

Structural Equation Modeling of Seafood Consumption Behavior

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Motivation

- Consumption decisions are influenced by factors that are not directly observable
 - E.g., Environmental concern and purchase decision of hybrid vehicle
- They are measured with errors
- Need for a comprehensive treatment for such factors in modeling

Structural Equation Modeling (SEM)

- Explicitly taking the measurement into account
- Unobserved (latent) variables usually measured with multiple items (indicators)
- More general case of systems of equation modeling

Objectives

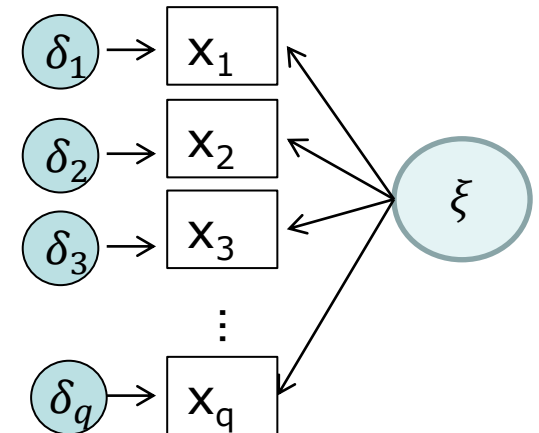
- Utilize the recently collected survey data on seafood consumption behavior
 - Multi-species
 - Multi-countries
- Specifically for this paper
 - Explore the relationship among country image, product perceptions, and consumption frequency
 - Employ SEM to explicitly include the measurement of latent variables
 - Focused on salmon in Germany and France

Latent and Indicator Variables

- Unobserved unidimensional *concept*
- Theoretically motivated
- Measured by indicator variables

$$x_j = \lambda_j \xi + \delta_j, \quad j = 1, \dots, q$$

- x is an indicator variable
- ξ is a latent variable
- λ is a coefficient relating x to ξ
- δ is a random error with zero expectation and is uncorrelated to ξ



Systems of Equations in Econometrics

$$\mathbf{y} = \mathbf{B}\mathbf{y} + \mathbf{\Gamma}\mathbf{x} + \boldsymbol{\zeta}$$

- \mathbf{y} is a $p \times 1$ vector of endogenous variables
- \mathbf{x} is $q \times 1$ vector of exogenous variables
- \mathbf{B} is a $m \times m$ matrix of coefficients
- $\mathbf{\Gamma}$ is a $m \times n$ matrix of coefficients
- $\boldsymbol{\zeta}$ is a $p \times 1$ vector of errors in the equations and uncorrelated to \mathbf{x}
- $(\mathbf{I} - \mathbf{B})$ is assumed to be nonsingular

Measurement Models

$$\mathbf{x} = \Lambda_x \boldsymbol{\xi} + \boldsymbol{\delta}$$

$$\mathbf{y} = \Lambda_y \boldsymbol{\eta} + \boldsymbol{\epsilon}$$

- \mathbf{x} and \mathbf{y} are a $q \times 1$ and $p \times 1$ vectors of observed indicators
- Λ_x and Λ_y are a $q \times n$ and $p \times m$ matrices of coefficients
- $\boldsymbol{\xi}$ and $\boldsymbol{\eta}$ are $n \times 1$ and $m \times 1$ vectors of latent variables
- $\boldsymbol{\delta}$ and $\boldsymbol{\epsilon}$ are $q \times 1$ and $p \times 1$ vectors of measurement errors
- Assumes $E(\boldsymbol{\xi})=0$, $E(\boldsymbol{\delta})=0$, $\boldsymbol{\delta}$ uncorr. to $\boldsymbol{\xi}$ $\boldsymbol{\eta}$ and $\boldsymbol{\epsilon}$, $\boldsymbol{\epsilon}$ uncorr. to $\boldsymbol{\xi}$ $\boldsymbol{\eta}$ and $\boldsymbol{\delta}$

Structural Equations

$$\boldsymbol{\eta} = \mathbf{B}\boldsymbol{\eta} + \boldsymbol{\Gamma}\boldsymbol{\xi} + \boldsymbol{\zeta}$$

$$\mathbf{y} = \boldsymbol{\Lambda}_y\boldsymbol{\eta} + \boldsymbol{\varepsilon}$$

$$\mathbf{x} = \boldsymbol{\Lambda}_x\boldsymbol{\xi} + \boldsymbol{\delta}$$

- \mathbf{B} is a $m \times m$ coefficient matrix
- $\boldsymbol{\Gamma}$ is a $m \times n$ coefficient matrix
- $\boldsymbol{\zeta}$ is a vector of random errors with zero expectations

