

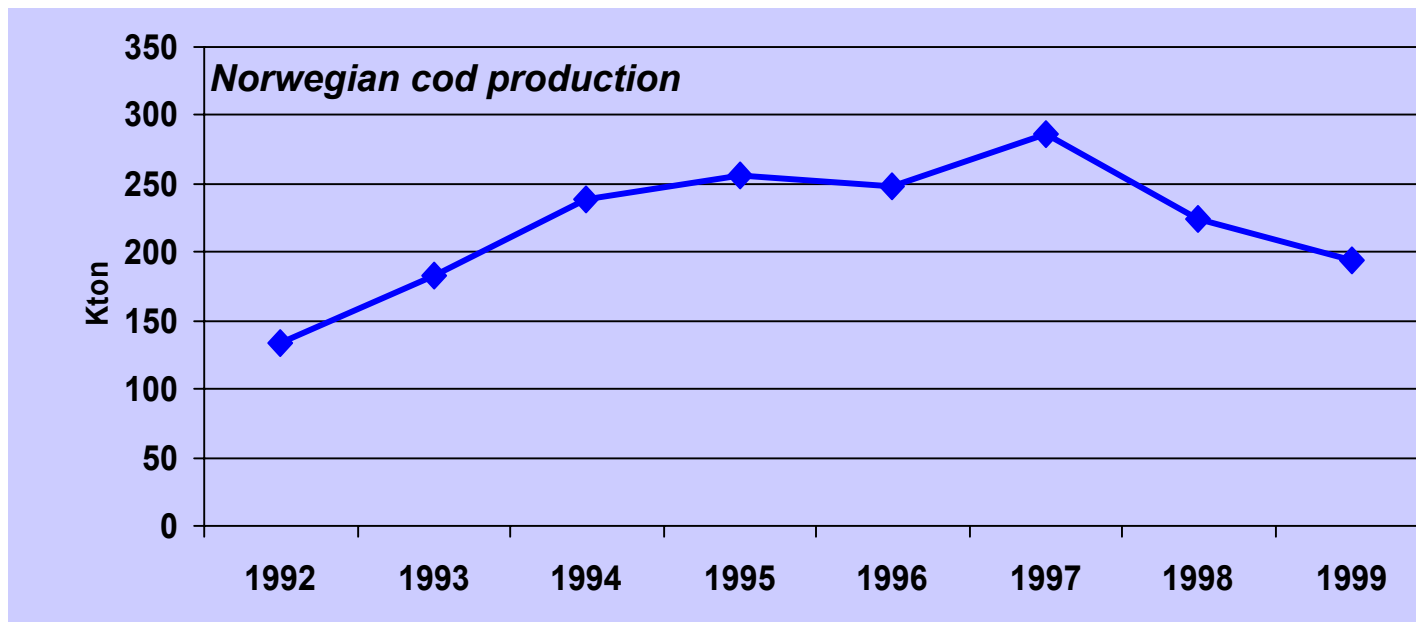
A black and white photograph of a four-masted sailing ship, likely a clipper, with all its sails deployed. The ship is sailing on the open sea, and the horizon is visible in the distance. The sky is clear and light-colored. The ship is positioned in the center-left of the frame, moving towards the right.

