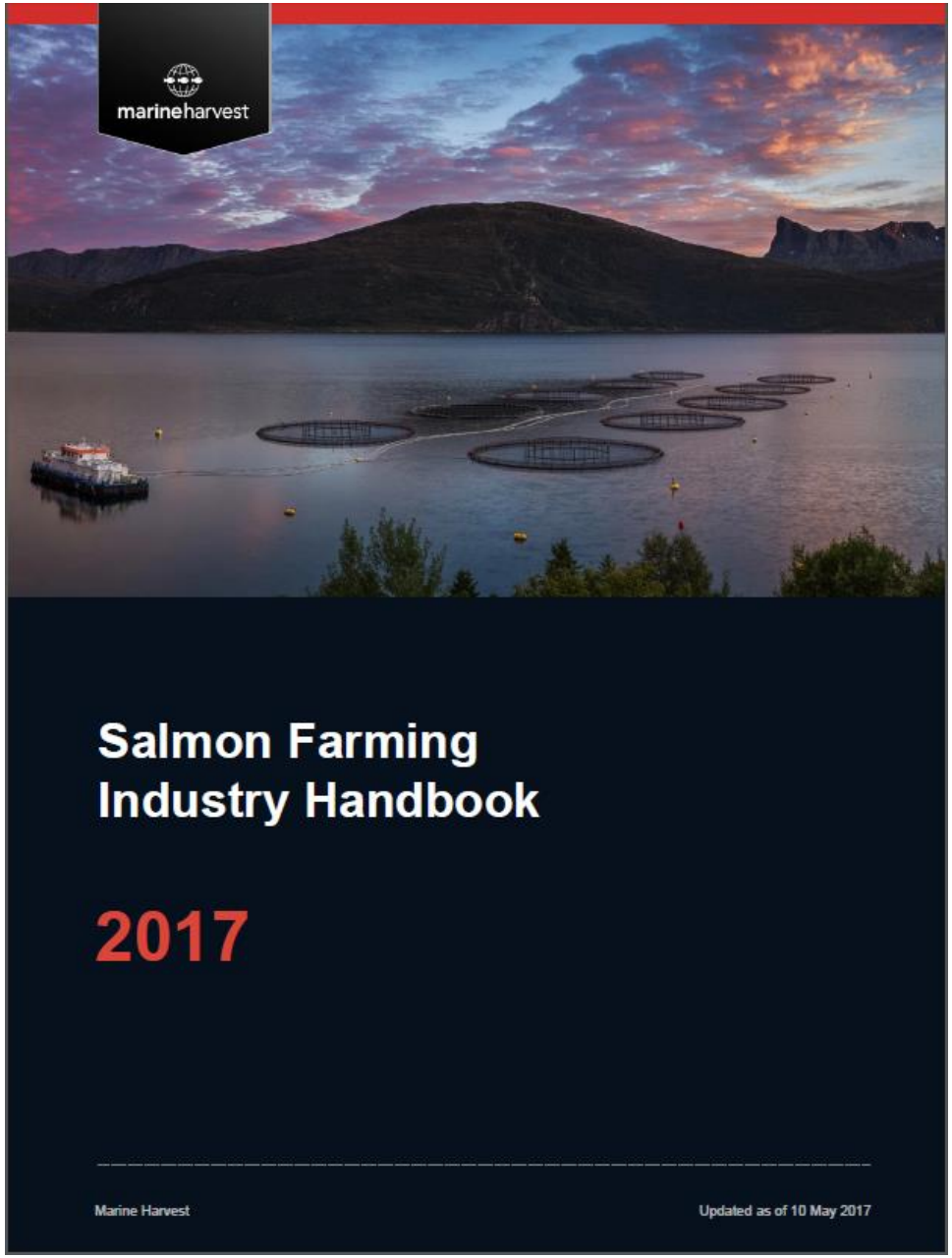
- Not to explain the specific costs, prices and profitability of Gulf of Mexico fish farming
  - I haven't studied them
  - Not enough information is available
  - Would vary widely by species

- To provide a general framework for thinking about the factors which affect costs, prices, and profitability of fish farming

The Marine Harvest *Salmon Farming Industry Handbook* offers a useful, detailed and clear overview of the economics of salmon farming.

