

Aus dem Institut für Agrarökonomie
der Christian-Albrechts-Universität zu Kiel

**Empirische Analysen der Preissetzung, des
Konsumentenverhaltens und des Marktpotenzials von
Fischprodukten in Deutschland**

Dissertation
zur Erlangung des Doktorgrades
der Agrar- und Ernährungswissenschaftlichen Fakultät
der Christian-Albrechts-Universität zu Kiel

vorgelegt von:
Julia Bronnmann, M.Sc.
Kiel, im März 2016

Dekan:	Prof. Dr. Eberhard Hartung
1. Berichterstatter:	Prof. Dr. Jens-Peter Loy
2. Berichterstatter:	Prof. Dr. Martin Schellhorn
Tag der mündlichen Prüfung:	04.05.2016

Gedruckt mit Genehmigung der
Agrar- und Ernährungswissenschaftlichen Fakultät
der Christian-Albrechts-Universität zu Kiel

Diese Dissertation kann als elektronisches Medium
über den Internetauftritt der Universitätsbibliothek Kiel
(www.ub.uni-kiel.de; eldiss.uni-kiel.de)
aus dem Internet geladen werden.

Danksagung

Ich möchte mich herzlich bei Prof. Dr. Jens-Peter Loy für die professionelle Betreuung meiner Promotion, die wertvollen Anregungen sowie die mir gewährten Freiräume bedanken. Zudem danke ich Prof. Dr. Martin Schellhorn für die Übernahme des Zweitgutachtens. Besonderer Dank gilt Prof. Dr. Frank Asche für die stets sehr gute und hilfreiche Zusammenarbeit. Seine wertvollen Ratschläge und Unterstützungen haben wesentlich zum Gelingen dieser Arbeit beigetragen. Eine wesentliche Rolle für das Gelingen dieser Arbeit spielt auch das sehr angenehme und freundliche Arbeitsklima am Institut für Agrarökonomie Kiel. Dafür möchte ich mich bei meinen ehemaligen und derzeitigen Kollegen aufrichtig bedanken.

Ein großer Dank gilt außerdem Kirsten Kriegel für ihre ausgezeichnete Arbeit am Institut, die sorgfältige und gewissenhafte Korrektur und Durchsicht diverser Manuskripte sowie der großen organisatorischen Hilfestellung.

Anschließend möchte ich mich bei meiner Familie sowie allen Freunden bedanken, die mich stets unterstützen und mir den Rücken stärken.

Dankeschön!

Kiel, im Mai 2016

Inhaltsverzeichnis

1. Abbildungsverzeichnis	II
2. Tabellenverzeichnis	III
3. Abkürzungsverzeichnis	IV
4. Abbildungsverzeichnis Anhänge der Kapitel	V
5. Tabellenverzeichnis Anhänge der Kapitel.....	V
6. Einleitung und Zusammenfassung	1
7. The German Whitefish Market: An Application of the LA/AIDS Model using Retail-Scanner-Data	19
8. Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood in Germany: An Application of QUAIDS Modeling with Correction for Sample Selection	37
9. Assessing Consumer Preferences and Willingness to Pay for Fish from Aquaculture and Eco-labeled Fish: Insights from a Discrete Choice Experiment in Northern Germany.....	64
10. Preference Heterogeneity in the Demand for Salmon: A Random Coefficients Approach	102
11. Market Integration between Farmed and Wild Fish: Evidence from the Whitefish Market in Germany	121
12. The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany	141
13. Price Premiums for Eco-labeled Seafood: MSC –Certification in Germany.	167
14. Schlussbetrachtung.....	183
15. Summary	197
16. Methoden der Nachfrageanalyse.....	205

Abbildungsverzeichnis

Figure 2.1: Average Monthly Retail Fish Price in €/100 g, 2008-2012.....	28
Figure 3.1: Monthly Fish Prices from 2006-2010 in € per kg	45
Figure 4.1: Example of a Choice Set for Salmon.....	70
Figure 5.1: Kernel Density Estimates of the Random Variables for Model 1	114
Figure 6.1: Annual Production of Farmed and Wild Caught Species.....	126
Figure 6.2: Annual German Imports of Whitefish Species 2010-2014.....	127
Figure 6.3: Monthly Import Prices of Wild-Caught and Aquaculture Whitefish €/kg.....	128
Abbildung 11.1: Verlauf der logistischen Funktion.....	215
Abbildung 11.2: Normalverteilung und Log-Normalverteilung.....	217
Abbildung 11.3: Dreiecksverteilung und Gleichverteilung.....	218

Tabellenverzeichnis

Table 2.1: Imports of Frozen Whitefish Fillets from Wild Caught Species to Germany.....	24
Table 2.2: Imports of Frozen Whitefish Fillets of Species from Aquaculture to Germany...	24
Table 2.3: Average Whitefish Retail Prices and Market Share, 2008-2012.....	27
Table 2.4: Goodness of Fit Statistic.....	29
Table 2.5: Price and Expenditure Elasticities.....	29
Table 3.1: Variables and their Descriptive Statistics.....	47
Table 3.2: Estimation Results of the QUAIDS from 2006 to 2010.....	50
Table 3.3: Standard Errors and Goodness-of-fit Statistics for the QUAIDS.....	51
Table 3.4: Expenditure Elasticities and Price Elasticities of Fish Species, 2006 to 2010.....	52
Table 4.1: Selected Attributes and Attribute Levels.....	69
Table 4.2: Sociodemographic Characteristics of the Sample.....	71
Table 4.3: Seafood Consumption and Purchase Pattern, Fish Consuming People (n=455).	72
Table 4.4: Important buying Criteria regarding Seafood (Fish Consuming People; n=455).	73
Table 4.5: Respondents' Beliefs about Aquaculture (n=485).....	74
Table 4.6: Respondents' Beliefs concerning Sustainable Fishing Methods (n=485).....	75
Table 4.7: Estimation Results of the Mixed Logit Model, Uninformed Respondents.....	80
Table 4.8: Estimation Results of the Mixed Logit Model, Informed Respondents.....	83
Table 5.1: Descriptive Statistics for Consumers.....	107
Table 5.2: Descriptive Statistics, Brands, Labels and Production Mode.....	108
Table 5.3: Estimation Results of the Mixed Logit Model.....	112
Table 6.1: Data Summary Statistics on German Imports, Annual Average 2010-2014.....	128
Table 6.2: ADF Unit Root Test for Logarithm of Imported Prices.....	131
Table 6.3: Bivariate Johansen Test for Integration between Imported Whitefish Prices.....	132
Table 6.4: Model Diagnostics.....	132
Table 6.5: Test for Weak Exogeneity.....	134
Table 7.1: Descriptive Statistics of the Product Attributes.....	147
Table 7.2: Parameter Estimations and Price Premiums.....	152
Table 7.3: Tests of the Relevance of each Attribute Category.....	153
Table 8.1: Descriptive Statistic.....	172
Table 8.2: Parameter Estimates and Computed Premiums.....	175
Table 8.3: Hypothesis for Attribute Category Inclusion.....	176

Abkürzungsverzeichnis

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
AIDS	Almost Ideal Demand System
ASC	Aquaculture Stewardship Council
AWZ	Ausschließliche Wirtschaftszone
CIF	Cost Insurance Freight
CTS	Consistent Two-Step-Estimation
DCE	Discrete Choice Experiment
EAN	European Article Number Code
ECM	Error Correction Model
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FIZ	Fisch Informations Zentrum
FPE	Final Prediction Error
GfK	Gesellschaft für Konsumforschung
HQ	Hannan-Quinn Information Criterion
IID	Independent and Identically Distributed
LA/AIDS	Linear Approximated Almost Ideal Demand System
LEH	Lebensmitteleinzelhandel
LES	Linear Expenditure System
LOP	Law of One Price
LR	Likelihood Ratio
MNL	Multinomial Logit Model
MSC	Marine Stewardship Council
MIXL	Mixed Logit Model
QUAIDS	Quadratic Almost Ideal Demand System
RU	Random Utility
SC	Schwarz Information Criterion
SUR	Seemingly Unrelated Regression
UK	United Kingdom
VAR	Vector Autoregressive Representation
WTP	Willingness to Pay
IV	

Abbildungsverzeichnis Anhänge der Kapitel

Figure A3.1: Postal Code Areas Germany.....	62
---	----

Tabellenverzeichnis Anhänge der Kapitel

Table A3.1: Parameter Estimation Quality Adjusted Prices.....	62
Table A3.2: Estimation Results of the Probit Analysis.....	63
Table A4.1: Description of the Variables used in the Model.....	91
Table A7.1: Descriptive Statistics based on EAN Codes.....	163
Table A7.2: Parameter Estimations and Price Premiums Interaction Model.....	165

1. Kapitel

Einleitung und Zusammenfassung

Der Markt für Fisch und Fischereierzeugnisse ist innerhalb der letzten Jahrzehnte zu einem globalen Markt zusammengewachsen. Technische Verbesserungen und Weiterentwicklungen in der Lagerhaltung sowie in der Konservierung von Fischerzeugnissen haben dazu geführt, dass die Transportkosten für Fisch und Fischereierzeugnisse signifikant gesunken sind und der weltweite Handel mit diesen Produkten kontinuierlich angestiegen ist. Insbesondere die Verbesserung der Gefriertechnik ermöglicht es, dass viele Fischprodukte mehrfach eingefroren und wieder aufgetaut werden und somit durch die Weiterbearbeitung in Niedriglohnländern wie z.B. Polen oder China komparative Kostenvorteile realisiert werden können (Anderson et al., 2010). Ferner hat sich mit Einführung der 200-Meilen-Zone als ausschließliche Wirtschaftszone (AWZ)¹ der internationale Handel mit Fisch und Fischereierzeugnissen verstärkt. Länder, die zuvor darauf angewiesen waren, innerhalb der 200-Meilen Zone vor fremden Küsten zu fischen, müssen ihre Importe ausdehnen, um den inländischen Bedarf an Fisch und Fischereierzeugnissen zu decken. Im Jahr 2013 wurden 37 % der weltweit produzierten Fisch und Fischereierzeugnisse international gehandelt. Im selben Jahr beträgt der Exportanteil der Produktion von Getreide 13 %, von Weizen 21 %, von Fleisch und Fleischwaren 10 % und von Milch und Milchprodukten 9 % (FAO, 2014a). Das zeigt, dass der Fischereisektor einer der globalsten und dynamischsten Industrien der weltweiten Nahrungsmittelproduktion ist.

Die Verbesserung der Logistik hat jedoch nicht nur die Verarbeitung von Fischprodukten und generelle Handelsmuster positiv beeinflusst, sondern führte ebenso zu Skalen- und Verbunderträgen entlang der gesamten Wertschöpfungskette. Insbesondere im Lebensmitteleinzelhandel (LEH), der u.a. in Europa durch eine hohe Konzentration

¹ Peru, Ecuador und China haben die AWZ bereits 1952 eingeführt, die USA im Jahr 1978. Die restlichen Küstenregionen folgten bis zur Mitte der 1980er Jahre.

gekennzeichnet ist, haben große Supermarktketten die kleinen Fischläden und –märkte zu weiten Teilen ersetzt (Anderson et al., 2010).