Hypothesis and Estimation

The general hypothesis: $\Sigma = \Sigma(\boldsymbol{\theta})$

Σ : the population covariance matrix of observed variables

$\Sigma(\boldsymbol{\theta})$: the covariance matrix based on the model parameters $\boldsymbol{\theta}$

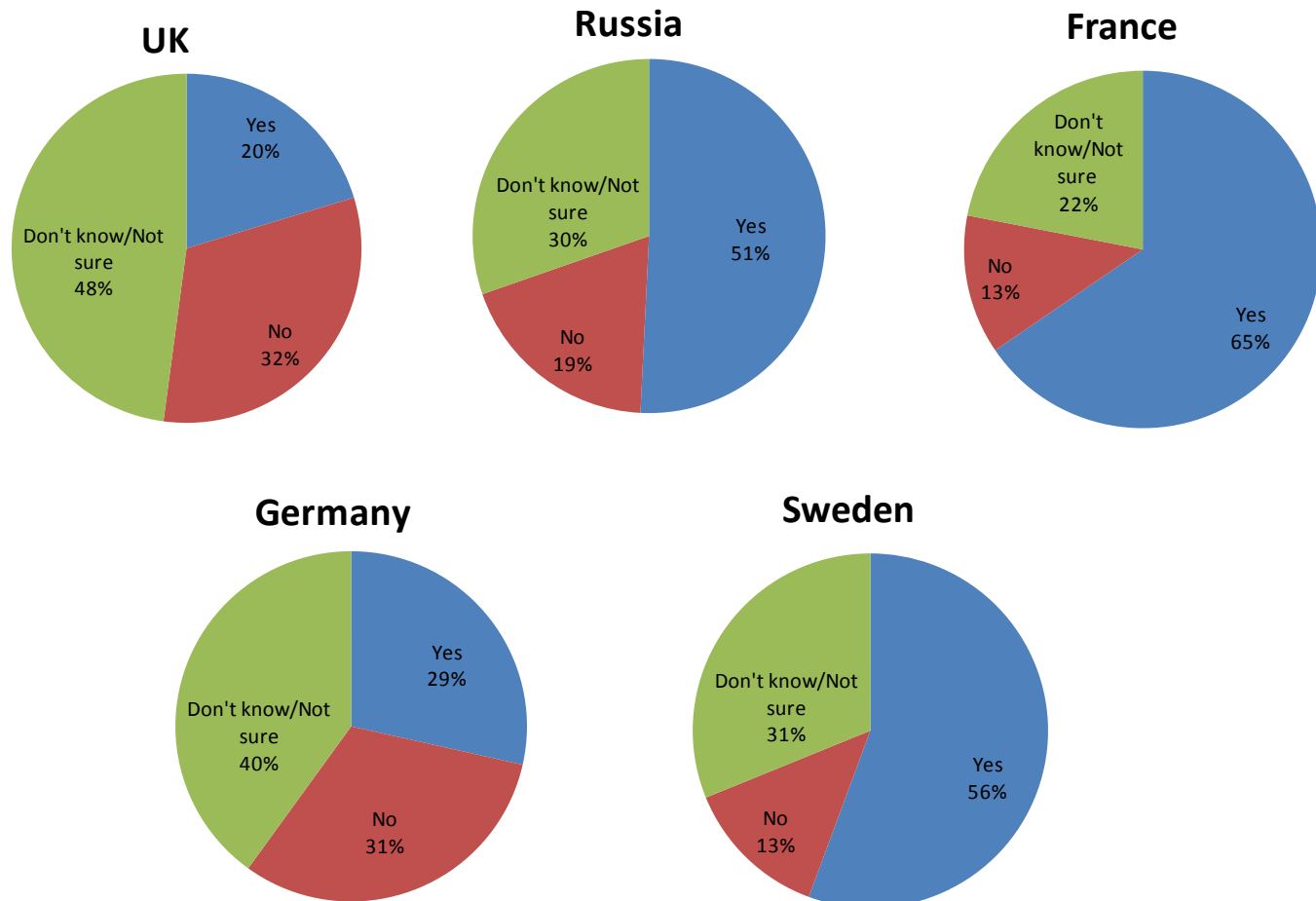
$$F_{ML} = \log|\Sigma(\boldsymbol{\theta})| + \text{tr}\{S\Sigma^{-1}(\boldsymbol{\theta}) - \log|S| - (p + q)\}$$