Gulf of Mexico fish farming would be different from salmon farming—but the same kinds of economic factors would matter.

We don't have similar detailed information for Gulf of Mexico fish farming because the industry doesn't exist yet.



http://marineharvest.com/investor/industry-handbook/

Aquaculture is farming—not fishing.

- Fish farming is like other types of meat farming:
  - Beef
  - Poultry
  - Pigs

- Basic tasks of fish farming
  - Produce juveniles
    - Produce eggs from breed stock
    - Hatch eggs
  - Grow juveniles to market size
    - Feed them
    - Keep them healthy
    - Protect them from predators
  - Deliver fish to market

Fundamental conditions for economic viability of fish farming

It must be profitable:

Revenues > Costs
Price/lb > Cost/lb

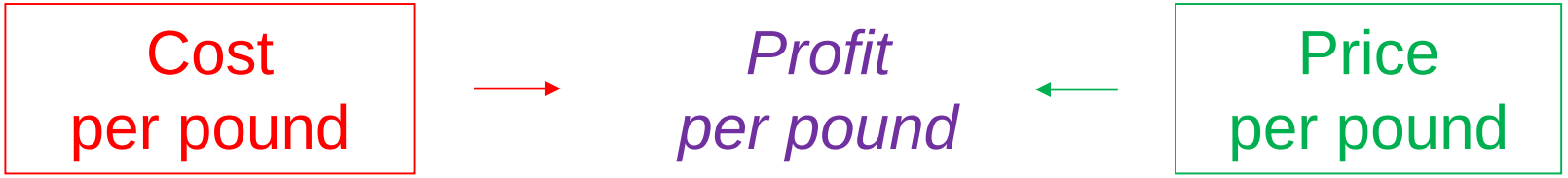
If farms aren't profitable, farmers can't say in business.

It must be competitive.

The rate of return must be as good as
can be earned on alternative investments of equal risk.

If investments aren't competitive, farmers won't invest.

Factors affecting profitability of a fish farm . . .



Major fish farming cost components . . .