Zudem konnte das Fischereimanagement in den letzten Jahren dahingehend verbessert werden, dass es für die Fischer einfacher ist, neue Märkte zu erschließen und somit ihre Margen zu erhöhen (Smith, 2012). Weiter können Margen durch die immer bedeutender werdende Aquakulturproduktion erhöht werden, denn diese Produktionsmethode erlaubt eine bessere Kontrolle des Produktionsprozesses (Asche, 2008). Gezüchteter Fisch aus Aquakulturanlagen ist in den letzten 20 Jahren durch die Entwicklung neuer Produktionstechnologien zu einem bedeutenden Segment des globalen Fischmarktes herangewachsen (Asche et al., 2001).

Das weltweite Angebot an Fisch und Fischereierzeugnissen hat sich mehr als verdoppelt. Es ist von 72 Millionen Tonnen im Jahr 1976 auf 191 Millionen Tonnen im Jahr 2013 angestiegen. Die wesentlichen Triebfedern dieser Entwicklung sind zum einen die stetig wachsende Weltbevölkerung und zum anderen die zunehmende globale Pro-Kopf-Nachfrage nach Fisch und Fischereierzeugnissen, die von durchschnittlich 9,9 kg in den 60er Jahren auf 19,7 kg im Jahr 2013 angestiegen ist (FAO, 2014). Die Produktion von Fischen und Meerestieren in Aquakulturanlagen ist international gesehen eine der am schnellsten wachsenden Nahrungsmittelproduktionen. Nach den letzten Angaben der Food and Agriculture Organization of the United Nations (FAO, 2015) beträgt die Wachstumsrate der weltweiten Produktion von Fisch und Fischereierzeugnissen innerhalb der Periode von 2000 – 2013 6,7 %. Im selben Zeitraum kann eine Stagnation der Anlandungen von wild gefangenen Fischen beobachtet werden, die zwischen 90 und 95 Millionen Tonnen schwankt. Im Jahr 2013 übersteigt die Produktionsmenge von Fisch aus Zuchtanlagen (97,2 Millionen Tonnen) zum ersten Mal die Menge der wildgefangenen Fische (93,8 Millionen Tonnen). Aquakultur ist somit zur wichtigsten Versorgungsquelle der Bevölkerung mit Fischen und anderen Meerestieren herangewachsen (FAO, 2015).

Seit Mitte der 1980er Jahre hat sich das wissenschaftliche Interesse an internationalen Fischmärkten deutlich erhöht. Dabei stehen insbesondere Kennzahlen wie der Preis, die nachgefragten Mengen, die Produktqualität sowie Konsumentenpräferenzen im Fokus der Betrachtungen (Asche et al., 2007). In der jüngeren Forschung wird vermehrt auf die verschiedenen Produktionsmethoden von Fischarten (Aquakultur versus wildgefangener

Fisch) sowie auf Nachhaltigkeit suggerierende Variablen wie beispielsweise die Marine Stewardship Council (MSC) Zertifizierung, die Fangmethode oder die Regionalität von Fischprodukten abgezielt. In der Literatur gibt es verschiedene methodische Ansätze, Fischmärkte zu untersuchen. Dabei stehen insbesondere Nachfragemodelle (Einzelgleichungen und Nachfragesysteme sind die meist angewandten Methoden) hervor, welche die Sensitivität von Änderungen nachgefragter Mengen oder Preise untersuchen. Ein besonderer Fokus liegt dabei auf der Berechnung von Preiselastizitäten sowie der Untersuchung von substitutiven und komplementären Beziehungen zwischen einzelnen Fischprodukten auf verschiedenen Märkten. Es gibt eine Reihe von internationalen Arbeiten zur Schätzung von Elastizitäten der Nachfrage nach Fisch und Fischprodukten. Exemplarisch genannt seien die Arbeiten von Dey (2000), Asche et al. (2005), Xie et al. (2008), Dey et al. (2008), Dey et al. (2011), Xie und Myrland (2011), Chidmi et al. (2012) und Singh et al. (2014).

Studien, welche die Nachfrage nach Fischprodukten auf dem deutschen Markt untersuchen, sind dagegen selten. Es gibt einige wenige ältere Arbeiten, wie beispielsweise Ryll (1984), Sommer (1985) und Tönniges (2005). Die Studien von Thiele (2001), Wildner (2001) und Hoffmann (2003) untersuchen die Nachfrage nach Fisch neben anderen Lebensmitteln. In allen diesen Arbeiten werden Elastizitäten auf relativ aggregierter Ebene und nicht mit aktuellen Marktdaten geschätzt.

Aktuelle Marktdaten, die tatsächliches Kaufverhalten von Konsumenten widerspiegeln, wie beispielsweise Scannerdaten, sind sehr teuer. Auch ist es schwer, ohne diese Daten die nachgefragten Mengen von Fischprodukten zu ermitteln. Informationen über Preise sind hingegen zum Teil (länder- und marktspezifisch) öffentlich zugänglich. Daraus resultierend finden sich in der Literatur zahlreiche Marktintegrationsstudien, für die nur Preisinformationen benötigt werden. Diese Untersuchungen zielen insbesondere auf die Konkurrenzbeziehungen zwischen einzelnen Fischprodukten auf verschiedenen Märkten ab. Weiter zeigt der Grad der Marktintegration auf, inwiefern umwelt- und ökonomisch bedingte Veränderungen den Preis von Fischprodukten beeinflussen. Der Einfluss einer angebotsseitigen Veränderung ist beispielsweise geringer, je stärker die Märkte miteinander verbunden sind, da die Substitutionsbeziehung auf solchen Märkten stärker ist und der Konsument somit schneller auf substitutive Produkte ausweicht. Es gibt verschiedene Studien, welche die Marktintegration auf Fischmärkten untersuchen. Wichtige Studien, die

sich auf Märkte der EU beziehen, sind u.a. Asche et al. (2002), Asche et al. (2004), Asche et al. (2007) sowie Nielsen et al. (2009). Eine Studie, die sich explizit auf den deutschen Markt bezieht ist Nielsen et al. (2007), welche die Marktintegration von Forellen untersucht. Darüber hinaus ist es hinreichend bekannt, dass der Preis von Fischprodukten eine Funktion verschiedener Attribute wie beispielsweise der Fischart, der Größe, der Prozess- sowie der Produktform ist. Mittels hedonischer Preisanalysen wird der Einfluss verschiedener Attribute auf den Preis untersucht. Es wird davon ausgegangen, dass diese Attribute einen unterschiedlichen Nutzen für Konsumenten haben und dadurch die Kaufentscheidung maßgeblich beeinflussen. Kennen Produzenten die nutzenstiftenden Attribute, können sie diese verwenden, um durch Preisaufschläge ihren Gewinn zu maximieren. Die Arbeit von Roheim et al. (2007) ist eine der ersten hedonischen Preisanalysen, welche die Auswirkungen von Attributen auf den Preis von Fischprodukten untersuchte und damit den Grundstein für weitere Studien wie beispielsweise McConnell und Strand (2000), Lee (2014), Asche et al. (2015) und Blomquist et al. (2015) legte. Mit Ausnahme der Arbeit von Blomquist et al. (2015), die sich auf Schweden bezieht, haben die Studien gemeinsam, dass sie Preis- bzw. abschlüsse, die durch einzelne Attribute generiert werden können, für den Markt Großbritanniens berechnen. Studien für den deutschen Fischmarkt sind nicht bekannt.

Es gibt außerdem eine lange Liste internationaler Literatur, in der die relativen Vorzüge von wildgefangenem vs. gezüchtetem Fisch aus verschiedenen Blickwinkeln diskutiert werden. In einigen Studien wird dabei die Erkenntnis gewonnen, dass die umweltbedingten Externalitäten, die mit der Aquakulturproduktion in Verbindung gebracht werden, des Öfteren zu einer negativen Wahrnehmung von Fisch aus Zuchtanlagen seitens der Konsumenten führt (Wessells et al., 1999; Roheim et al., 2012). Diese Aussagen stammen zumeist aus Discrete Choice Experimenten (DCE), die ursprünglich aus der quantitativen Psychologie (Luce und Tukey, 1964) kommen, sich jedoch schnell im Bereich der Marktforschung (McFadden, 1974) etabliert haben. Heutzutage werden DCE in vielen Bereichen der Forschung angewendet, so auch in der Agrar- und im Speziellen in der Fischökonomie. Die Methode der DCE wird in der Fischökonomie im Wesentlichen angewendet, um Konsumentenpräferenzen zu messen, hypothetisches Verhalten zu quantifizieren sowie Zahlungsbereitschaften für bestimmte Fischprodukte abzuleiten.

Im Allgemeinen zeigen die verschiedenen internationalen Studien auf, dass es deutliche Unterschiede zwischen den Märkten und dem Nachfrageverhalten der Konsumenten gibt.

Die durchgeführten Studien liefern Informationen über den untersuchten Markt innerhalb des untersuchten Zeithorizontes. Es gibt kein Argument dafür, dass die Marktsituation in anderen Ländern die Situation in Deutschland widerspiegelt.

Hier soll die vorliegende Dissertation anknüpfen. Es wird in unterschiedlichen Studien ein Markt untersucht, der noch wenig Beachtung gefunden hat, aber zu einem der wichtigsten europäischen Importmärkte für Fisch und Fischprodukten zählt (Asche und Bjørndal, 2011). Ferner ist Deutschland ein besonders interessanter Markt, da deutsche Konsumenten als preissensibler sowie weniger qualitätsbewusst gelten als Konsumenten auf anderen europäischen Fischmärkten (Asche et al., 2004). Produktion und Verbrauch von gezüchteten Fisch aus Aquakulturproduktion sind innerhalb der letzten Dekade signifikant gestiegen. Auch wenn die Verfahren der Aquakulturproduktion sehr unterschiedliche Voraussetzungen und Wirkungen haben (z.B. auf Tiergesundheit, Kosten etc.), so gibt es bei der Kennzeichnung der Konsumprodukte in Deutschland basierend auf der EU-Richtlinie von 2002 nur eine Kategorie, die „Fisch aus Zuchtanlagen“ heißt. Ziel der Dissertation ist es, anhand verschiedener methodischer Forschungsrichtungen den deutschen Fischmarkt zu analysieren. Es soll insbesondere der Frage nachgegangen werden, wie die deutschen Verbraucher auf die vermehrte Aquakulturproduktion reagieren und wie die Lebensmitteleinzelhändler diese Produkte preislich platzieren.

Die kumulativ angelegte Dissertation umfasst sieben Artikel, die in englischer Sprache verfasst sind. Zum Zeitpunkt der Veröffentlichung der Dissertation sind vier der Artikel veröffentlicht bzw. zur Veröffentlichung angenommen. Ein Artikel befinden sich im Begutachtungsprozess und zwei Artikel sind Working Paper, die zur Veröffentlichung vorbereitet werden. Aus methodischer Sicht sind die Artikel zwei Forschungsfeldern zuzuordnen, der Nachfrageanalyse und der Preisanalyse. Dem Methodenfeld der Nachfrageanalyse sind vier, dem Methodenfeld der Preisanalyse drei Beiträge zugeordnet.

Zunächst wird anhand von Nachfrageanalysen das Verbraucherverhalten in Bezug auf unterschiedliche Fischarten aus Aquakulturanlagen und wildgefangene Fische sowie in Bezug auf nachhaltig gefangenen Fisch untersucht. Hierzu werden zum einen Nachfragesysteme geschätzt und Substitutionsbeziehungen analysiert. Zudem werden Preis- und Ausgabenelastizitäten ermittelt (Kapitel 2 und 3). In der Studie in Kapitel 3 werden soziodemographische Merkmale der Konsumenten in das Nachfragesystem miteinbezogen.