where S is the sample covariance matrix of the observed data

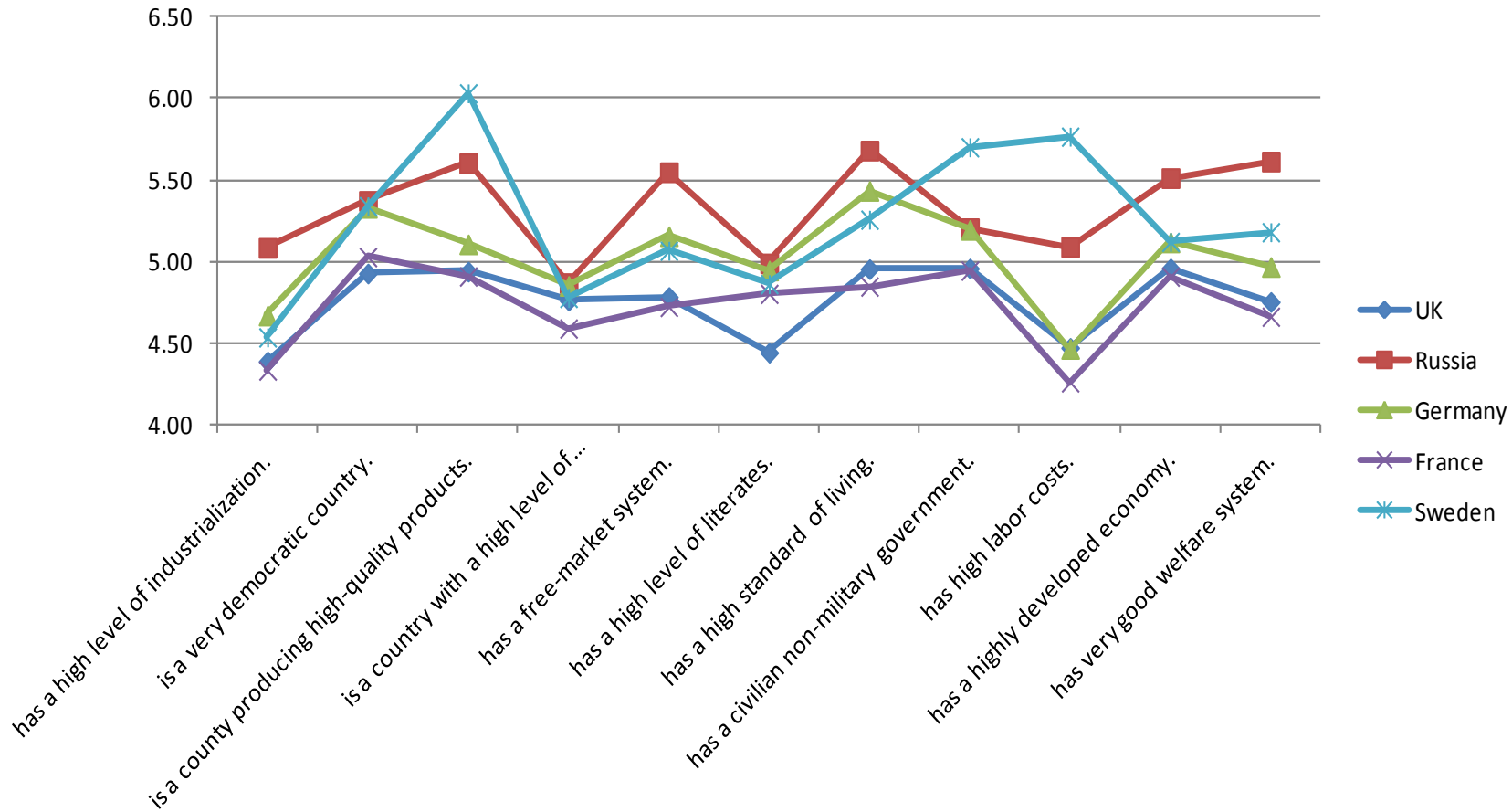
- The estimated coefficients $\hat{\boldsymbol{\theta}}_{ML}$ minimizes the above likelihood function