Facilities costs

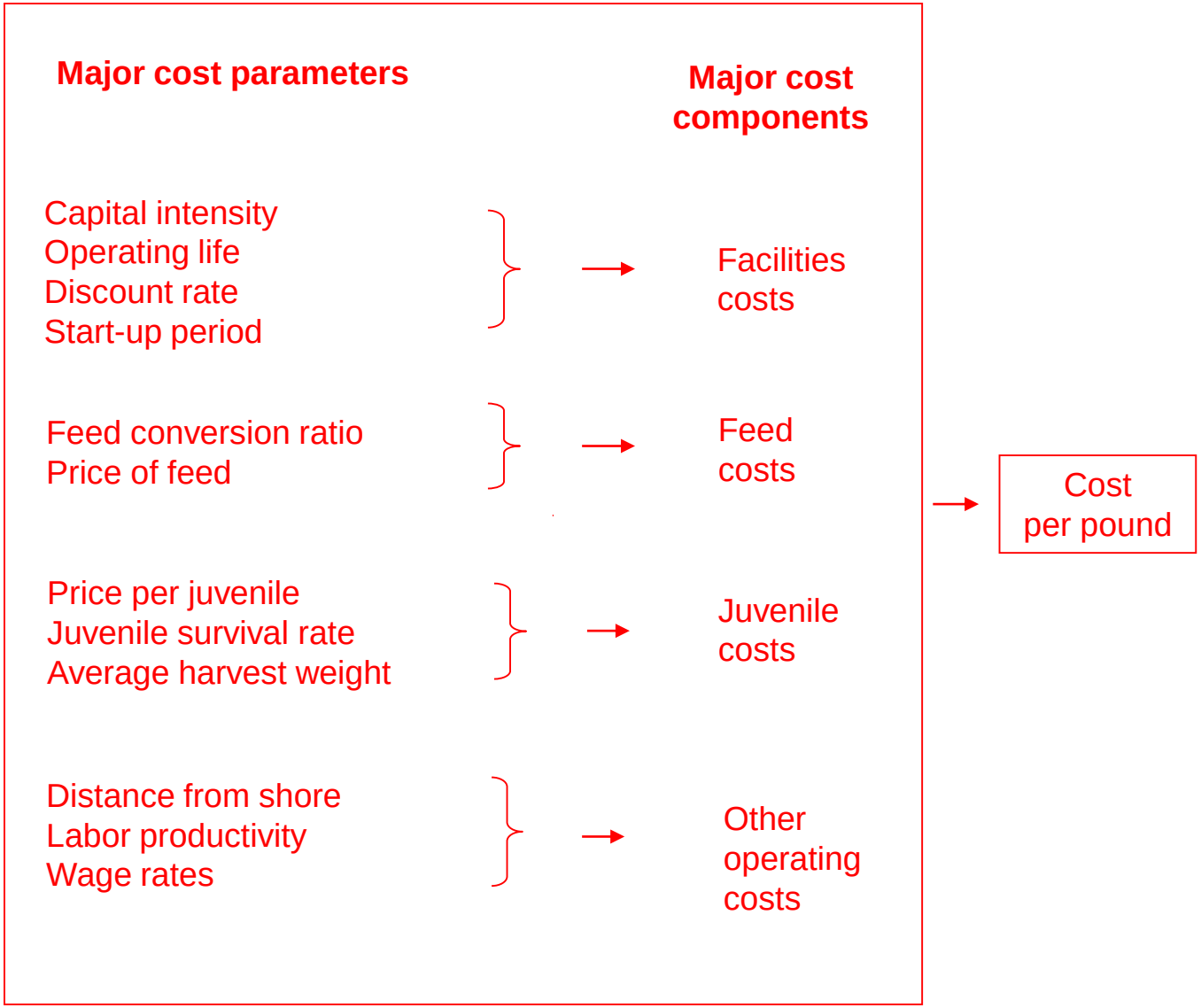
Juvenile costs

Feed costs

Other operating costs

- Costs vary widely for different species, technologies & locations
- In general, feed and juveniles account for the highest share of costs

Major parameters affecting fish farming costs . . .



Selected factors affecting major cost parameters . . .

Economic factors

Labor supply & wages
Infrastructure (roads, ports, energy, etc.)
Political & economic stability

Environmental factors

Do suitable sites exist?
Site exposure
Water quality, depth, flow and temperature
Predators
Diseases in environment

Industry factors

Availability and cost of juveniles
Availability of skilled labor and technical specialists
Farm support infrastructure
Processing & distribution infrastructure
Farming technology
Industry production scale

Regulatory factors

Regulatory restrictions and requirements
Permitting process cost and time
Regulatory certainty
Taxes and royalties

→ Farm design, technology & scale

↓

→

Major cost parameters	Major cost components
Capital intensity Operating life Discount rate Start-up period	→ Facilities costs
Feed conversion ratio Price of feed	→ Feed costs
Price per juvenile Juvenile survival rate Average harvest weight	→ Juvenile costs
Distance from shore Labor productivity Wage rates	→ Other operating costs

→ Cost per pound

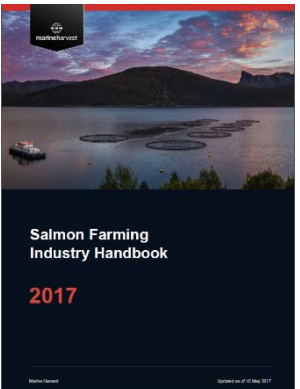
For a given species, costs vary between locations because of differences in economic, environmental, industry and regulatory factors —which in turn affect farm design, technology and scale

Salmon production costs for Marine Harvest in 2016

Feed →

Juveniles →

	Norway (NOK)	Canada (CAD)	Scotland (GBP)	Chile (USD)
Feed	15.20	2.44	1.56	1.96
Primary processing	2.76	0.47	0.29	0.50
Smolt	2.91	0.58	0.42	0.67
Salary	2.00	0.51	0.22	0.25
Maintenance	1.18	0.21	0.16	0.23
Well boat	1.06	0.18	0.19	0.26
Depreciation	1.00	0.25	0.19	0.23
Sales & Marketing	0.30	0.01	0.04	0.02
Mortality	0.71	0.00	0.12	0.03
Other	6.36	1.11	0.81	1.44
Total*	33.49	5.77	4.00	5.58



Key assumptions in Marine Harvest model of the capital return on salmon farming investments

