Vessel-level modelling of a landing obligation in Scottish fisheries

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"Mapping and modelling the incentives for a landing obligation in demersal fisheries" (FIS06)

- 2015 - six-month study funded by *Fisheries Innovation Scotland*
- Modelling discarding for industry/policy makers
- Context: demersal landing obligation 2016
- Microeconomics of discarding in multispecies fisheries
- Accompanying survey of trawler skippers in NE Scotland
- Modelling discarding behaviour of a "typical" North Sea whitefish trawler

EU landing obligation

- Discard ban
- All catches of quota species must be landed against quotas
- *Including* undersize fish (below MCRS)
- Undersize fish cannot go for human consumption
- Pelagic fisheries: 2015
- Demersal fisheries: phased in 2016-2019
- Exemptions...
  - survivability exemptions
  - *de minimis* exemptions (%)
- Enforcement???
- TAC "uplift"

LO for North Sea trawlers

2016	All catches of saithe (if deemed a saithe targeting vessel), plaice and haddock to be landed. Any bycatches of Northern prawn to be landed.
2017	All catches of whiting and cod to be landed. Bycatches of sole and, in IIa and IV, *Nephrops* to be landed.
2018	Any bycatches of saithe to be landed.
2019	All catches of all quota species to be landed.

Economic model

- Profit function with $i = 1, 2, ..., N$ quota species

$$\sum p_i \left[h_i e - d_i\right] - \sum r_i q_i - ce - \gamma \sum \left[h_i e - d_i - q_i\right] - \omega \sum d_i \\ + \lambda \left[L - \sum \left[h_i e - d_i\right]\right] + \mu \left[E - e\right]$$

- Quota leasing condition

$$r_i = \gamma, \quad i = 1, 2, ..., N$$

- Discarding condition (hold constraint not binding)

$$p_i + \omega = r_i, \quad i = 1, 2, ..., N$$

- Discarding condition (hold constraint binding)

$$p_i + \omega - r_i = \lambda, \quad i = 1, 2, ..., N$$

- Optimal effort ($e^* < E$)