***System Dynamics and Time Series Analysis:  
two approaches for a convergent answer***

---

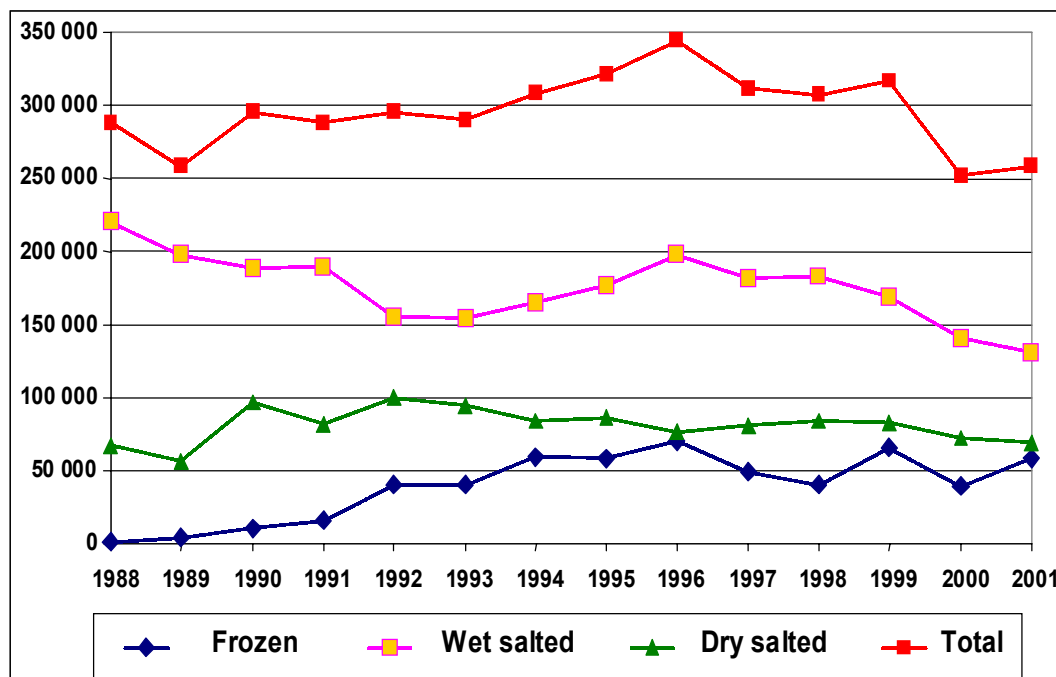
# *Norway: the largest World producer of Cod*

- *Norway is the largest seafood exporter (~ 3,7 Beuros in 2001)*
- Norway is the largest cod producer (~200 Kton lwe, 1999, decreasing)
- Norway is the largest cod exporter
  - Fresh/frozen market: UK, USA, etc
  - Wet salted market: Portugal, Spain
  - Dried salted: Portugal, Brasil, Spain
  - Dried not salted: Italy



# Portugal: the largest World market of Cod

- Portugal is the 4th biggest fish & seafood world consumer (~ 60 kg / year)
  - Cod consumption ~300 Kton lwe (til 2000) valued > 500 Meuros
  - Almost all cod consumed in Portugal are dried salted cod
- Portugal is the 1<sup>st</sup> importer of wet salted and 2<sup>nd</sup> of frozen and dried salted cod
- Portugal is one of the largest cod processor