Investments and payback time (Norway) - assumptions

Normal site consisting of 4 licenses

Equipment investment: MEUR 3.5 - 4.5
Number of licenses: 4
License cost (second hand market) MEUR: 28 - 40 (~MEUR 7 - 10 per license)
Output per generation: ~4 000 tonnes GWE
Number of smolt released: 1 000 000

Smolt cost per unit: EUR 1
Feed price per kg: EUR 1.3 (LW)
Economic feed conversion ratio (FCR): 1.2 (to Live Weight)
Conversion rate from Live Weight to GWE: 0.84
Harvest and processing incl. well boat cost per kg (GWE): EUR 0.4

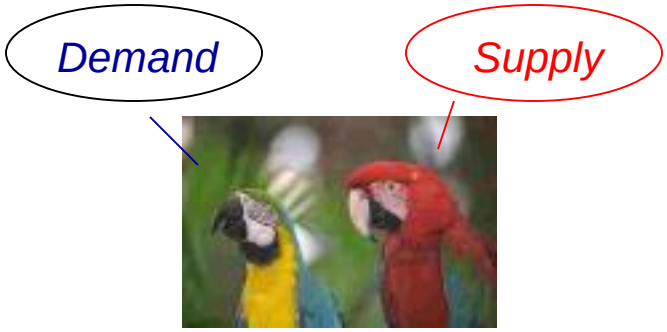
Average harvest weight (GWE): 4.5kg
Mortality in sea: 10%

Sales price: EUR 5/kg

What determines prices received by fish farmers?

Prices of both farmed and wild fish tend towards levels which balance SUPPLY with DEMAND.

Numerous complex factors affect supply and demand!



Economists

An old joke is that if you need an economist, just teach a parrot to say "supply and demand."

Selected factors which would affect supply and demand for Gulf of Mexico farmed fish . . .

- SUPPLY
  - Gulf production of farmed fish
  - Gulf harvests of wild fish
  - Global production of competing farmed and wild fish
- DEMAND
  - Consumer Incomes
  - Consumer tastes
  - Exchange rates
  - Prices of other fish and other foods
  - Distribution costs
  - Trade barriers
  - Marketing
  - Market power of buyers

Factors affecting prices . . .

- Prices for Gulf farmed fish would depend on:
  - The markets they sell into
  - The extent to which they increase supply to those markets
  - The extent to which they build demand from those markets

- Gulf farmed fish could command higher or lower prices than competing wild and farmed fish depending on other attributes:
  - Supply volume, timing, frequency and reliability
  - Processing, transportation and distribution costs
  - Buyer perceptions of quality, safety, sustainability, etc.

- Individual farmers—and the industry—could influence prices
  - by marketing
  - by attention to all attributes which matter to buyers
  - by affecting costs of processing and distribution

The more “local” and “specialized” the markets for Gulf farmed fish,
the more markets can be driven by local supply and demand.

The larger the scale of Gulf farmed fish production,
the harder it will be to sell to “local” and “specialized” markets,
and the more prices will be driven by global supply and demand.

Farmed fish prices can and do vary widely over both the short and long term!

- Price fluctuations reflect short and long term variations in numerous factors affecting both supply and demand.

- In global markets, low-cost producers' costs of production set a floor on average prices over the long-term:
  - if prices fall below production costs, farmers lose money
  - Some farmers reduce production and/or go out of business
  - Supply declines and prices rise until farming is profitable again

- In the short-term, fish farming profitability can vary widely as prices rise and fall.

Fish farming profitability can vary widely over time as prices rise and fall.

- Farmers are better able to survive periods of low prices and unprofitability if they
  - Are cost efficient
  - Are diversified by species and region of production
  - Have deep pockets

Some of the factors affecting profitability are *fundamental economic and environmental factors which neither the industry nor regulators can change*

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Taxes and royalties

→ *Farm design, technology & scale*

→

Major cost parameters		Major cost components
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→ Cost per pound → Profit per pound ← Price per pound

Market factors

Demand in local, national & international markets

Local supply

Supply from national and international competitors

Transportation & processing cost differentials relative to competitors

Market quality perception differentials relative to competitors

Exchange rates

↓

Price per pound

Some of the factors affecting fish faming profitability *can be influenced by industry through growth, experience and cooperation*

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Governance—how fish farming is permitted and regulated—can critically affect the profitability of fish farming