Seafood Country of origin knowledge

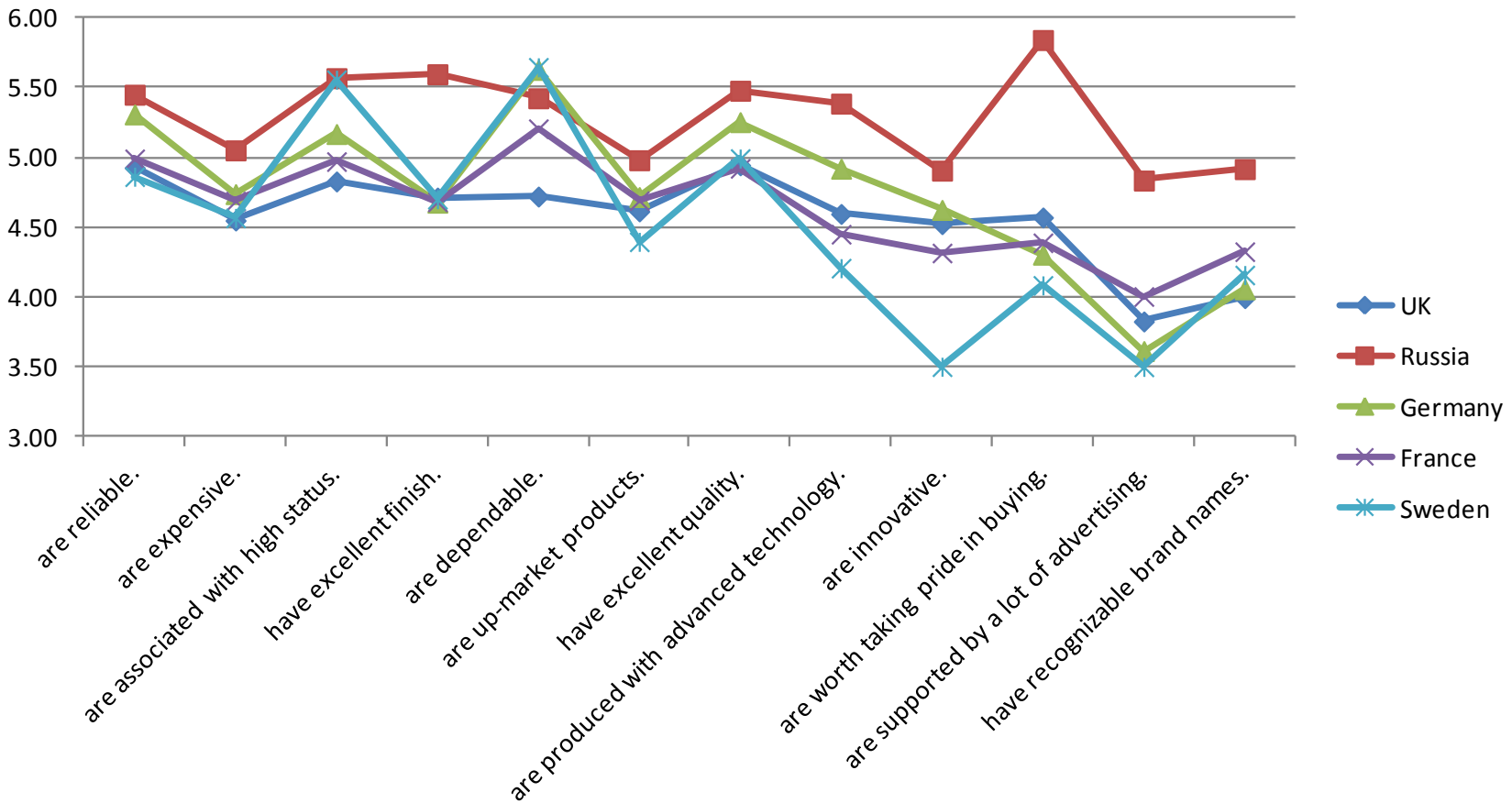
Q: Have you bought seafood products from Norway before?