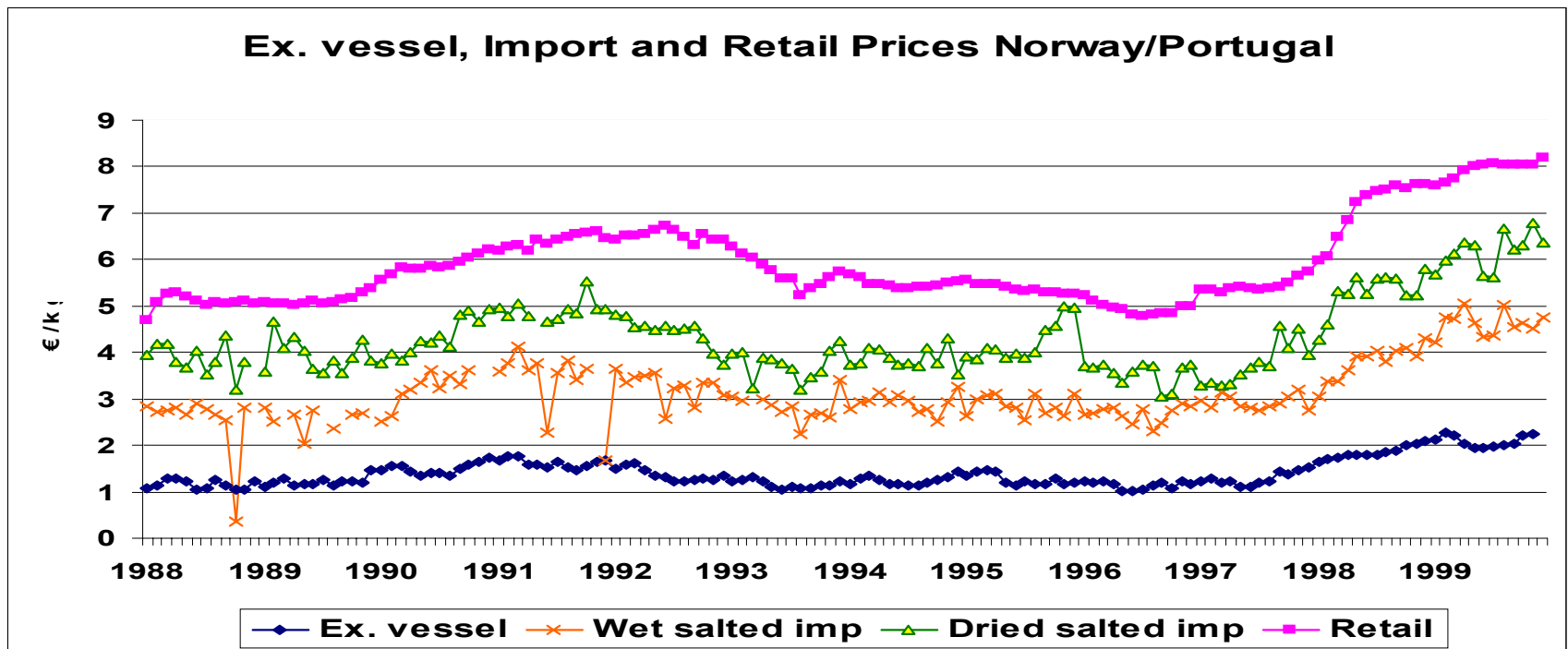
## Portugal imports of cod

Geographical specialization of supplying markets:

- Frozen: Russia, US
- Wet salted: Norway, Iceland
- Dried salted: Norway

# The Norway-Portugal Cod Value Chain

- Norway and Portugal are the biggest World players in the Cod market
  - Norway is the largest producer and Portugal is the largest consumer
  - Norway and Portugal have an important cod salting and drying industry
  - Norway is a supplier and a concurrent in the Portuguese market
    - Norway is the largest supplier of the Portuguese cod processing industry
    - Norway disputes the consumer market of salted dried cod



# The Norway-Portugal Cod Value Chain

## MAIN QUESTIONS

- Are the markets integrated (in the economic sense)?
- Is exchange rates exogenous to this value chain?
- What are the mark-up dynamics?

## METHODOLOGICAL APPROACHES

- The System Dynamic Approach  
FROM system structure  $\Rightarrow$  TO price and cost behavior
- The Econometric Approach, based on the cointegration  
FROM price series behavior  $\Rightarrow$  TO structure (market integration)

# ***The System Dynamic Approach***

# *The Econometric Approach*

- **Markets (for a group of products) are integrated if prices move proportionally over time, i.e., the LOP holds**

$$P_{1t} = \Theta_t P_{2t}$$

- **Market integration can be analysed by cointegration analysis**

$$\ln p_{1t} = \Theta + \sum_{i=1}^n \Psi_i \ln p_{1,t-i} + \sum_{j=0}^m \Lambda_j \ln p_{2,t-j} + \Xi_t$$