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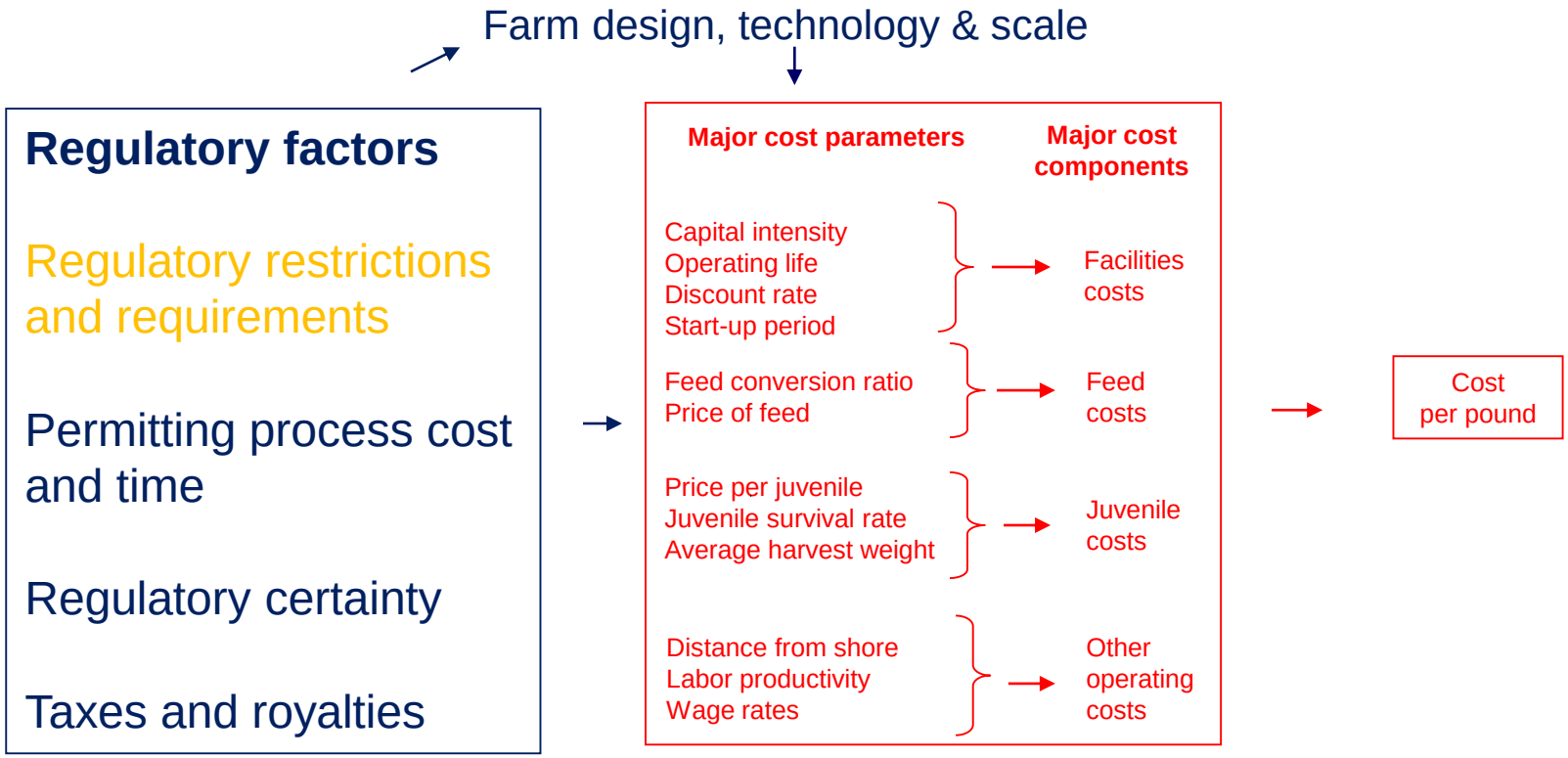