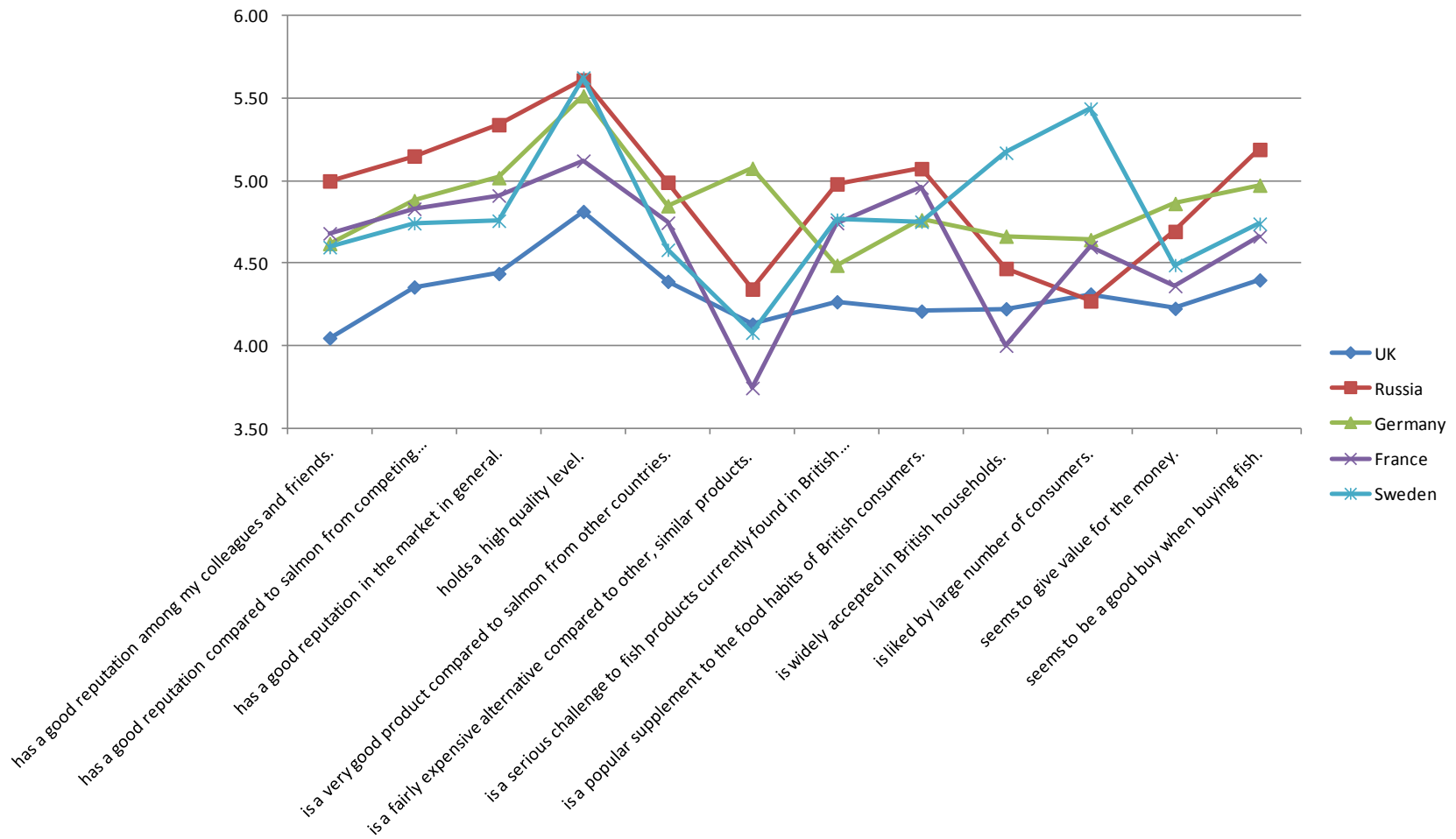
Macro Country Image Mean Scores (Peppu, et al., 2007)