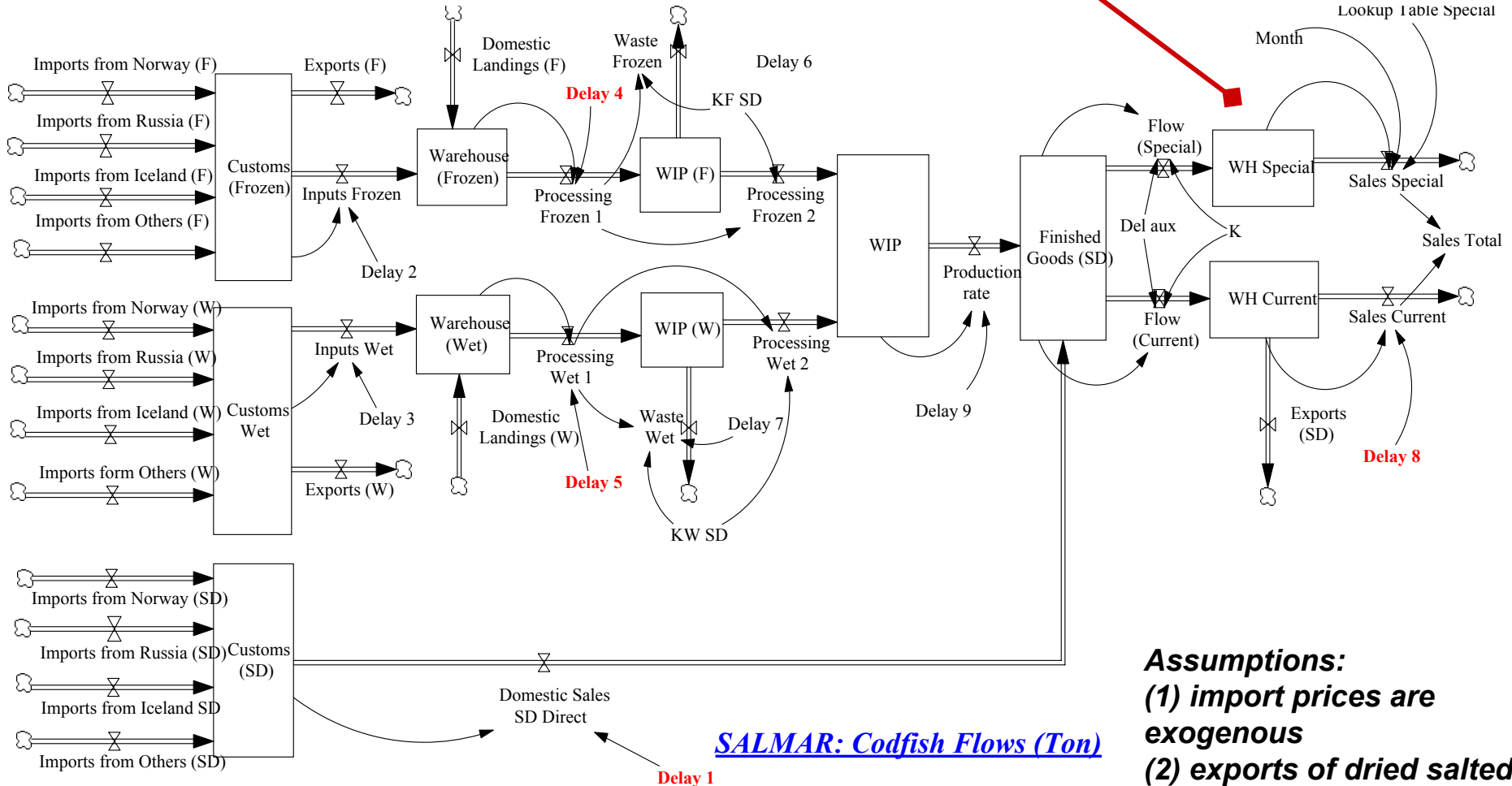
- **To analyse the exchange rate (E) effect we use the functional form**

$$P_{1t} = a P_{2t}^b E_t^c$$

- b=c gives complete exchange rate pass through
- b=c=1 gives perfect price transmission