Als eine Alternative und Erweiterung zu den in den vorigen Kapiteln angewendeten Methoden werden in den zwei nachfolgenden Studien (Kapitel 4, 5) erweiterte Schätzmodelle eingesetzt, um die Heterogenität der Konsumenten explizit zu berücksichtigen. In Kapitel 4 wird anhand eines DCE, das im November 2015 in Kiel und Kaltenkirchen durchgeführt wurde, das Entscheidungsverhalten sowie die Akzeptanz von Konsumenten gegenüber Fisch aus Aquakulturanlagen und nachhaltigem Fisch untersucht. Zur Analyse der Daten wird auf das Mixed Logit Modell zurückgegriffen. In Kapitel 5 werden anhand aktueller Marktdaten die Präferenzen von Konsumenten gegenüber tiefgekühlten Lachsprodukten, mit dem Fokus auf Aquakultur- und MSC-zertifizierten Produkten, ebenfalls mittels eines Mixed Logit Modells analysiert. Somit können Vergleiche zwischen den in den DCE angegebenen Präferenzen der Konsumenten sowie den tatsächlichen Präferenzen, die aus den Marktdaten abgeleitet werden, gezogen werden.

Im Methodenfeld der Preisanalysen wird zunächst anhand von reinen Preiseffekten in einer Marktintegrationsstudie (Kapitel 6) untersucht, ob der Markt für Fangfische und der Markt für gezüchtete Fische in Deutschland als ein zusammenhängender Markt gesehen werden kann, oder ob es sich um getrennte Märkte handelt. Es wird ferner getestet, ob das Gesetz einheitlicher Preise (Law of One Price (LOP)) hält². Zum anderen werden mittels hedonischer Preisanalysen (Kapitel 7, 8) die Zahlungsbereitschaft der Konsumenten und die Kostenstrukturen der Anbieter hinsichtlich ausgewählter Eigenschaften von Fischprodukten untersucht.

Die erhaltenen Ergebnisse der Beiträge können Auswirkungen auf Produzenten, Importeure sowie Anbieter von Fischprodukten haben. Für die methodischen Untersuchungen wird zumeist auf tatsächliche Marktdaten über die Käufe von Tiefkühlfischprodukten in Form von Scannerdaten zurückgegriffen. Die Verwendung von Daten zu Tiefkühlfischprodukten ist als angemessen anzusehen, da dieses Segment nach Angaben des Fischinformationszentrums (FIZ, 2015) etwa ein Drittel des Gesamtkonsums an Fisch und Fischerzeugnissen ausmacht. In Kapitel 9 erfolgt eine abschließende Betrachtung und kritische Würdigung der Beiträge. Kapitel 10 beinhaltet eine englischsprachige Zusammenfassung der einzelnen Beiträge der kumulativen Dissertation. Die theoretischen Grundlagen der Nachfrageanalyse werden in Kapitel 11 erläutert.

² Das LOP besagt, dass Preisänderungen bei homogenen Gütern auf differenzierten Märkten proportional, gleichgerichtet und mit möglichst geringem zeitlichen Verzug erfolgen (Isard, 1977).

Die vorliegende kumulative Dissertation besteht aus sieben Beiträgen, die im Folgenden kurz vorgestellt werden.

The German Whitefish Market: An Application of the LA/AIDS Model using Retail-Scanner-Data

Aquakulturproduktion hat sich in den letzten Jahren zu einer der am schnellsten wachsenden Nahrungsmittelproduktionen entwickelt. Nach Angaben der FAO (2014) ist die Produktion mit einer durchschnittlichen Rate von 6,2 % im Zeitraum von 2000 bis 2012 angestiegen und erreicht im Jahr 2012, mit einer weltweiten Produktion von 90 Millionen Tonnen, einen historischen Höchstwert. Diese Entwicklung hat Einfluss auf eine Reihe von internationalen Fischmärkten.

Als Beispiel wird in dem Beitrag der Weißfischmarkt gewählt, da dieser zu einem der bedeutendsten Segmente im Fischmarkt zählt. Jahrelang wurde der Weißfischmarkt durch Fischarten wie Kabeljau, Seelachs oder Alaska-Seelachs dominiert. Innerhalb der letzten zehn Jahre ist es jedoch zu signifikanten Veränderungen auf dem Markt gekommen, da vermehrt subtropische Fischarten aus Aquakulturanlagen (wie beispielsweise Pangasius und Tilapia) günstig auf dem Markt angeboten werden. Die Nachfrage nach diesen Fischarten (insbesondere Pangasius) ist auch auf dem deutschen Markt schnell angestiegen und Produzenten können, trotz des geringen Verkaufspreises, große Margen erzielen.

In diesem Beitrag werden auf der Basis eines Linear Approximated Almost Ideal Demand Systems (LA/AIDS) Nachfrageelastizitäten für wildgefangene und gezüchtete Weißfischsorten ermittelt. Es soll untersucht werden, ob es Unterschiede in den Konsumentenpräferenzen hinsichtlich der beiden Produktionsmethoden gibt. Es ist bekannt, dass insbesondere deutsche Verbraucher preissensibel sind. Aufgrund dessen kann erwartet werden, dass die Konsumenten höherpreisige wildgefangenen Fischarten wie Kabeljau gegen niedrigpreisigere Sorten aus Aquakulturproduktion wie beispielsweise Pangasius substituieren.

Als Datengrundlage für die Berechnungen steht ein Einzelhandelsscannerdatensatz (IRISymphony Group) zur Verfügung. Die Weißfischkategorie umfasst Daten, die

wöchentlich in über 500 Lebensmitteleinzelhandelsgeschäften in ganz Deutschland zwischen 2008 und 2012 gesammelt wurden. In diese Studie fließen 743.145 Preisbeobachtungen ein. Weiter können 48 unterschiedliche Produkte anhand der European Article Number (EAN)³ identifiziert werden.

Die Nachfrage nach wildgefangenen Fischarten ist etwas elastischer als die Nachfrage nach Fischen aus Aquakulturproduktion. Im Allgemeinen stehen die Weißfischsorten in einer substitutiven Beziehung zueinander und befriedigen somit ähnliche Bedürfnisse der Konsumenten. Auf dem deutschen Weißfischmarkt ist insbesondere Pangasius wettbewerbsfähig, während Tilapia keine große Rolle spielt.

Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood in Germany: An Application of QUAIDS Modeling with Correction for Sample Selection

Anhand tatsächlicher Marktdaten soll in dem Beitrag untersucht werden, ob deutsche Konsumenten unterschiedlich auf Preisänderungen bei wildgefangenen Fischen und Meerestieren reagieren als bei Fischen und Meerestieren aus Aquakulturanlagen. Der Kern der Studie besteht in der Schätzung eines Nachfragesystems, genauer eines Quadratic Almost Ideal Demand Systems (QUAIDS), für das Tiefkühlfleischsegment im Zeitraum 2006 bis 2010 sowie in der Ableitung von Preis- und Nachfrageelastizitäten. Als Beispiel werden Lachs und Shrimps aus beiden Produktionen sowie gezüchteter Pangasius und wildgefangener Rotbarsch herangezogen, da diese Sorten einen großen Anteil am weltweiten Handel sowie am deutschen Konsum ausmachen. Die Datengrundlage für die Schätzung bildet das Haushaltspanel der Gesellschaft für Konsumforschung (GfK). Die GfK erhebt die Ausgaben der Verbraucher auf Ebene der getätigten Einkäufe. Die Daten umfassen Menge und Wert der Einkäufe auf Basis der EAN-Produktcodes, d.h. jedes einzelne Produkt wird getrennt erfasst.

Eine Besonderheit ergibt sich im Zusammenhang mit den Daten des Haushaltspanels aufgrund der Selektionsproblematik, d.h. nicht alle Haushalte werden in jedem Zeitabschnitt

³ Die European Article Number (EAN) ist ein 13-stelliger Barcode zur eindeutigen Artikelidentifikation.

die betrachteten Fischarten kaufen. Ein Grund kann sein, dass Fisch in einer Woche besonders teuer oder Substitute von Fisch besonders billig waren. Werden diese Beobachtungen nicht oder nur ohne Korrektur berücksichtigt, so kann es zu einer Verzerrung der Schätzer kommen (Intriligator et al., 1996). Eine Möglichkeit der Berücksichtigung dieser Problematik besteht in einem zweistufigen Schätzverfahren nach Shonkwiler und Yen (1999), die in diesem Beitrag Anwendung findet.

Die Ergebnisse zeigen, dass deutsche Konsumenten im Allgemeinen sensibel auf Preisänderungen der betrachteten Produkte reagieren. Entgegen der Erwartungen sind die untersuchten Produkte, hergestellt aus Zuchttieren, auf dem deutschen Markt preislich höher platziert als die Produkte, die aus wildgefangenen Fischen und Shrimps hergestellt werden. Dennoch können interessanterweise keine wesentlichen Unterschiede in der Höhe der Elastizitäten für Lachs aus beiden Produktionsrichtungen festgestellt werden. Für Shrimps kann die Aussage getroffen werden, dass die Nachfrage nach wildgefangenen Shrimps elastischer reagiert als die Nachfrage nach Shrimps aus Aquakulturanlagen.

Assessing Consumer Preferences and Willingness to Pay for Farmed and Eco-labeled Fish: Insights from a Discrete Choice Experiment in Northern Germany

Vermeint werden Discrete Choice Experimente (DCE) in der Untersuchung von internationalen Fischmärkten dazu verwendet, um die Präferenzen von Konsumenten für verschiedene Eigenschaften von Fischprodukten zu quantifizieren. Diesem Beitrag liegt ein selbstdurchgeführtes DCE zugrunde, in dem untersucht wird, welchen Einfluss die Attribute Preis, Produktionsmethode (gezüchteter vs. wildgefangener Fisch), Verarbeitungsform (tiefgekühlt vs. frisch) sowie die Zertifizierung mit einem Nachhaltigkeitslabel auf die Kaufwahrscheinlichkeit von Lachs und Steinbutt haben. Die Befragung besteht insgesamt aus vier Teilen⁴: Im ersten Teil werden die Konsumenten gebeten, jeweils für beide Fischarten zwischen zwei Produktalternativen, bestehend aus verschiedenen Ausprägungen der betrachteten Attribute, und einer Nicht-Kauf Alternative zu wählen. Im zweiten Teil der Befragung werden die Konsumenten zu einigen soziodemographischen Merkmalen wie Einkommen, Alter, Bildung und Beruf befragt. Der dritte Teil identifiziert generelle

⁴ Ein Fragebogen befindet sich im Anhang des Beitrages in Kapitel 4.

Konsumneigungen hinsichtlich Fisch sowie Einstellungen und Wahrnehmungen bezüglich gezüchtetem Fisch aus Aquakulturanlagen und nachhaltiger Fischproduktion. Im vierten Teil des Fragebogens werden die Teilnehmer über die Produktion der betrachteten Fischarten in Aquakulturen sowie die Bedeutung der Nachhaltigkeitslabel Marine Stewardship Council (MSC)⁵ und Aquaculture Stewardship Council (ASC)⁶ informiert. Anschließend sollen sich die Konsumenten wieder zwischen zwei Produktalternativen sowie der Nicht-Kauf Alternative entscheiden. Es wird entsprechend der Hypothese nachgegangen, ob der besser informierte Konsument bestimmte Attribute der Fischprodukte anders betrachtet als der weniger informierte Konsument.