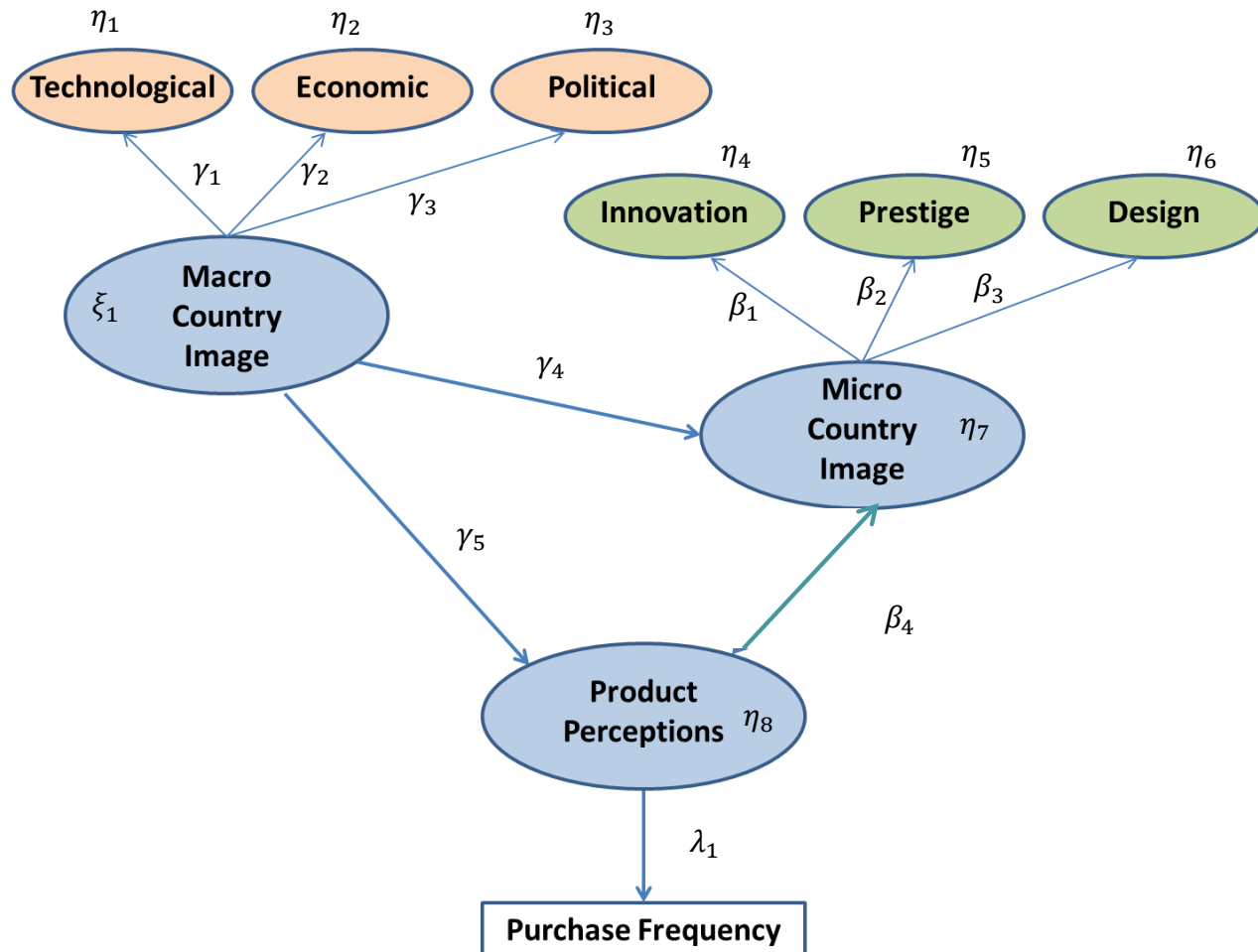
Micro Country Image (Norwegian Seafood Products) (Peppu, et al., 2007)