# SD approach: the Portuguese value chain of Cod

**Storage of special/big cod (10%) is done all year for selling in Eastern, Summer, Christmas**

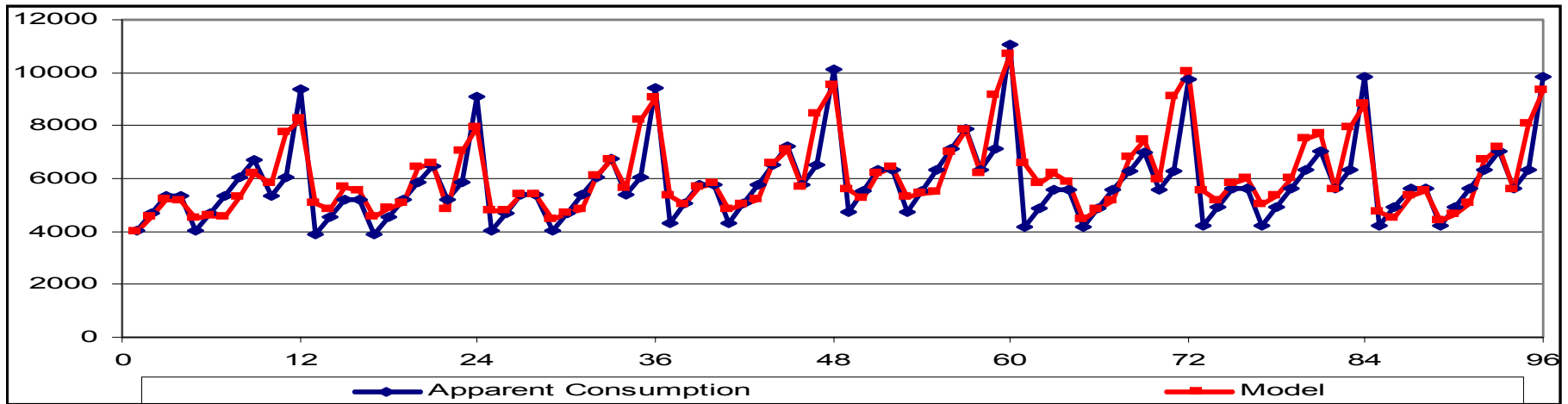


**SALMAR: Codfish Flows (Ton)**

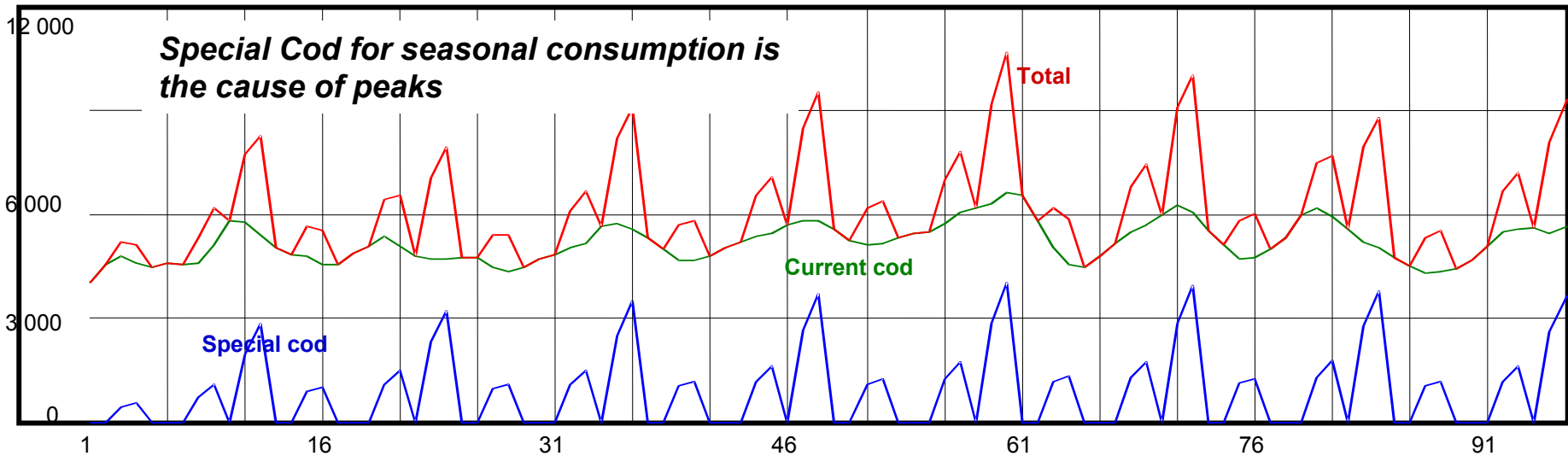
**Assumptions:**  
**(1) import prices are exogenous**  
**(2) exports of dried salted are done by the processing firms**



# SD approach: the Portuguese value chain of Cod



Quantities in tones dried salted equivalent



Legend: 1=1/1992; 96=12/1999



## ***Cross Validation***

***Markets are integrated in a competitive value chain***



***Exchange rate is exogeneous***

# ***Econometric approach: cointegration results***

## **Bivariate Johansen Tests**

<b>Price 1*</b>	<b>Price 2*</b>	<b>Cointegration</b>	<b>Proportionality</b>	<b>Exogeneity</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
<b>Ex. vessel</b>	<b>Wet salted</b>	<b>yes</b>	<b>no</b>	<b>Ex. vessel</b>
<b>Ex. vessel</b>	<b>Dried salted</b>	<b>yes</b>	<b>yes</b>	<b>None</b>
<b>Ex. vessel</b>	<b>Retail</b>	<b>yes</b>	<b>yes</b>	<b>None</b>
<b>Wet salted</b>	<b>Dried salted</b>	<b>yes</b>	<b>yes</b>	<b>None</b>
<b>Wet salted</b>	<b>Retail</b>	<b>yes</b>	<b>yes</b>	<b>Retail</b>
<b>Dried salted</b>	<b>Retail</b>	<b>yes</b>	<b>yes</b>	<b>None</b>