$$\sum \left[p_i - r_i\right] h_i - c = \lambda \sum h_i$$

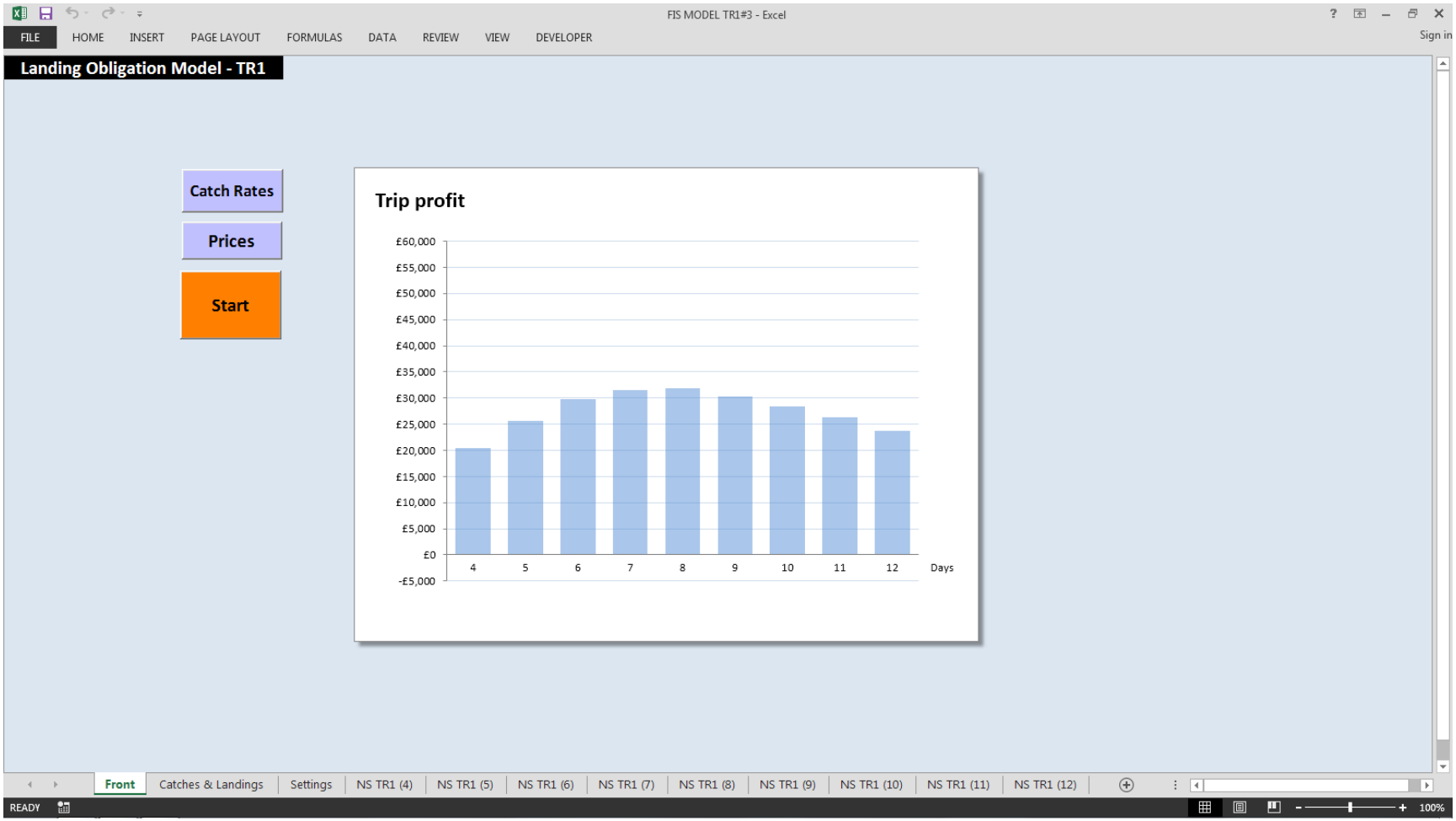
Simulation model

- Based on economic model
- LO can be imposed for different species
- Calculates catches, landings, discards, profits
- Trip basis
- Crew and fixed/quasi-fixed (boat) costs paid from trip profits
- Includes (2) size grades and undersize fish
- Undersize fish counted against quota if a LO in force
- Problem of quota limits per trip...
- Choke species: inelastic quota supply/high quota price

Simulation model

- Discarding/over-quota costs: shadow prices or (expected) penalties
- Discarding cost ignored if no LO in force
- Undersize fish automatically discarded if no LO in force
- Shadow prices can be discounted in profit calculations
- Most valuable fish counted against quota limits first
- Quota price ignored for fish within quota limits
- If the hold constraint binds, least valuable fish discarded first
- Note: with or without a LO, fish is discarded when the hold is full
- Problem: requires *many* parameters!