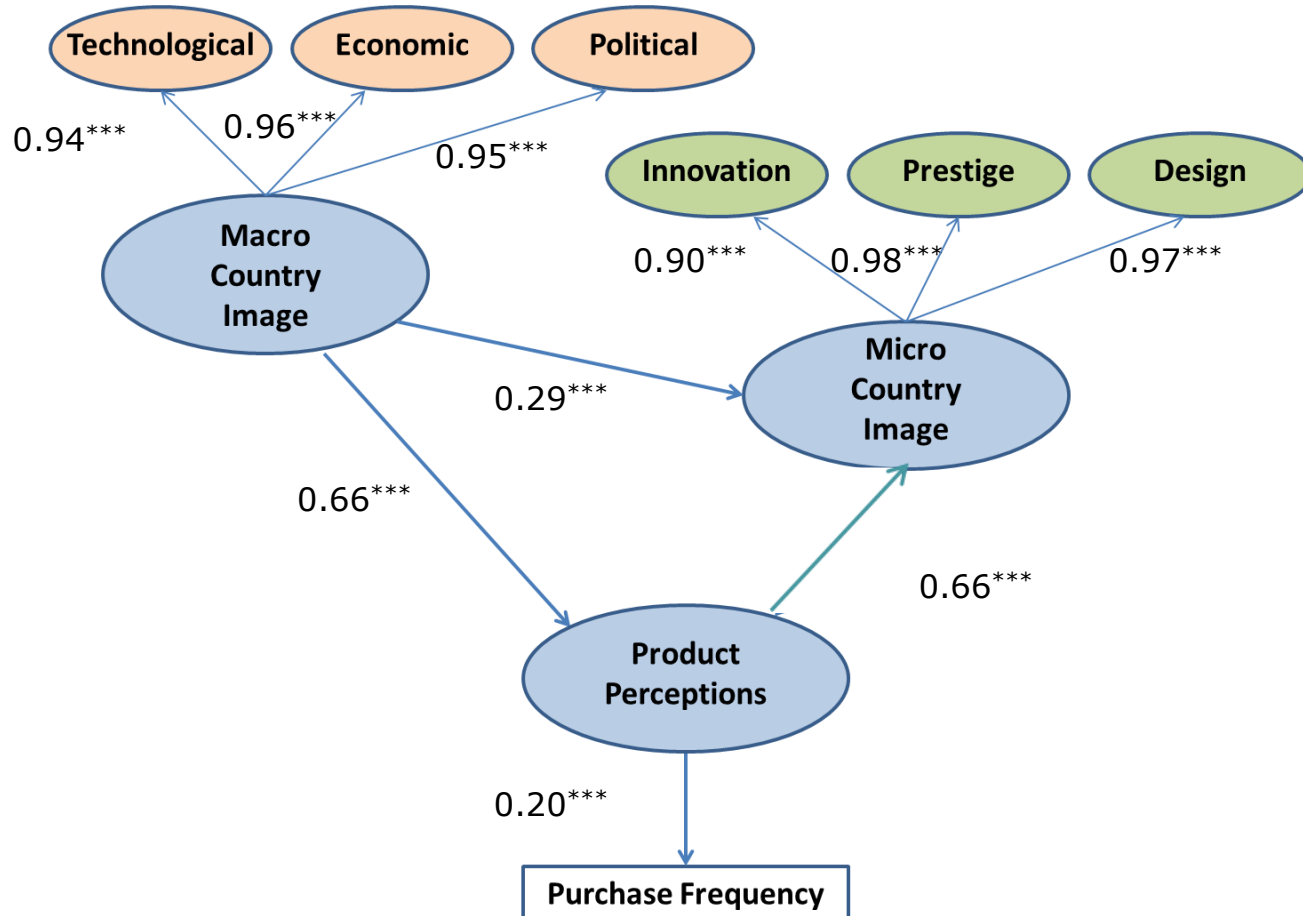
Product Perceptions of Norwegian Salmon



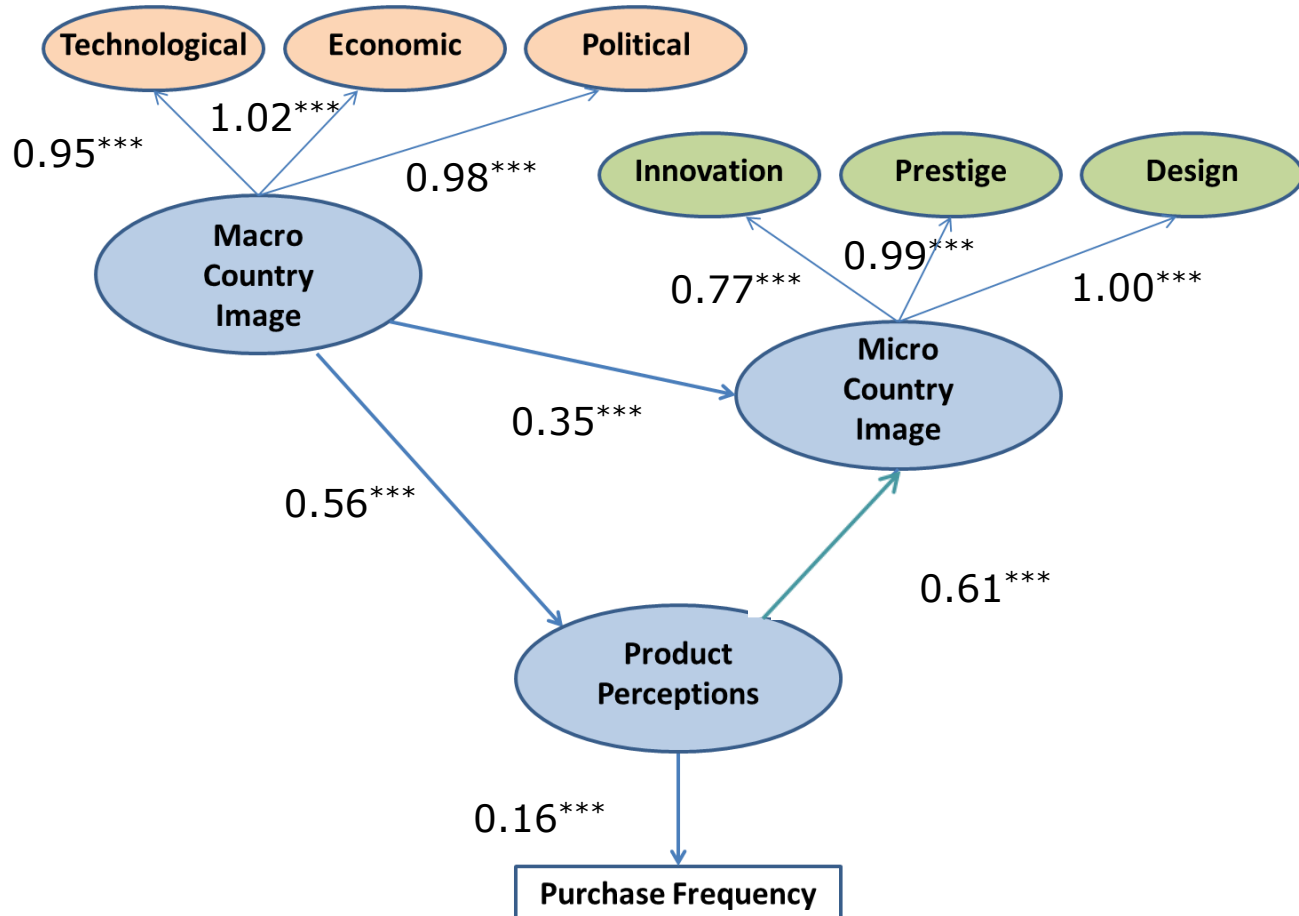
Conceptual Diagram



Estimation Results (Germany)