**\* all series are non-stationary but integrated of 1st order**

# ***Econometric approach: cointegration results***

## **Bivariate Johansen Tests**

<b>Price 1*</b>	<b>Price 2*</b>	<b>Cointegration</b>	<b>Proportionality</b>	<b>Exogeneity</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
<b>Ex. vessel</b>	<b>Wet salted</b>	<b>yes</b>	<b>no</b>	<b>Ex. vessel</b>
<b>Ex. vessel</b>	<b>Dried salted</b>	<b>yes</b>	<b>yes</b>	<b>None</b>
<b>Ex. vessel</b>	<b>Retail</b>	<b>yes</b>	<b>yes</b>	<b>None</b>
<b>Wet salted</b>	<b>Dried salted</b>	<b>yes</b>	<b>yes</b>	<b>None</b>
<b>Wet salted</b>	<b>Retail</b>	<b>yes</b>	<b>yes</b>	<b>Retail</b>
<b>Dried salted</b>	<b>Retail</b>	<b>yes</b>	<b>yes</b>	<b>None</b>

**\* all series are non-stationary but integrated of 1st order**

# Econometric approach: exchange rate

The exchange rates are always found to be exogenous of this value chain

## Cointegration results for wet salted trade

Ho:rank=p	Max test	Critical values	Trace test	Critical value
p == 0	25.19*	22.0	37.39*	34.9
p <= 1	9.35	15.7	12.2	20.0
p <= 2	2.84	9.2	2.84	9.2
LM(12) <sup>a</sup>	Full exchange rate pass through		Perfect price transmission	
0.862 (0.814) <sup>b</sup>	4.070* (0.043) <sup>b</sup>		7.881* (0.019) <sup>b</sup>	

\* indicates significant at a 5% level

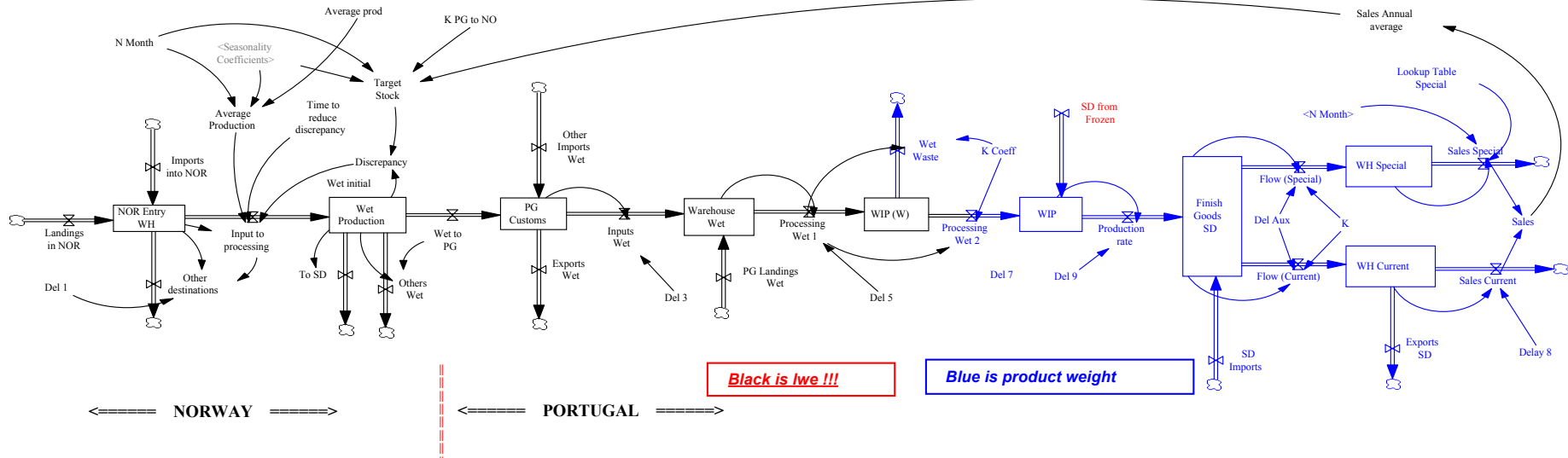
<sup>a</sup> LM is a Lagrange Multiplier test against autocorrelation up to 12 lags

<sup>b</sup> *p-values in parenthesis*



***Wet salted cod prices in Norway  
are influenced by Norge Production  
and Portuguese Market: HOW?***

# Norway-Portugal value chain of wet salted Cod



## Assumptions:

- (1) previous assumptions (on the Portuguese part) accepted
- (2) quantities and prices of exports and imports are similar to the external trade data
- (3) no storage at the input level in the processing plants