Die empirische Analyse beruht auf einer Befragung von 485 Konsumenten in zwei Verbrauchermärkten in Kiel und einem Verbrauchermarkt in Kaltenkirchen, die innerhalb von zwei Wochen im November 2015 durchgeführt wurde. Um die Präferenzheterogenität der Befragten zu berücksichtigen, wird für die Schätzung ein Mixed Logit Modell verwendet. Die Befragten nehmen im Mittel Fisch aus Aquakulturanlagen negativer wahr als wildgefangenen Fisch, die Zahlungsbereitschaft fällt für dieses Produktattribut negativ aus. Auch mögen die Teilnehmer im Mittel keine Tiefkühl Fischprodukte, obwohl diese in Deutschland die meist konsumierte Form von Fisch darstellen (FIZ, 2015). Hingegen beeinflusst das ASC Siegel zumindest für Lachs die Kaufentscheidung positiv und das MSC Siegel erhöht für beide betrachteten Fischarten die Kaufwahrscheinlichkeit. Die Zahlungsbereitschaft der Konsumenten für die Nachhaltigkeitsiegel erhöhte sich nach dem Erhalt der Informationen.

Preference Heterogeneity in the Demand for Salmon: A Random Coefficients Approach

Der Konsument von Fischprodukten wird heutzutage mit einer Fülle an Informationen überflutet, die von ihm verarbeitet werden und in den Kaufprozess mit einfließen. Wesentliche Komponenten stellen dabei die Marke eines Produktes, die

⁵ MSC zertifiziert Fischereien, die ein effektives und verantwortungsbewusstes Management im Sinne der Nachhaltigkeit betreiben.

⁶ ASC kennzeichnet Fischprodukte, die aus Fischen hergestellt werden, die aus verantwortungsbewusster Zucht stammen.

Produktionsmethode (gezüchtet vs. wildgefangener Fisch) sowie die Zertifizierung der Fischprodukte mit einem Nachhaltigkeitslabel dar. Insbesondere stehen die Produktionsmethode und die Zertifizierung von Fischprodukten im Fokus bisheriger Forschungen, wobei der Markeneffekt von Fischprodukten und der Einfluss der Einkaufsstätte auf Kaufentscheidungen von Konsumenten weitestgehend unberücksichtigt bleiben.

Dieser Beitrag ergänzt die bisherige Literatur dahingehend, dass tatsächliche Marktdaten (GfK Scannerdaten) und somit bereits getroffene Kaufentscheidungen von Haushalten für die Analyse des Einflusses der Produktionsmethode, des Nachhaltigkeitslabels des Marine Stewardship Councils (MSC) sowie Hersteller- und Handelsmarken auf die Entscheidung von Haushalten für oder gegen tiefgekühlte Lachsprodukte zur Verfügung stehen. Zudem wird durch die Anwendung eines Mixed Logit Modells die Heterogenität der Konsumenten bei der Bewertung der Produktattribute in die Untersuchung explizit mit einbezogen. Bisherige Studien, die ähnliche Effekte untersuchen konzentrieren sich fast ausschließlich auf Stated Preference Daten oder bedienen sich hedonischen Preisanalysen, die zwar Marktdaten verwenden, jedoch weder soziodemographische Merkmale von Konsumenten noch Präferenzheterogenitäten zwischen den Konsumenten berücksichtigen.

Die Ergebnisse der Studie sind äußerst interessant, da sie teilweise im Widerspruch zu Verbraucherbefragungen stehen und somit einen Hinweis darauf liefern, dass es in Verbraucherbefragungen vermutlich zu einer Verzerrung, beispielsweise durch sozialerwünschtes Antwortverhalten, kommen kann. Die Resultate dieser Studie zeigen, dass deutsche Haushalte im Durchschnitt gezüchteten Lachs dem wildgefangenen Lachs vorziehen sowie die Kaufwahrscheinlichkeit für MSC zertifizierten Lachs geringer ist als für nicht zertifizierten. Diese Ergebnisse widersprechen zuvor durchgeführten Studien. Außerdem zeigen die Ergebnisse dieser Studie, dass es hinsichtlich der Bewertung der untersuchten Produktattribute deutliche Heterogenitäten in den Präferenzen der Haushalte gibt. Sozioökonomische Charakteristika haben einen geringen Einfluss auf die Entscheidung Lachsprodukte zu kaufen. Hingegen wird deutlich herausgestellt, dass die Marke eines Lachsproduktes eine Rolle bei der Kaufentscheidung spielt. In einigen Fällen ist der Markeneffekt sogar so stark, dass er den negativen Einfluss der MSC Zertifizierung auf die Kaufentscheidung relativiert oder sogar gänzlich unterdrückt.

Market Integration between Farmed and Wild Fish: Evidence from the Whitefish Market in Germany

In dem fünften Beitrag der Dissertation wird die Marktintegration von gezüchteten und wildgefangenen Weißfischen auf dem deutschen Markt empirisch untersucht. Die Analysen erfolgen mit Hilfe von Kointegrationstests sowie durch Testen des LOP. Als Datengrundlage dienen monatliche Importpreise der Jahre 2010-2014.

Der Beitrag stellt eine empirische Grundlage für starke Marktintegration zwischen wildgefangenen und gezüchteten Fischen auf einem der wichtigsten Importmärkte für Fisch dar. Preise von „neuen“ Fischarten wie Pangasius und Tilapia werden nicht nur durch das eigene Angebot determiniert sondern ebenso durch das Angebot wildgefangener Fischarten wie Kabeljau und Alaska-Seelachs. Der Einfluss einer angebotsseitigen Veränderung ist geringer, je stärker die Märkte miteinander verbunden sind, da die Substitutionsbeziehung auf solchen Märkten stärker ist und der Konsument somit schneller auf substitutive Produkte ausweicht.

The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany

Es ist hinlänglich bekannt, dass der Preis von Nahrungsmitteln eine Funktion verschiedener Attribute ist. Bei Fischprodukten wirken sich insbesondere die Fischart, die Produktform, die Zubereitungsform sowie die Packungsgröße auf den Produktpreis aus. Die Arbeit von Roheim et al. (2007) ist eine der ersten hedonischen Preisanalysen, welche die Auswirkungen von Attributen auf den Preis von Fischprodukten untersucht und damit den Grundstein für weitere Studien, die sich aber zum größten Teil auf den englischen Markt beziehen, legt. Bei der bisherigen Analyse der Preisgestaltung von Fischprodukten wird bisher jedoch der Einfluss von Handelsmarken, Produktionsmethode (Aquakulturproduktion vs. wild gefangener Fisch), MSC-Zertifizierung sowie Sonderangeboten weitestgehend vernachlässigt. Die vorliegende Studie erweitert die bestehende Literatur dahingehend, dass anhand eines einzigartigen Scanner-Datensatzes der GfK Handelsmarken verschiedener Lebensmitteleinzelhändler genauestens identifiziert werden können. Außerdem kann

zwischen Fischprodukten aus gezüchteten und wildgefangenen Fischen unterschieden werden.

In diesem Beitrag wird ein hedonisches Preismodell für die Jahre 2000 bis 2010 geschätzt. Die Ergebnisse zeigen, dass insbesondere die Markenzugehörigkeit eines Fischproduktes bei der Preissetzung eine wichtige Rolle spielt. Es kann ein Preisnachlass von 20 % für Handelsmarken identifiziert werden, während Herstellermarken klare Preisaufschläge erzielen. Ebenso zeigt die Studie, dass Fische aus Aquakulturproduktion Preisprämien generieren.

Price Premiums for Eco-labeled Seafood: MSC-Certification in Germany

Das MSC-Siegel zertifiziert Fisch und Meeresfrüchte aus nachhaltiger Fischerei. Durch das Siegel setzt das MSC Standards für verantwortungsbewusste und umweltfreundliche Fischerei, um der Überfischung und Zerstörung der Weltmeere entgegenzuwirken. Ende des Jahres 2014 gibt es weltweit 252 zertifizierte Fischereien. Dennoch wird die Wirksamkeit der MSC-Siegel kontrovers diskutiert. Hauptkritikpunkt ist die Frage, ob das MSC-Siegel den Fischereien tatsächlich einen Anreiz für ein effektives und verantwortungsbewusstes Management gibt.

Eine Vielzahl von Studien hat anhand von Befragungen herausgefunden, dass Konsumenten Präferenzen für Ökokennzeichen wie das MSC-Siegel haben. Somit sind die Konsumenten, nach eigenen Angaben, bereit einen höheren Preis für zertifizierte Produkte zu bezahlen. Jedoch gibt es kaum einen wissenschaftlichen Nachweis darüber, ob diese Präferenzen sich in tatsächlichen Preisaufschlägen niederschlagen und somit den Fischereien einen Anreiz zum verbesserten Management bieten.

In diesem Beitrag wird empirisch untersucht, ob und wie das MSC-Siegel den Preis von Fischprodukten in Deutschland beeinflusst. Dazu wird ein hedonisches Preismodell mit Scannerdaten (GfK-Daten) geschätzt. Ferner kann unter Berücksichtigung von Interaktionseffekten analysiert werden, ob es sortenspezifische Unterschiede in der Höhe der durch das MSC-Siegel generierten Preisaufschläge gibt.

Die Ergebnisse der durchgeführten Studie verdeutlichen, dass es von der Fischart abhängt, ob durch das MSC-Siegel Preisaufläge generiert werden können und wie hoch diese sind. Auf dem deutschen Markt variieren die Prämien von einem hohen Preisauflage von 30,6 % für zertifizierten Kabeljau bis hin zu einem kleinen aber nicht signifikanten Preisauflage für zertifizierten Seelachs.

Literaturverzeichnis

- Anderson, J., Asche, F., & Tveterås, S. (2010). World fish markets. In R. Grafton, R. Hilborn, D. Squires, M. Tait, & M. Williams, *Handbook of Marine Fisheries Conservation and Management* (pp. 113-123). Oxford: Oxford University Press.
- Asche, F. (2008). Farming the Sea. *Marine Resource Economics, Vol. 23*, 527-547.
- Asche, F., & Bjørndal, T. (2011). *The Economics of Salmon Aquaculture. -2nd ed.* UK: Wiley-Blackwell.
- Asche, F., Bjørndal, T., & Gordon, D. (2007). Studies in the Demand Structure for Fish and Seafood Products. In A. Weintraub, C. Romero, T. Bjørndal, & R. Epstein, *Handbook of Operations Research in Natural Resources* (S. 295-314). New York: Springer.
- Asche, F., Bjørndal, T., & Young, J. (2001). Market interactions for aquaculture products. *Aquaculture Economics and Management, Vol. 5*, 303-318.
- Asche, F., Gordon, D., & Hannesson. (2002). Searching for price parity in the European whitefish market. *Applied Economics, Vol. 34*, 1017-1024.
- Asche, F., Gordon, D., & Hannesson, R. (2004). Tests for market integration and the law of one price: the market for whitefish in France. *Marine Resource Economics, Vol. 19*, 195-210.
- Asche, F., Guttormsen, T., Sebulonsen, T., & Sissener, E. (2005). Competition between Farmed and Wild Salmon: The Japanese Salmon Market. *Agricultural Economics, Vol. 33*, 333-340.
- Asche, F., Larsen, A., Smith, M., Sogn-Grundvåg, & Young, J. (2015). Pricing of eco-labels with retailer heterogeneity. *Food Policy, Vol. 67*, 82-93.
- Asche, F., Shabbar, J., & Hartmann, J. (2007). Price transmission and market integration: vertical and horizontal price linkages for salmon. *Applied Economics, Vol. 39*, 2535-2545.