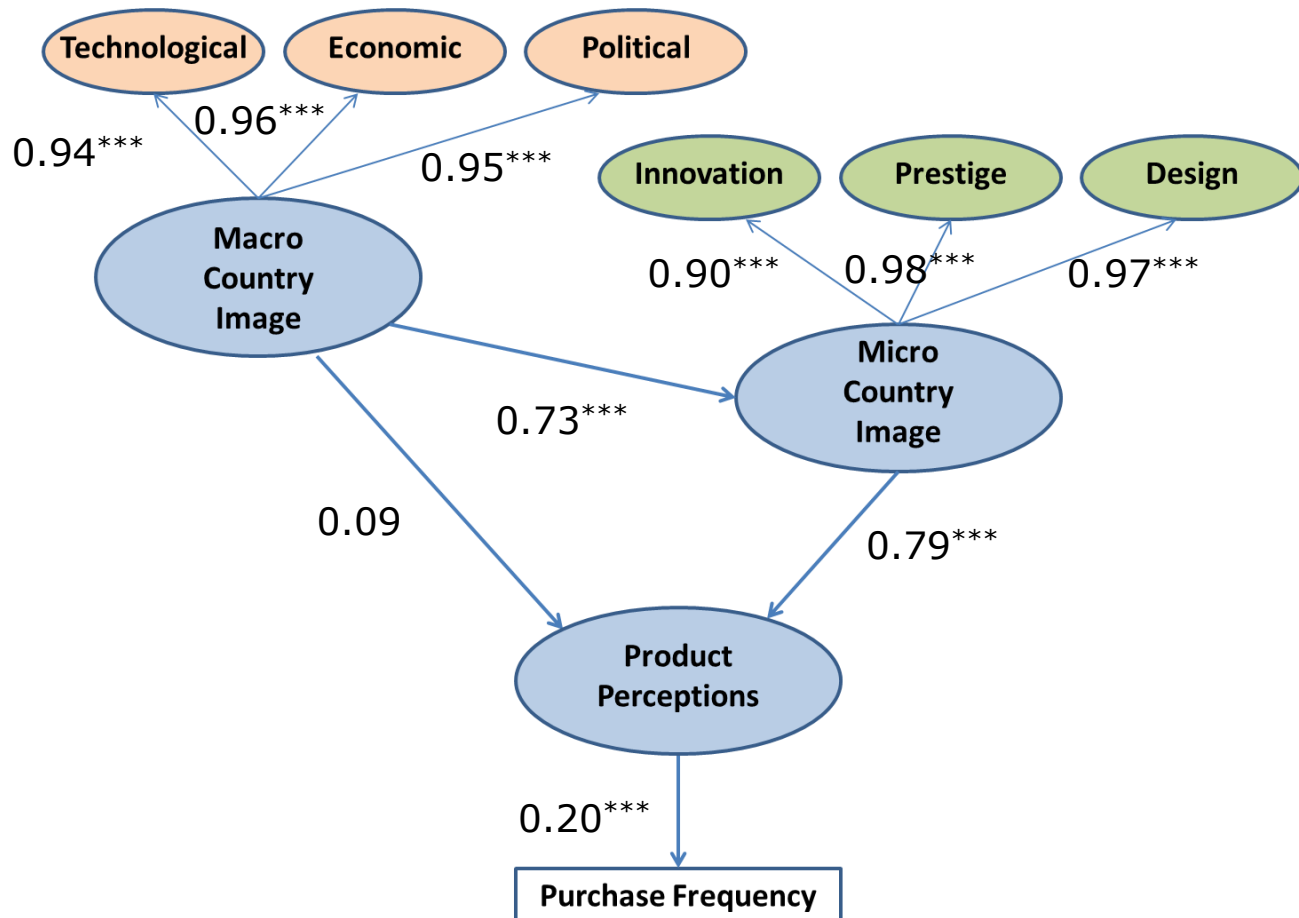
Estimation Results (France)



Summary

- Macro image positively affects images of Norwegian seafood and salmon
 - Emphasizing Norway evokes positive image
- Also found positive association with the consumption frequency
- Perception of Norwegian salmon affects the image of Norwegian seafood
 - Improving the image of Norwegian salmon would also improve the image of Norwegian seafood
 - This may be different for other species
- Need to elaborate more on the relationship with the observed behavior

Alternative Specification (Germany)



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