Front page


FIS MODEL TR1#3 - Excel
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DATA
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Sign in
Landing Obligation Model - TR1
Catch Rates
Prices
Start
Trip profit
£60,000
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Days
Front
Catches & Landings
Settings
NS TR1 (4)
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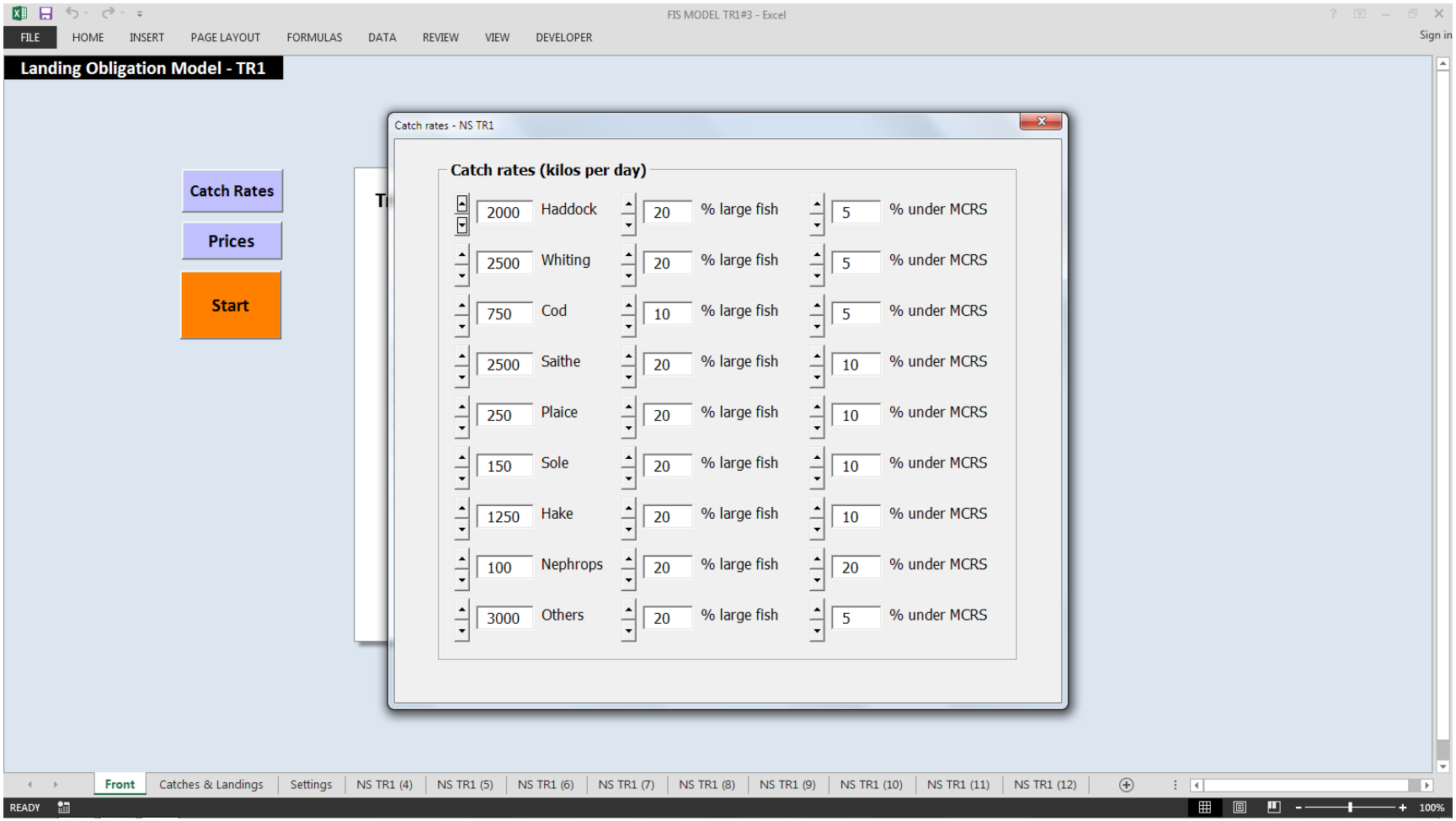
READY
100%