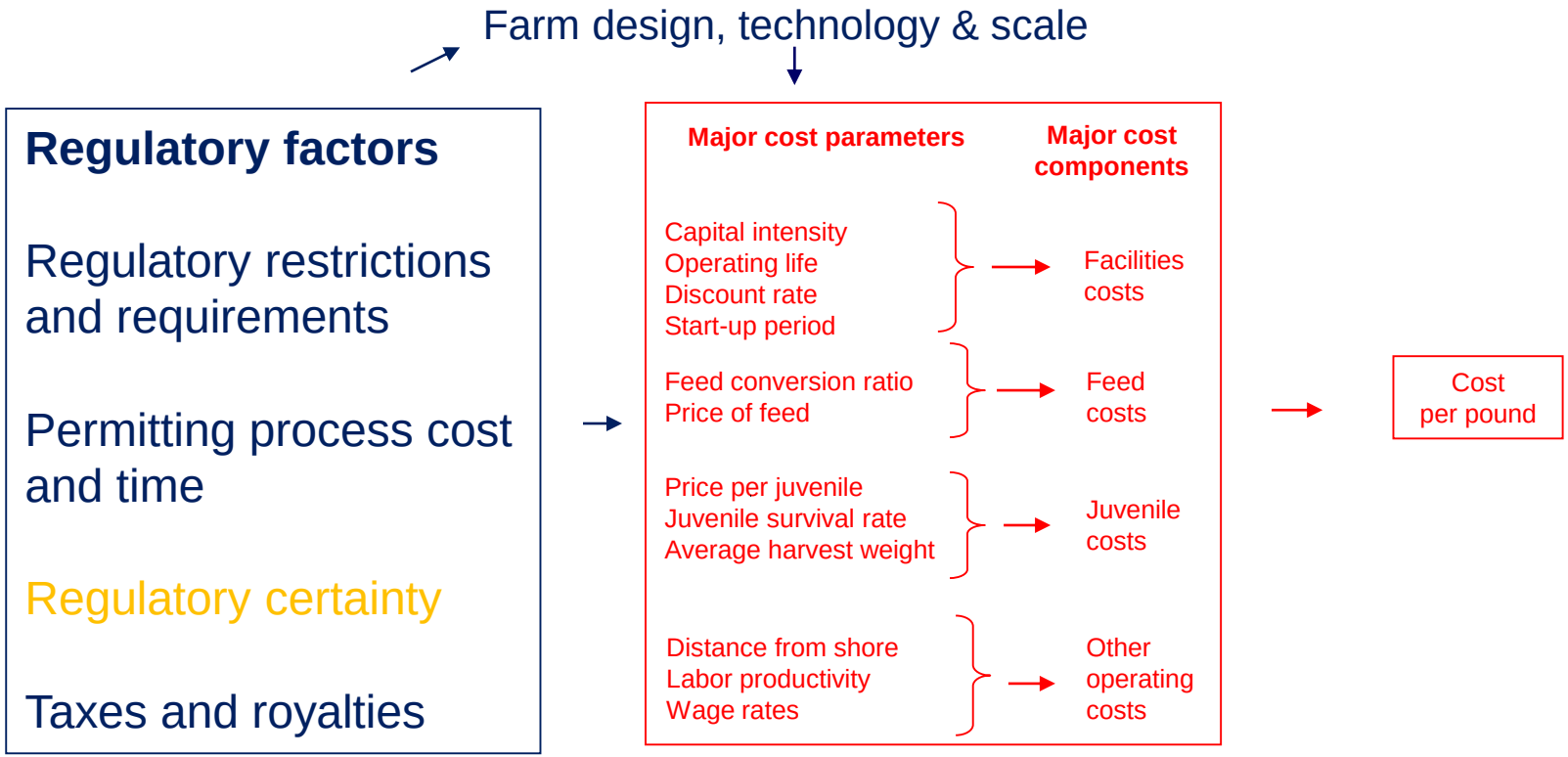
Key ways in which governance can affect economic viability of fish farming . . .