- Blomquist, J., Bartolino, V., & Waldo, S. (2015). Price premiums for providing eco-labelled seafood: Evidence from MSC-certified cod in Sweden. *Journal of Agricultural Economics*, Vol. 66, 690-704.
- Chidmi, B., Hanson, T., & Nguyen, G. (2012). Substitutions between fish and seafood products at the US national retail level. *Marine Resource Economics*, Vol. 27, 359-370.
- Dey, M. M. (2000). Analysis of demand for fish in Bangladesh. *Aquaculture Economics and Management*, Vol. 4, 63-79.
- Dey, M. M., Alam, M. F., & Paraguas, F. J. (2011). A Multistage Budgeting Approach to the Analysis of Demand for Fish: An Application to Inland Areas of Bangladesh. *Marine Resource Economics*, Vol. 26, 35-58.
- Dey, M. M., Yolanda, T. G., Kumar, P., Piumsombun, S., Haque, M. S., Luping, L., . . . Koeshendrajana, S. (2008). Demand for Fish in Asia: A Cross-Country Analysis. *The Australian Journal of Agricultural and Resource Economics*, Vol. 52, 321-338.
- FAO. (2014). *The State of World Fisheries and Aquaculture 2014*. Rome: Food and Agriculture Organization of the United Nations.
- FAO. (2014a). *Food Outlook - Biannual Report on Global Food Markets October 2014*. Rome: Food and Agricultural Organization of the United Nations .
- FAO. (2015). *FAO Fisheries and Aquaculture Department*. Retrieved from Online Query Panels: <http://www.fao.org/fishery/topic/16140/en> , accessed 21.12.2015
- FIZ. (2015). *Fischwirtschaft -Daten und Fakten 2014*. Von Fischinformationszentrum: <http://www.fischinfo.de>. abgerufen
- Hoffmann, C. (2003). Die Nachfrage nach Nahrungs- und Genußmitteln privater Haushalte vor dem Hintergrund zukünftiger Rahmenbedingungen. In *Studien zur Haushaltsökonomie* 28. Frankfurt on the Main: Peter Lang.
- Intriligator, M. D., Bodkin, R. G., & Hsiao, C. (1996). *Econometric Models, Techniques and Applications*. Upper Saddle River, NJ: Prentice-Hall.
- Isard, P. (1977). How Far Can We Push the "Law of One Price?". *The American Economics Review*, Vol. 67, 942-948.

- Lee, M.-Y. (2014). Hedonic Pricing of Atlantic Cod: Effects of Size, Freshness and Gear. *Marine Resource Economics, Vol. 29*, 259-277.
- Luce, R., & Tukey, J. (1964). Simultaneous Conjoint Measurement: A new Type of fundamental measurement. *Journal of Mathematical Psychology, Vol. 1*, 1-27.
- McConnell, K., & Strand, I. (2000). Hedonic Prices for Fish: Tuna Prices in Hawaii. *American Journal of Agricultural Economics, Vol. 82*, 133-144.
- McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka, *Frontiers of Econometrics*. New York: Academic Press.
- Neubacher, H. (2010). Viet Nam-Seafood from Waterland. In *Globefish Research Programme, Vol. 99*. Rome: FAO.
- Nielsen, M., Setälä, J., Laitinen, J., Saarni, K., Virtanen, J., & Honkanen, A. (2007). Market integration of farmed trout in Germany. *Marine Resource Economics, Vol. 22*, 199-214.
- Nielsen, M., Smit, J., & Guillen, J. (2009). Market integration of fish in Europe. *Journal of Agricultural Economics, Vol. 60*, 367-385.
- Roheim, C., Gardiner, L., & Asche, F. (2007). Value of brands and other attributes : hedonic analysis of retail frozen fish in the UK. *Marine Resource Economics, Vol. 22*, 239-253.
- Roheim, C., Sudhakaran, P., & Durham, C. (2012). Certification of shrimp and salmon for best aquaculture practice: Assessing consumers preferences in Rhode Island. *Aquaculture Economics and Management, Vol. 16*, 266-286.
- Ryll, E. (1984). Bestimmungsgründe und Elastizitäten der Nachfrage nach Fisch und Fischwaren in der Bundesrepublik Deutschland. In *Berichte über Landwirtschaft 62* (pp. 208-221). Hamburg, Berlin: Paul Parey.
- Shonkwiler, J. S., & Yen, S. T. (1999). Two-step estimation of a censored system of equations. *American Journal of Agricultural Economics, Vol. 81*, 972-982.
- Singh, K., Dey, M., & Surathkal. (2014). Seasonal and spatial variations in demand for and elasticities of fish products in the united states: an analysis based on market-level scanner data. *Canadian Journal of Agricultural Economics, Vol. 62* , 343-363.

- Smith, M. (2012). The new fisheries economics: Incentives across many margins. *Annual Review of Resource Economics*, Vol. 4, 379-402.
- Sommer, U. (1985). Quantitative Analyse der Nachfrage nach Fisch und Fischwaren in der Bundesrepublik Deutschland 1965-1981. In *Berichte über die Landwirtschaft*, Vol. 63 (pp. 82-101). Hamburg, Berlin: Paul Parey.
- Thiele, S. (2001). Ausgaben- und Preiselastizitäten der Nahrungsmittelnachfrage auf Basis von Querschnittsdaten: Eine Systemschätzung für die Bundesrepublik Deutschland. *Agrarwirtschaft*, Vol. 50, 108-115.
- Tönniges, S. (2005). Die Determinanten der Nachfrage nach Fisch und Fischwaren. *Diplomarbeit am Institut für Agrarpolitik und Marktlehre an der Universität Gießen*.
- Wessells, C., Johnston, R., & Donath, H. (1999). Assessing consumer preferences for ecolabeled seafood: the Influence of species, certifier and household attributes. *American Journal of Agricultural Economics*, Vol. 81, 1084-1089.
- Wildner, S. (2001). Quantifizierung der Preis- und Ausgabenelastizität für Nahrungsmittel in Deutschland: Schätzung eines LA/AIDS. *Agrarwirtschaft*, Vol. 50, 275-285.
- Xie, J., & Myrland, Ø. (2011). Consistent aggregation in fish demand: a Study of French salmon demand. *Marine Resource Economics*, Vol. 26, 267-280.
- Xie, J., Kinnucan, H., & Myrland, Ø. (2008). The effects of exchange rates on export prices of farmed salmon. *Marine Resource Economics*, Vol. 23, 439-457.
- Xie, J., Kinnucan, H., & Myrland, Ø. (2009). Demand elasticities for farmed salmon in world trade. *European Review of Agricultural Economics*, Vol. 36, 425-445.

2. Kapitel

The German Whitefish Market: An Application of the LA/AIDS Model using Retail-Scanner-Data

Autoren:

Julia Bronnmann

Dieser Artikel ist zur Veröffentlichung angenommen im Journal
Aquaculture Economics and Management

Eine auf dem Beitrag basierende Präsentation wurde auf der Aquaculture America 2015
Conference, 19-22. Februar 2015, New Orleans, Louisiana vorgestellt.

The German Whitefish Market: An Application of the LA/AIDS Model using Retail-Scanner-Data

JULIA BRONNMANN

Abstract

Whitefish is one of the largest segments in the global seafood market. The whitefish market includes traditional wild caught species; cod, pollock and Alaska pollock, and the more recent introduction of aquaculture species; pangasius and tilapia. This study specifically addresses price elasticity estimates for wild and aquacultured whitefish on the German market. For demand estimation, the general form of the Almost Ideal Demand System (AIDS) with linear approximation (LA) is used. The demand for whitefish on the German market is found to be relatively elastic. The uncompensated cross-price elasticities indicate substantial substitution between pangasius and the three wild species, while tilapia does not seem to be a part of the larger whitefish market in Germany.

Keywords: Seafood demand, scanner data, Almost Ideal Demand System, consumer demand, price elasticity

JEL Classification Codes: D12, Q11, Q22

2.1 Introduction

Aquaculture has been the world's fastest food production technology during the last decades (FAO, 2014). Production expanded at an average annual rate of 6.2 % in the period 2000-2012 and at a rate of 9.5 % in the decade before reaching its all-time high in 2012 at more than 90 million tonnes which translates to 42 % of total annual fisheries supply (FAO, 2014). This development substantially transforms many seafood markets. One example is the whitefish market, which is one of the largest segments in the global seafood market and the quantity landed ranges from 6 million tonnes to 15 million tonnes, depending on the species accounting to the category (Asche et al., 2009). Traditionally, cod was the leading species on the whitefish market, which also consisted of other northern Atlantic species like haddock and saithe. In the 1990s this market was exposed to competition from cheaper (wild) alternatives like Alaska pollock, New Zealand hoki and Argentinian hake, making the market global.⁷ First, the demand of these species was linked on the cod price, as consumers choose the alternative species when the prices were low related to cod (Asche et al., 2009). Nowadays, these species have a higher influence on the price determination process. From the turn of the millennium, tropical farmed freshwater fish like pangasius and tilapia entered this segment, giving an important presence of aquacultured species in the whitefish market. The most important competitive advantage of farmed species is the ability to increase production in response to market demand (Asche et al., 2009), as aquaculture is farming, while fisheries are our last big harvesting industry depending on nature for primary production (Anderson, 2002).

While it is obvious that aquaculture is winning market share in some markets, there has been limited interest in investigating how this process progresses. The quantity impact of aquaculture species like pangasius and tilapia is already significant and will grow fairly rapidly in the following years (Kobayashi et al., 2015), but little evidence is found if the farmed and wild species are substitutes and if the farmed species also determined the prices in the whitefish market (Asche et al., 2009). During the last years, several empirical studies analyzed the market competition between farmed and wild species (Asche et al., 2001; Norman-López, 2009; Asche et al., 2012; Park et al., 2012). Following Asche et al. (2001) the market impact from aquaculture species cannot be generalized and the impact is most

⁷ Seafood is the most traded of the larger food commodities as the market for most groups of species has become global in recent decades (Tveterås et al., 2012; Asche et al., 2015)

important for the wild counterpart species. The influence of farmed species on prices are higher on smaller markets with less competitors. Some empirical market integration studies like Nielsen et al. (2007) and Anderson et al. (2010) show that there is market interaction between the farmed and wild species and that the species are substitutes. There is evidence, that pangasius and tilapia have changed a number of seafood markets in Europe and the United States (Asche et al., 2009). Norman-López and Bjørndal (2008) show that the tilapia market is segmented. Further, Norman-López and Asche (2008) as well as Norman-López (2009) examined whether different wild caught whitefish species compete in the same market with farmed tilapia. Asche and Zhang (2013) show that tilapia imports to the US caused a structural change in import demand for whitefish. But information regarding competition between farmed and wild fish and the household demand on the particular markets is scarce.

On the whitefish market consumers have the choice between farmed and wild species. There exists a wide range of international studies focusing on demand for fish in the literature, including Xie et al. (2008, 2009), Dey (2000), Dey et al. (2008), Dey et al. (2011), Xie and Myrland (2011), Chidmi et al. (2012) and Singh et al. (2014). The knowledge of the demand structure and consumers' preferences regarding species from both production technologies on the whitefish market using actual purchase data is limited.