Catch rates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Landing Obligation Model - TR1
Catch Rates
Prices
Start
Catch rates - NS TR1
Catch rates (kilos per day)
2000 Haddock 20 % large fish 5 % under MCRS
2500 Whiting 20 % large fish 5 % under MCRS
750 Cod 10 % large fish 5 % under MCRS
2500 Saithe 20 % large fish 10 % under MCRS
250 Plaice 20 % large fish 10 % under MCRS
150 Sole 20 % large fish 10 % under MCRS
1250 Hake 20 % large fish 10 % under MCRS
100 Nephrops 20 % large fish 20 % under MCRS
3000 Others 20 % large fish 5 % under MCRS
Front Catches & Landings Settings NS TR1 (4) NS TR1 (5) NS TR1 (6) NS TR1 (7) NS TR1 (8) NS TR1 (9) NS TR1 (10) NS TR1 (11) NS TR1 (12)
READY
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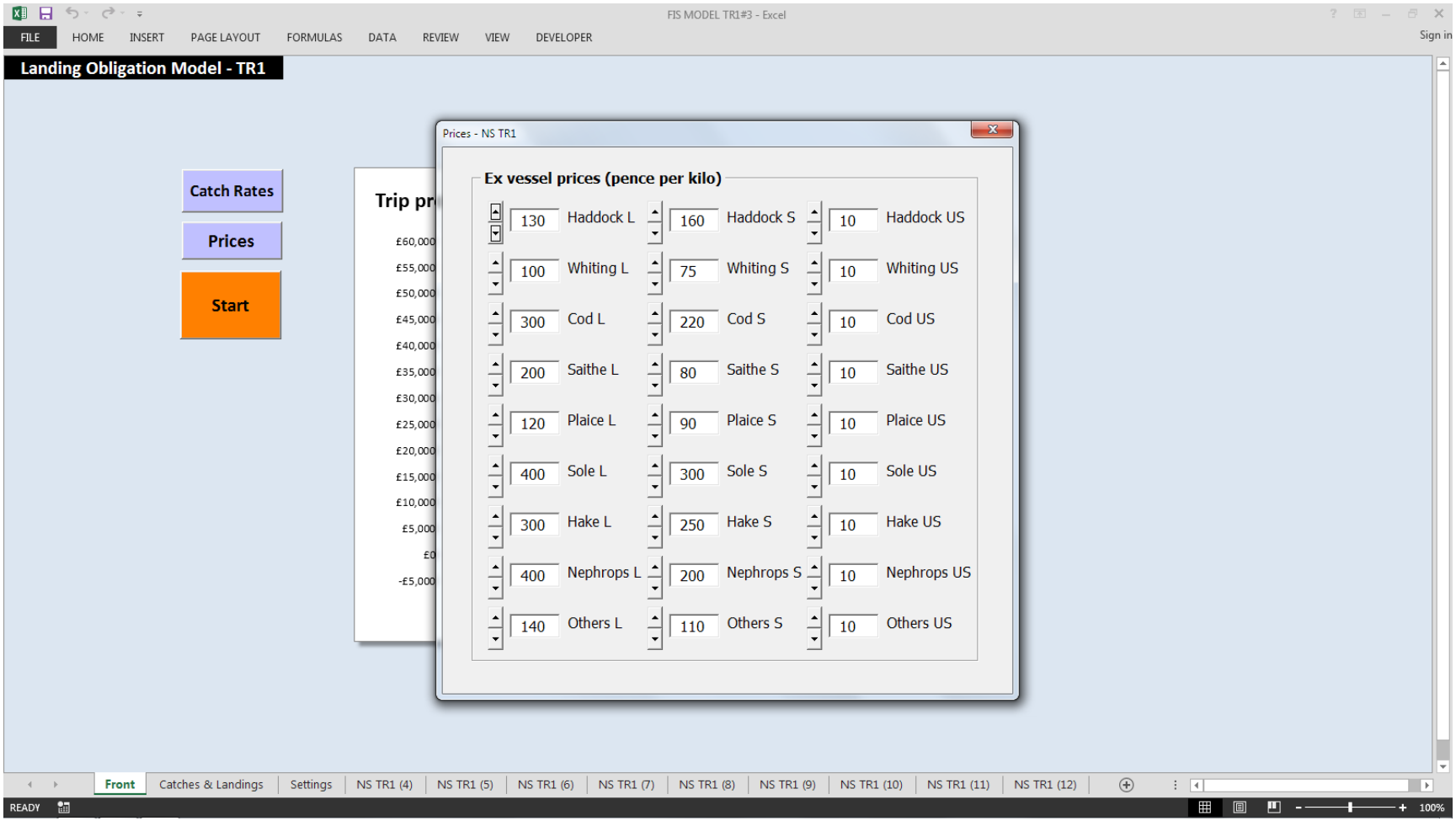