Regulatory restrictions and requirements
- directly affect capital and operating costs
- indirectly affect costs by affecting farm design, technology and scale
- affect opportunities and incentives for innovation



Permitting process cost and time affects the rate of return on fish farming investments.

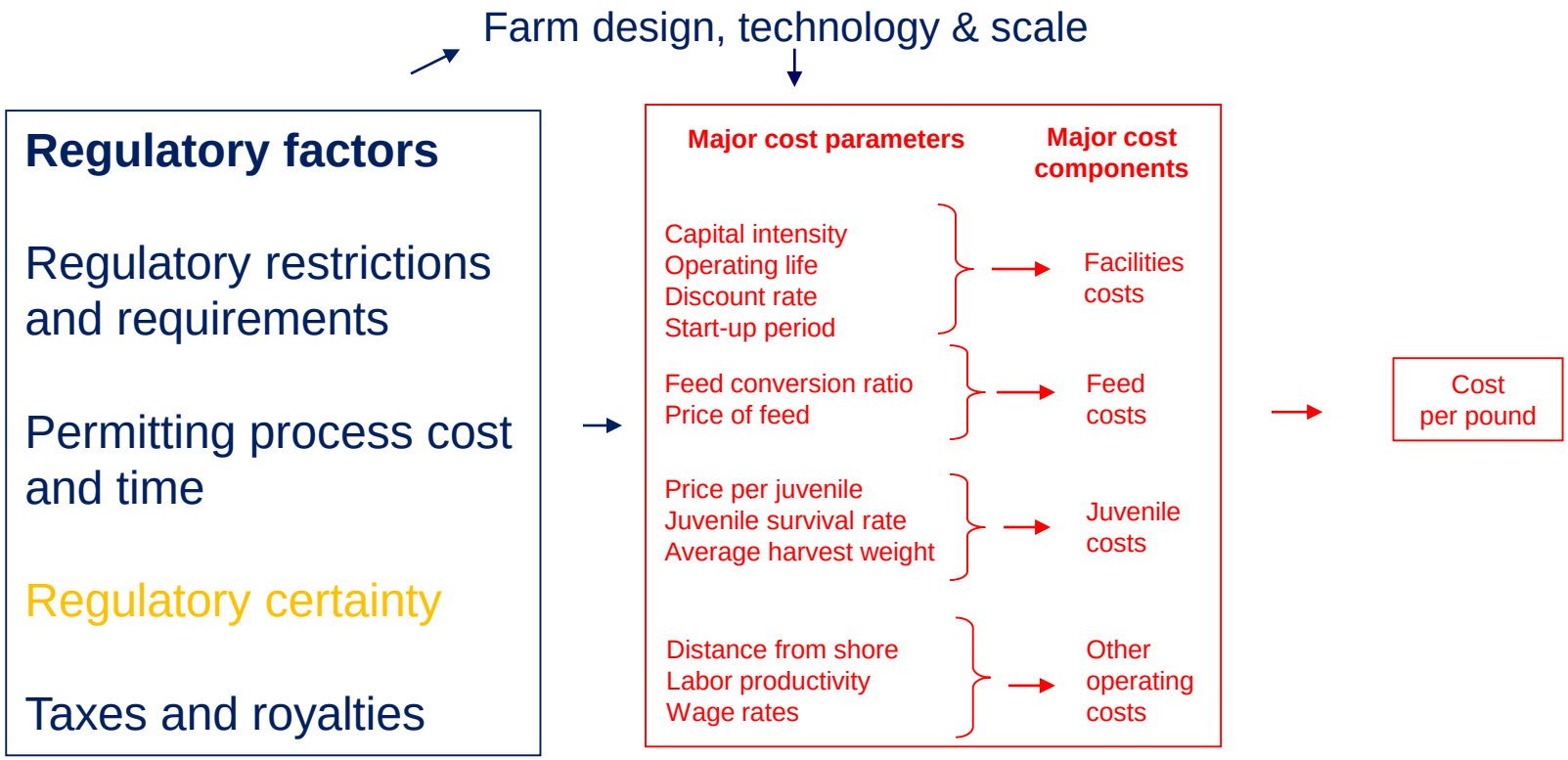
The higher the up-front costs of permitting and the longer it takes to receive permits the lower the rate of return on permitting investments.



Regulatory certainty affects the risk of fish farming investments.

The greater the risk associated with whether permits will be approved and regulations will change, the less competitive fish farming is compared with:

- other potential investments
- fish farming in other places with more regulatory certainty



Successful aquaculture requires good governance

- Healthy fish depend on a healthy environment
- Successful aquaculture must:
  - protect the environment
  - be socially acceptable
  - be profitable
- Successful aquaculture is more likely if governance
  - Is stable and predictable
  - Allows for timely recovery of investments in planning
  - focuses on end-goals of governance, rather than how to achieve those goals
  - facilitates innovation to achieve goals