In this study we conducted a demand study for Germany and the objective of this research is to determine whether there are differences in the consumption behavior of German households with respect to price changes of farmed and wild whitefish species. It is well known that the German consumers are extremely price sensitive, so it could be expected that the consumers substitute the high-price species like cod against the low-value species originating from aquaculture. However, several empirical studies show that consumers often state preferences for wild fish (Wessells et al., 1999; Roheim et al. 2012).

In this paper we focus on the traditional wild caught species; cod, pollock and Alaska Pollock, and the more recent introduction of aquaculture species; pangasius and tilapia. In particular we analyze the substitution pattern between the traditional wild whitefish species and the new species from aquaculture imported to Germany on the basis of an extensive and unique retail scanner dataset for the years 2008 to 2012. The general form of the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980) is used to estimate the

demand equations. The study analyzes frozen whitefish fillets, as this is the most consumed product form on the German fish market (Destatis, 2015).

The remainder of this paper is organized as follows: Next section briefly describes the German fish market. The LA/AIDS model is described in the subsequent section. The data and empirical specification of the estimated demand model is introduced in section 4. The estimation results are then discussed in section 5, followed by the last section, which draws some conclusions.

2.2 The German Fish Market

In 2013, the total supply of German fish and fishery products add up to around 2 million tonnes (catch weight) with imports taking the largest part with a volume of 1.8 million tonnes or 88%. These imports are supplemented by domestic production consisting of national landing and the produce out of inland fishery and aquaculture.

The German fish processing sector relies heavily on imported products, the largest supplying countries being Poland, China, Norway and Denmark. The two main product categories are frozen and canned fish. In 2013, the per capita consumption of fish in Germany was 13.7 kg. The share of frozen fish was 30%, the share of canned fish 27% and fresh fish has a share of 9% of per capita consumption. Frozen fish is easily available, primarily being sold in the large retail chains and discounters, which do not sell fresh fish (Destatis, 2015).

Whitefish is most often processed into fillets as this is the most popular product form on the German market. In 2013 the imports of frozen seafood fillets came up to 223,846 tonnes and the imports of frozen freshwater fish fillets reached 11,629 tonnes. Frozen whitefish fillets are among the most consumed fish products in Germany (Destatis, 2015). Table 1 shows the imported quantities, value and the average price of the imported wild caught whitefish species, cod, pollock and Alaska Pollock for the years 2010 to 2013.

As one can see, Alaska pollock is the leader in terms of imported value and quantity, followed by cod and pollock. In 2013 imports of frozen Alaska pollock fillets reached 136.686 tonnes with an average price of 2.24 € per kg. Frozen cod fillets command the highest import price on the German market.

Table 2.1: Imports of Frozen Whitefish Fillets from Wild Caught Species to Germany

Year	Frozen Cod			Frozen Pollock			Frozen Alaska Pollock		
	Value T€	Quantity t	Price €/kg	Value T€	Quantity t	Price €/kg	Value T€	Quantity t	Price €/kg
2010	88,486	21,757	4.07	52,045	16,875	3.08	364,287	146,591	2.49
2011	111,747	26,021	4.29	57,062	16,045	3.56	357,021	155,127	2.30
2012	102,951	21,855	4.71	36,212	9,726	3.72	372,891	157,079	2.37
2013	100,040	23,989	4.17	35,159	10,398	3.38	306,552	136,686	2.24

Source: Destatis (2015).

Within the last years, tropical freshwater fish has become one of the most important aquaculture commodities. The import statistics of the whitefish species originating from aquaculture, pangasius and tilapia, are presented in table 2.2.

Table 2.2: Imports of Frozen Whitefish Fillets of Species from Aquaculture to Germany

Year	Frozen Pangasius			Frozen Tilapia		
	Value T€	Quantity t	Price €/kg	Value T€	Quantity t	Price €/kg
2010	69,538	36,680	1.90	7,972	2,702	2.95
2011	67,839	32,764	2.07	10,471	3,037	3.45
2012	48,771	21,756	2.24	9,441	2,719	3.47
2013	35,729	18,664	1.91	9,694	2,734	3.55

Source: Destatis (2015).

Pangasius and tilapia are price competitive to the traditional whitefish species. Pangasius accounts for the cheapest price in the market, in 2013 the average price was 1.91 €/kg.

The produce is either sold to retailers or caterers (restaurants, canteens etc.). The share of direct marketing is tiny (below 1 %) (EU, 2014). Within the last years, a variety of fish species entered the German market and the fish market shows a high degree of product differentiation. Nonetheless, per-capita consumption of fish stagnates in Germany since the year 2000, while global per-capita consumption increased steadily. In 2013 the per-capita consumption fell slightly from 14.8 kg in 2012 to 13.7 kg (FAO, 2014; Destatis, 2015). This goes against the global increasing trend in per-capita consumption that averaged 19.7kg in 2012 (FAO, 2014).

2.3 The Demand Model

In line with previous research (Asche et al., 1998; Chidmi et al., 2012; Singh et al., 2012; Nguyen et al., 2013), the demand equations are estimated using the Almost Ideal Demand System (AIDS; cf. Deaton and Muellbauer, 1980). It is used extensively in demand analysis and gains its popularity by its flexible shape as well as its easy estimation and interpretation (Alston and Chalfant, 1993).

Each equation in the AIDS is given as:

$$w_{it} = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln p_{jt} + \beta_i \ln \left(\frac{X_t}{P_t} \right) + u_{it}, \quad (2.1)$$

where w_{it} is the expenditure share of the i th good, p_{jt} is the price of the j th good in period t , X_t is the total expenditure on the n whitefish species in the system, u_{it} is an error term. P_t denotes the price index. The parameters α_i, β_i and γ_{ij} have to be estimated, where β_i measures the effect of a real income change to the change in budget share of commodity i , γ_{ij} measures the effect of a price change of commodity j on the budget share of i . To avoid nonlinearity, the linear approximation of the AIDS (LA/AIDS) that uses the Stone price index instead of the translog price index is applied:

$$\ln P_t = \sum_{j=1}^n \bar{w}_{jt} \ln p_{jt} \quad (2.2)$$

\bar{w}_{jt} represents the sample mean of the expenditure share.

For theoretical consistency equations we use the usual restrictions of additivity (2.3), homogeneity (2.4), and symmetry (2.5):

$$\sum_{i=1}^n \alpha_i = 1; \sum_{i=1}^n \beta_i = \sum_{i=1}^n \gamma_{ij} = 0, \quad (2.3)$$

$$\sum_{j=1}^n \gamma_{ij} = 0, \quad (2.4)$$

$$\gamma_{ij} = \gamma_{ji} \quad \forall i \neq j. \quad (2.5)$$

The adding-up constraint (3) assures that the budget shares of all commodities sum to one. Homogeneity of degree zero (4) says that if all prices and income are multiplied by a positive constant k , the quantity demanded must remain unchanged. The symmetry constraint (2.5)

deals with the substitution effect between commodities. The matrix of substitution effects is symmetric, meaning the coefficient of the price of good i ($\ln P_i$) has the same value in the budget share equation of good j (w_j) as the coefficient of ($\ln P_j$) in w_i (Deaton and Muellbauer, 1980).

To derive the budget elasticities η_i and price elasticities eu_{ij} and ec_{ij} we follow Asche and Wessells (1997) and employ the following calculations:

The expenditure elasticities η_i are given by

$$\eta_i = 1 + \beta_i/w_i \quad (2.6)$$

The uncompensated (Marshallian) price elasticity eu_{ij} takes the income effect and the substitution effect into account and is calculated by

$$eu_{ij} = \frac{\gamma_{ij}}{w_i} - \delta_{ij} \quad \text{where: } \delta_{ij} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases} \quad (2.7)$$

The compensated (Hicksian) price elasticity ec_{ij} , which does not reflect the income effect, is computed by the following equation (2.8):

$$ec_{ij} = \frac{\gamma_{ij} - \beta_i w_j}{w_i} - \delta_{ij} \quad (2.8)$$

The respective own-, cross-price and expenditure elasticities are a function of the parameter estimates of the demand system as well as the expenditure shares. In this study, we use sample means of the shares to calculate the elasticities.

2.4 Data and Empirical Specification

In this study a unique retail scanner dataset is used. The data consists of weekly sales, volume and price information for frozen processed whitefish fillets from the SymphonyIRIGroup and covers 261 weeks from January 2008 to December 2012. The information on the whitefish species was gathered in 507 stores on a weekly basis resulting in 743,145 price observations. The whitefish category contains 48 different products, which can be identified by means of the European Article Number (EAN). The price observations are deflated by

the consumer price index (base year = 2010) and averaged across all stores which yields in different price series for each product. The EANs are aggregated with reference to the fish species, namely traditional wild caught species; cod, pollock and Alaska pollock, and more recent introduction of aquaculture species; pangasius and tilapia. The study only considers frozen whitefish fillets. The empirical statistics are calculated with 100g weighted average prices due to ensure comparability over different product prices and package sizes.

Table 2.3 presents the descriptive statistics of whitefish prices and market shares averaged over the years 2008 to 2012. In terms of market shares, Alaska pollock commands the highest market share at roughly 45 %, followed by pangasius at about 26 %. The average market share for cod and pollock is about 13 % respectively. Tilapia is not so common on the German market, the average market share for this species is 3 % over the study period.

Table 2.3: Average Whitefish Retail Prices and Market Share, 2008-2012

Product Attribute	frequency in %	Mean (price)	Min (price)	Max (price)	Std. Dev. (price)	Marketshare ^a in %
Fish Species						
Cod	14.36	0.95	0.85	1.15	0.05	12.70
Pollock	15.10	0.80	0.67	0.94	0.06	13.00
Alaska-Pollock	42.86	0.43	0.39	0.46	0.02	45.09
Pangasius	22.47	0.67	0.49	0.93	0.12	26.47
Tilapia	5.20	1.14	0.58	1.56	0.25	2.73

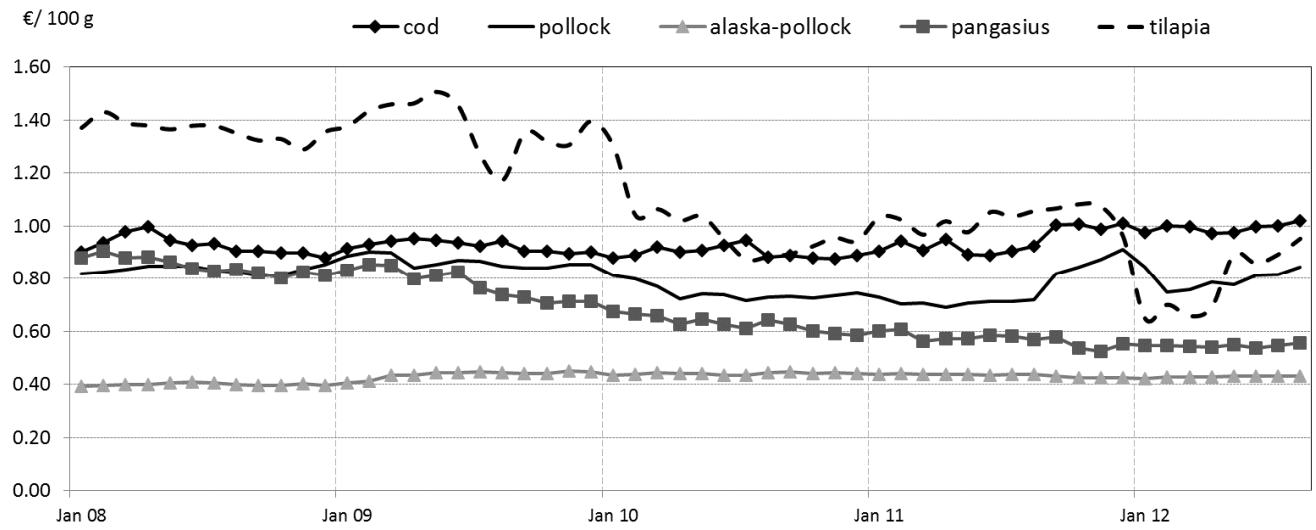
^a Revenue based

Source: Own calculations based on data from the SymphonyIRIGroup 2008-2012.