## Key aspect:

Processing of wet salted in Norway with 2 parts: average annual value (= 250 Kton lwe) weighted by the catching seasonality; variable, given by the gap reduction, within a month, between the inventory level of wet salted cod and an ideal level indexed (1,4) to the consumption in Portugal



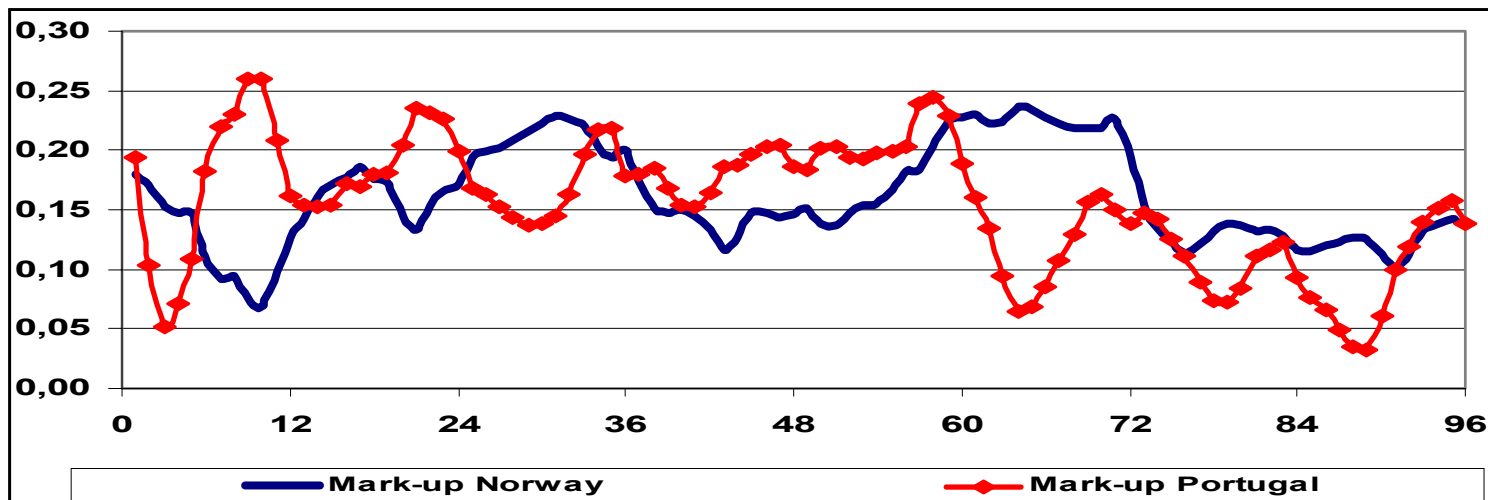
***Final Results***



# The Norway-Portugal Cod Value Chain

## Conclusions

- *Exchange rate is exogenous to the value chain*
- *Perfect price transmission in the value chain*
- *Competitive value chain*
- *Decision of salting cod in Norway is influenced by both sides: production and consumption*
- *Aggregate mark-ups shows a contra-cycle behavior till 1997 when prices went up*



# **The Norway-Portugal Cod Value Chain**

## **Conclusions**

---

- ***Two contrasting approaches:***

- ***Econometric models start from the relationships between the variables to estimate the underlying model. Validation by statistical tests.***
- ***SD models start from modelling the structure of the system that determines the behaviour of the variables. Validation by analogy.***
- ***The use of both approaches cross-validated the results and gave important insights to a robust model of the value chain***

- ***The same result***

***Portugal - Norway value chain of cod is an integrated one***

- ***Our perceptions about two audiences***

- ***Econometrics is well accepted by scientists but not understood by professionals***
- ***SD is well accepted by professionals and engineers, but scientists statistical oriented are sceptical about it***

# ***Poster Plan***

<b>2</b>	<b>1</b>	<b>3</b>
	<b>4</b>	
	<b>5</b>	
<b>6</b>		<b>7</b>
<b>8</b>	<b>10</b>	<b>11</b>
<b>9</b>	<b>14</b>	<b>12</b>
<b>15</b>	<b>16</b>	<b>13</b>
	<b>17</b>	
	<b>18</b>	