Prices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£15,000
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£5,000
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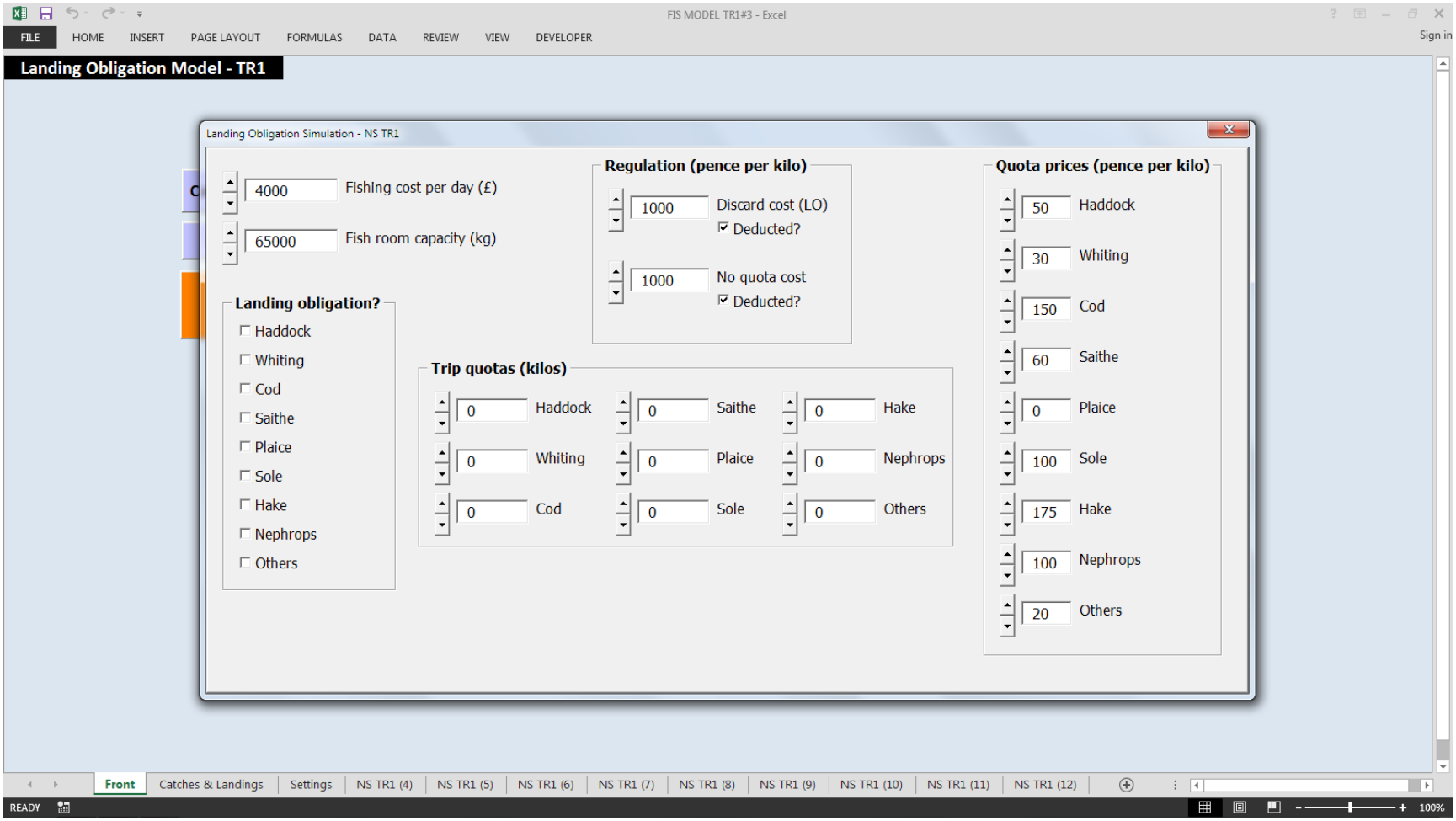
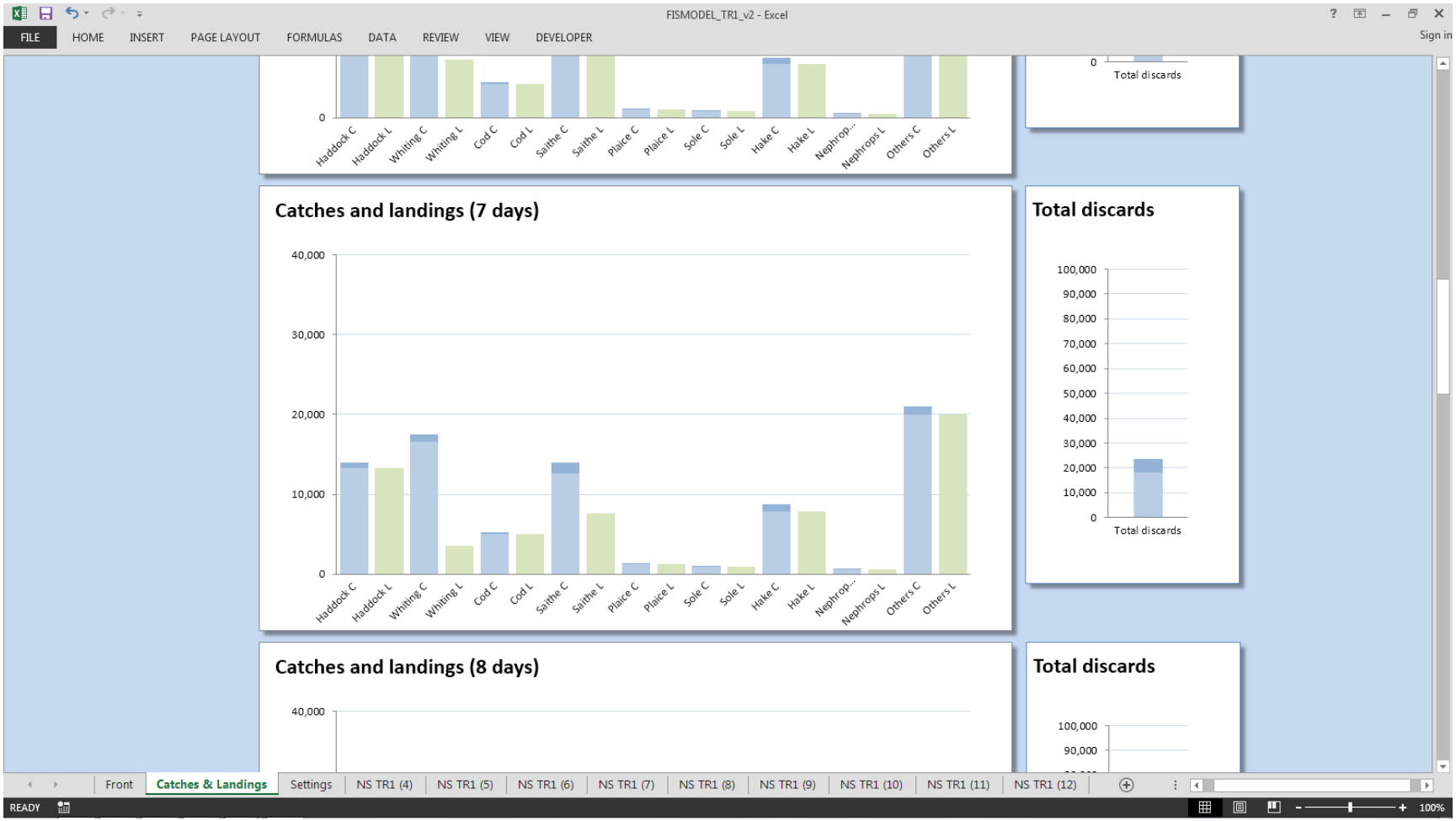
-£5,000
Prices - NS TR1
Ex vessel prices (pence per kilo)
130 Haddock L
160 Haddock S
10 Haddock US
100 Whiting L
75 Whiting S
10 Whiting US
300 Cod L
220 Cod S
10 Cod US
200 Saithe L
80 Saithe S
10 Saithe US
120 Plaice L
90 Plaice S
10 Plaice US
400 Sole L
300 Sole S
10 Sole US
300 Hake L
250 Hake S
10 Hake US
400 Nephrops L
200 Nephrops S
10 Nephrops US
140 Others L
110 Others S
10 Others US
Front
Catches & Landings
Settings
NS TR1 (4)
NS TR1 (5)
NS TR1 (6)
NS TR1 (7)
NS TR1 (8)
NS TR1 (9)
NS TR1 (10)
NS TR1 (11)
NS TR1 (12)
READY
100%

Main control panel



Catches and landings



Example

- North Sea whitefish trawler (TR1)
- Fish room capacity 60 tonnes
- Running costs £4,200 per day
- All quota leased
- Profits maximised on 8 day trip (approx. £40k)
- Hold full on day 5
- Discards of marketable whiting and saithe as well as *all* undersize fish

Example

- Impact of introducing LO for different species...
- Assume discard compliance/effective deterrence ($\omega = 20$)
- LO for haddock and plaice: relatively little impact
- LO for haddock, plaice, whiting and cod: $\sim$£33k from 6 day trip
- LO for all quota species: $\sim$£27k from 5 day trip
- What if $\omega = 0$?

Report/model

- http://www.fiscot.org/projects/2014-15-projects/
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