The figure 2.1 graphically depicts the development of the average monthly retail fish prices in € per 100 g fish. There are substantial variations in the average prices, which range from 0.43 € per 100g for Alaska pollock to 1.13 € per 100g for tilapia. The prices of the wild whitefish species cod, pollack and Alaska pollack are relatively stable over the period 2008 to 2012. However, the prices for the aquaculture species are more volatile⁸. As expected, price of pangasius ranges in the lower price segment: on average 0.68 € per 100 g. Interestingly, the price for tilapia ranges in the upper price segment: on average 1.12 € per 100g. Notice the major price drop first in 2010 and again in 2012.

⁸ This contradicts the finding in the literature that farmed fish prices in general are less volatile than wild fish prices (Dahl and Oglend, 2014; Asche et al., 2015).

Figure 2.1: Average Monthly Retail Fish Price in €/100 g, 2008-2012



Source: Own representation based on data from the SymphonyIRIGroup 2008-2012.

Covering a sample period of five years shifts in the structure and product assortment of the whitefish market may have influenced the consumer behavior. To control the assumption that consumer preferences change over the observed period, a linear time trend (T) is introduced to the model. F-tests confirm that there is a significant difference between the models with and without the trend for all equations, which verifies the use of the unrestricted model. Further, monthly dummy variables (D) are added to control for seasonality, which results in the final specification of the estimated equations:

$$w_{it} = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln p_{jt} + \beta_i \ln \left(\frac{x_t}{p_t} \right) + \tau_i T_t + \sum_{d=1}^{11} \delta_{id} D_{dt} + u_{it} \quad (2.9)$$

A seemingly unrelated regression (SUR) procedure is used for the dataset. The SUR-procedure adjusts for cross-equation contemporaneous correlation and takes the optimization process that underlies the demand system into consideration (Gallagher and Eakins, 2003). To avoid singularity issues, the demand system was estimated without the equation for tilapia.

2.5 Empirical Results

Table 2.4 shows that the explanatory power of the equation range from 0.225 to 0.831, thus each equation describes a considerable amount of the variability of each dependent variable.

Table 2.4: Goodness of Fit Statistics

Equation	RMSE	R ²	Chi ²	p-Value
Cod	0.019	0.831	1284.99	0.000
Pollock	0.043	0.552	329.82	0.000
Alaska-Pollock	0.030	0.497	549.31	0.000
Pangasius	0.053	0.225	346.02	0.000
Tilapia (omitted)	-	-	-	-

Source: Own calculations based on data from the SymphonyIRIGroup 2008-2012.

Table 2.5 presents the expenditure- and price elasticities. The expenditure elasticities for the five whitefish species are positive and highly significant at the 1 % level, indicating increasing consumption with higher expenditure on fish. Whitefish tends to be a normal good on the German market. The magnitudes range from 0.926 for pangasius to 1.074 for tilapia.

Table 2.5: Price and Expenditure Elasticities

	Cod	Pollock	Alaska-Pollock	Pangasius	Tilapia
<i>Expenditure Elasticities</i>	1.007***	1.246***	0.968***	0.926***	1.074***
<i>Uncompensated Price Elasticities</i>					
Cod	-1.032***	-0.061	0.022	0.022	-0.012
Pollock	-0.037	-1.099***	-0.052	-0.039	-0.02
Alaska-Pollock	0.011	0.021	-1.008***	-0.001	0.008
Pangasius	0.022	0.022	0.018	-0.990***	0.003
Tilapia	-0.066	-0.064	0.079	-0.015	-1.007***
<i>Compensated Price Elasticities</i>					
Cod	-0.901***	0.121***	0.480***	0.285***	0.016
Pollock	0.124***	-0.941***	0.514***	0.286***	0.016
Alaska-Pollock	0.137***	0.143***	-0.567***	0.252***	0.035***
Pangasius	0.142***	0.139***	0.439***	-0.748***	0.028***
Tilapia	0.073	0.071	0.567***	0.266***	-0.978***

***p < 0.01, **p < 0.05, *p < 0.10.

Source: Own calculations based on data from the SymphonyIRIGroup 2008-2012.

The uncompensated own-price elasticities are all negative and vary about unity, indicating a negative relationship between the prices of a normal good and its demand. According to Asche et al. (2009) the demand for most fish species is found to be elastic. In this study, we also found a relatively elastic demand for the examined whitefish species.

The demand for wild species is more elastic than the demand for species from aquaculture. The highest price sensitivity exists for pollack and cod, which is in line with previous studies indicating that more valuable fish has more elastic demand (Asche et al., 2009).

The estimated demand for frozen cod fillets is -1.032 and for frozen pollock fillet -1.099. These results are comparable with the study of Singh et al., (2012), the authors utilized scanner data for estimating the price elasticities of frozen cod and pollock, among others, on the U.S. market. They found own-price elasticities for cod of -1.10 and for pollock of -2.08.

Alaska Pollock and pangasius is found to be almost unitary own-price elastic. This is not surprising, because pangasius is a low-valued fish (Xie et al., 2009). The overall decline in prices is consistent with this finding. Increase in price does not result in significant declines in demand for these species. Also, low prices for pangasius are used to achieve access to this important international market (Asche et al., 2009).

The demand for frozen tilapia fillets is found to be -1.007 and slightly higher than in other markets. Dey et al. (2011) found an uncompensated own-price elasticity of -0.95 for tilapia in Bangladesh. Chidmi et al. (2012), also using retail scanner data, estimated an own-price elasticity of -0.773 for tilapia for the US market. Further, Singh et al. (2012) calculated an elasticity of -0.83 for frozen tilapia, also with the help of scanner data. Findings of Ligeon et al., (2007) indicate an own-price elasticity of frozen tilapia fillets imported from different countries between -0.96 and -0.14 for the U.S market. Norman-López and Asche (2008) reported own-price elasticity for frozen tilapia fillets of -0.689.

The compensated cross-price elasticities provide the pure substitution effect. As expected, all cross-price elasticities are positive, indicating substitutes. Most cross-price elasticities are statistically significant, with the exception of the relationships between tilapia and cod and pollock. However, tilapia is a substitute to the lowest priced wild species, Alaska pollock, as well as pangasius. Alaska pollock and pangasius have a relatively strong impact on all the

other species. For Alaska pollock this is not unexpected, because of its large market share. That pangasius has such a strong impact is more surprising, but clearly indicate that it has become an integrated part of the German whitefish market. The limited impact of tilapia can most likely be explained by its limited market share. As in many other studies, the income effect reverses the substitution effect, and the uncompensated cross-price elasticities are all close to zero.

2.6 Conclusions

The whitefish market has undergone significant changes in recent years. The better control of the production process has made aquaculture fish products a keen competitor of wild species. More and more different species from all over the world entered the whitefish market from the 1980s and made the market global, as well as having a substantial impact on the price determination process (Asche et al., 2009). Due to the large quantities produced at low production cost the farmed species are traded at a relatively low price level. As a result, frozen pangasius and tilapia fillets could for instance win market shares at the expense of traditional wild caught whitefish species like cod on different international markets.

The German whitefish market is a good example of how new farmed species have come to play an important role, although the main species in the globalization of the whitefish market, Alaska Pollock, still is the most important species. This study used retail scanner data from the SymphonyIRIGroup from 2008 to 2012 to analyze the demand for frozen whitefish fillets in Germany. The focus of the research lays on the substitution pattern between wild and farmed whitefish species. We model a LA/AIDS for five different whitefish species, cod, Alaska-pollock, pollock, pangasius and tilapia.

The German whitefish market heavily relies on imports. Since years, Alaska pollock has the highest market shares on the German market, reaching 45 % in the period under study. The revenue based market share of pangasius command the second highest market share at about 26 %. Contrary to the U.S. market, tilapia is not common on the German market, reaching just a revenue based market share of 3 %. The demand for wild species is slightly more elastic than the demand for farmed species. Estimated elasticities show that the expenditure elasticities for whitefish species are quite similar to unity, but lower for pangasius and Alaska

pollock. The own-price elasticities vary about -1. The results are conform to demand studies from other markets.

Concentrating on the compensating price elasticities, we found some interesting substitution pattern between the analyzed whitefish species. Overall, the whitefish species are substitutes and satisfy similar needs of the consumers. With regard to the relationship between farmed and wild species, we found that pangasius fillets are strong substitutes for the fillets of cod and pollock. Pangasius seems to be very competitive on the German market and the price-sensitive German consumers will buy more pangasius when the price of the wild caught species increases. Hence, pangasius is winning market shares on the German market and it is priced at a level that makes the products very interesting for consumers. This finding clearly indicates that pangasius has become an integrated part of the German whitefish market which is in line with other studies.

References

- Alston, J., & Chalfant, M. (1993). The silence of the lambdas: a test of the Almost Ideal and Rotterdam models. *American Journal of Agricultural Economics*, Vol. 75, 304-313.
- Anderson, J. (2002). Aquaculture and the future: why fisheries economists should care. *Marine Resource Economics*, Vol. 17, 133-151.
- Anderson, J., Asche, F., & Tveterås, S. (2010). World fish markets. In R. Grafton, R. Hilborn, D. Squires, M. Tait, & M. Williams, *Handbook of Marine Fisheries Conservation and Management* (pp. 113-123). Oxford: Oxford University Press.
- Asche, F., & Wessells, C. (1997). On Price Indices in the Almost Ideal Demand System. *American Journal of Agricultural Economics*, Vol. 79, 1182-1185.
- Asche, F., & Zhang, D. (2013). Testing structural changes in U.S. whitefish import market: an inverse demand system approach. *Agricultural and Resource Economics Review*, Vol. 42, 453-470.
- Asche, F., Bellemare, M., Roheim, C., Smith, M., & Tveterås, S. (2015). Fair enough? Food security and the international trade of seafood. *World Development*, Vol. 67, 151-160.
- Asche, F., Benneer, L., Oglend, A., & Smith, M. (2012). U.S. shrimp market integration. *Marine Resource Economics*, Vol. 27, 181-192.
- Asche, F., Bjørndal, T., & Salvanes, K. (1997). The demand for salmon in the European Union: The importance of product form and origin. *Canadian Journal of Agricultural Economics*, Vol. 46, 69-81.
- Asche, F., Bjørndal, T., & Young, J. (2001). Market interactions for aquaculture products. *Aquaculture Economics and Management*, Vol. 5, 303-318.
- Asche, F., Dahl, R., & Steen, M. (2015). Price volatility in seafood markets: Farmed vs' wild fish. *Aquaculture Economics and Management*, Vol. 19, 316-335.

- Asche, F., Roll, K., & Trollvik, T. (2009). New Aquaculture Species-The Whitefish Market. *Aquaculture Economics & Management, Vol. 13*, 76-93.
- Asche, F., Roll, K., & Tveterås, R. (2007). Productivity growth in the supply chain – another source of competitiveness for aquaculture. *Marine Resource Economics, Vol. 22*, 329-334.
- Chidmi, B., Hanson, T., & Nguyen, G. (2012). Substitutions between fish and seafood products at the US national retail level. *Marine Resource Economics, Vol. 27*, 359-370.
- Dahl, R., & Oglend, A. (2014). Fish price volatility. *Marine Resource Economics, Vol. 29*, 305-322.
- Deaton, A. S., & Muellbauer, J. (1980). An Almost Ideal Demand System. *American Economic Review, Vol. 70*, 359-368.
- Destatis. (2015). *Statistisches Bundesamt Wiesbaden*. Retrieved from <https://www-genesis.destatis.de/genesis/online/>
- Dey, M. M. (2000). Analysis of demand for fish in Bangladesh. *Aquaculture Economics and Management, Vol. 4*, 63-79.
- Dey, M. M., Yolanda, T. G., Kumar, P., Piumsombun, S., Haque, M. S., Luping, L., Koeshendrajana, S. (2008). Demand for Fish in Asia: A Cross-Country Analysis. *The Australian Journal and Resource Economics, Vol. 52*, 321-338.
- Dey, M., Alam, M. F., & Paraguas, F. (2011). A Multistage Budgeting Approach to the Analysis of Demand for Fish: An Application to Inland Areas of Bangladesh. *Marine Resource Economics, Vol. 26*, 35-58.
- EU. (2014). *European Parliament*. [http://www.europarl.europa.eu/RegData/etudes/note/join/2014/514010/IPOL-PECH_NT %282014 %29514010_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/note/join/2014/514010/IPOL-PECH_NT%282014%29514010_EN.pdf) abgerufen
- FAO. (2014). *The State of World Fisheries and Aquaculture 2014*. Rome: Food and Agriculture Organization of the United Nations.

- Gallagher, L., & Eakins, J. M. (2003). Dynamic Almost Ideal Demand Systems: An Empirical Analysis of Alcohol Expenditure in Ireland. *Applied Economics*, Vol. 35 No. 9, 1025-1036.
- Kobayashi, M., Msangi, S., Batka, M., Vannucci, S., Dey, M., & Anderson, J. (2015). Fish to 2030: The Role and Opportunity for Aquaculture. *Aquaculture Economics and Management*, Vol. 19, 282-300.
- Lariviere, E., Larue, B., & Chalfant, J. (2000). Modeling the Demand for Alcoholic Beverages and Advertising Specifications. *Agricultural Economics*, Vol. 22, 147–162.
- Ligeon, C., Bayard, B., Clark, J., & Jolly, C. (2007). U.S. Import Demand for Tilapia from Selected FTAA Countries. *Farm & Business: The Journal of the Caribbean Agro-Economic Society*, Vol. 7, 139-156.
- Nguyen, G., Hanson, T., & Jolly, C. (2013). A demand analysis for crustaceans at the U.S. retail store level. *Aquaculture Economics and Management*, Vol. 17, 212-227.
- Nielsen, M., Setälä, J., Laitinen, J., Saarni, K., Virtanen, J., & Honkanen, A. (2007). Market integration of farmed trout in Germany. *Marine Resource Economics*, Vol. 22, 199-214.
- Norman-López, A. (2009). Competition between different farmed and wild species: the US tilapia market. *Marine Resource Economics*, Vol. 24, 237-251.
- Norman-López, A., & Asche, F. (2008). Competition between imported tilapia and US catfish in the US market. *Marine Resource Economics*, Vol. 23, 199-214.
- Norman-López, A., & Bjørndal, T. (2008). Is tilapia the same product worldwide or are markets segmented? *Aquaculture Economics & Management*, Vol. 13, 138-154.
- Park, S., Davidson, K., & Pan, M. (2012). Economic relationships between aquaculture and capture fisheries in the Republic of Korea. *Aquaculture Economics & Management*, Vol. 16, 102-116.
- Roheim, C., Sudhakaran, P. O., & Durham, C. (2012). Certification of shrimp and salmon for best aquaculture practices: assessing consumer preferences in Rhode Island. *Aquaculture Economics and Management*, Vol. 16, 266-286.

- Singh, K., Dey, M. M., & Surathkal, P. (2012). Analysis of a demand system for unbreaded frozen seafood in the United States using store-level scanner data. *Marine Resource Economics*, Vol. 27, 371-387.
- Singh, K., Dey, M., & Surathkal. (2014). Seasonal and spatial variations in demand for and elasticities of fish products in the united states: an analysis based on market-level scanner data. *Canadian Journal of Agricultural Economics*, Vol. 62, 343-363.
- Tveterås, S., Asche, F., Bellemare, M., Smith, M., Guttormsen, A., Lem, A., Vannuccini, S. (2012). *Fish is food-the FAO's fish price index*. From PLoS ONE 7(5): e36731. doi:10.1371/journal.pone.0036731.
- Wessells, C., Johnston, R., & Donath, H. (1999). Assessing consumer preferences for ecolabeled seafood: the Influence of species, certifier and household attributes. *American Journal of Agricultural Economics*, Vol. 81, 1084-1089.
- Xie, J., & Myrland, Ø. (2011). Consistent aggregation in fish demand: a Study of French salmon demand. *Marine Resource Economics*, Vol. 26, 267-280.
- Xie, J., Kinnucan, H., & Myrland, Ø. (2008). The effects of exchange rates on export prices of farmed salmon. *Marine Resource Economics*, Vol. 23, 439-457.
- Xie, J., Kinnucan, H., & Myrland, Ø. (2009). Demand elasticities for farmed salmon in world trade. *European Review of Agricultural Economics*, Vol. 36, 425-445.

3. Kapitel

Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood in Germany: An Application of QUAIDS Modeling with Correction for Sample Selection

Autoren:

Julia Bronnmann, Jens-Peter Loy und Karen J. Schröder

Dieser Artikel ist veröffentlicht in:

Marine Resource Economics, 2016, Vol. 31(3), DOI: 10.1086/686692, Published online April 21, 2016.

Eine auf dem Beitrag basierende Präsentation wurde auf der European Association of Fisheries Economics (EAFE) 2013 Konferenz in Edinburgh, Scotland vorgestellt.

Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood in Germany: An Application of QUAIDS Modeling with Correction for Sample Selection

JULIA BRONNMANN, JENS-PETER LOY UND KAREN J. SCHRÖDER

Abstract

The production of farmed fish is growing rapidly and presents a sustainable and possibly low-cost alternative to wild fish. Thus, we may expect retail prices of farmed to be lower than prices of wild fish and demand to be less elastic. Otherwise, marketing of farmed fish may generate some extra value that justifies higher prices and may exhibit more elastic demand. To test these hypotheses, we employ monthly household scanner panel data for Germany from 2006 to 2010 for six frozen seafood products that include farmed and wild fish. A QUAIDS model is estimated by a consistent two-step procedure to account for censoring of the dependent variable. We find consumers to be price sensitive, particularly with regard to the high-value seafood species salmon and shrimp. This price elastic market implies that the German seafood industry still has the potential for growing revenues if production increases.

Keywords: Aquaculture, QUAIDS, fish demand, price elasticities, consumer scanner panel data

JEL Classification Codes: C32 C33 D12 Q22

3.1 Introduction

The global market for fish has undergone significant changes in recent years. The worldwide population growth and associated increase in food demand, as well as the overfishing of several key marine stocks, have affected both the supply and demand of food and fish (Smith et al., 2010). Aquaculture, or farmed fish production, is one alternative to meet the increasing demand with respect to the production of fish. Over the last decades, the share of farmed fish has been rapidly increasing, and today it provides an almost equal share of seafood for human consumption. The improved competitiveness of farmed fish production and demand growth made aquaculture the fastest growing food production sector (FAO, 2014), and the importance of farmed seafood in international trade has grown even larger (Valderrama and Anderson, 2009; Asche et al., 2015). According to Anderson (2002), growth in aquaculture production leads to a decline in prices of both farmed fish and closely related wild species. The most important competitive advantage of aquaculture is the ability to increase production in response to market demand, and accordingly aquaculture has an impact on a number of seafood markets (Asche et al., 2009). Fish farming also allows greater flexibility in harvesting and control of production costs (Anderson, 2002; Asche, 2008). Farmers can pace harvests in response to expected changes in price and costs (Xie et al., 2009). This control can be used to achieve better market timing, improve valuable attributes, and generate more efficient logistics and sales (Guttormsen, 1999; Anderson, 2002; Forsberg and Guttormsen, 2006; Asche et al., 2007; Kvaløy and Tveterås, 2008) thereby increasing profits of culture operations.

For some species, consumers have the choice between farmed and wild seafood. But knowledge of the demand structure and consumers' preferences regarding seafood from both production technologies is limited and, so far, only from stated preference data (Roheim et al., 2012). Consumers' reaction to price changes of fish originating from different sources is largely unexplored, and using market data as a production mode in general is not available. In this article we use a household data set for the German seafood market, which also provides information on the production mode for the different species. The main objective is to investigate potential differences in consumption behavior with respect to price changes of fish from capture fisheries or aquaculture. The species studied are salmon, shrimp, pangasius, and redfish. Salmon and shrimp are available both as wild and farmed and are examples of relatively high-valued seafood. They are one of the most widely traded species

in international markets for farmed seafood with production increasing significantly over the last years (Anderson, 2002; Asche et al., 2009). Farmed salmon now represents two-thirds of world salmon supply, and farmed shrimp represents more than half of the world's shrimp supply (Knapp et al., 2007; Asche et al., 2012). On the other hand, the whitefish market is one of the largest segments in the international seafood market. Since redfish is a common species in this market (Asche et al., 2004), and pangasius has received substantial attention as a new aquacultured species in the whitefish market (Norman-López and Asche, 2008; Asche et al., 2009), these two species are also included in our analysis.

There exists a large number of international studies that have estimated demand systems for seafood products, including Xie et al. (2008, 2009); Dey et al. (2011); Xie and Myrland (2011); Chidmi et al. (2012); and Thong (2012). Other studies address the demand for fish species using market integration studies (e.g. Nielsen et al., 2009; Valderrama and Anderson, 2009; Norman-López and Asche, 2008; Asche et al., 2012). In addition, some stated preference studies show that consumers have preferences for wild fish and choose wild products over farmed (Wessells et al., 1999; Roheim et al., 2012). Studies about consumers' responses to price changes of fish products in the German market are scarce. In the last 30 years, only two studies explicitly investigated the demand for fish in Germany, (Ryll, 1984 and Sommer, 1985), while Wildner (2001) and Hoffmann (2003) include fish within an array of products under a demand system.

In this study, a scanner panel data set on household food purchase in Germany over the period from January 2006 to December 2010 is used to analyze the demand for fish in Germany. The use of scanner data for estimating food demand models is possible via European Article Number Codes (EAN-Code) on retail packages (Haller, 1994; Singh et al., 2012) and is useful for understanding food marketing (Roheim et al., 2007). While the utilization of scanner data for food demand analyses has become increasingly popular, only a few authors studied the demand for seafood using scanner data, particularly in the US (Capps and Lambregts, 1991; Wessells and Wallstrom, 1999; Chidmi et al., 2012; Singh et al., 2012; Nguyen et al., 2013; Singh et al., 2014).⁹ In general, scanner data is comprised revealed preference information that provides evidence of actual market choices, allowing for the estimation of observed price, income and cross-price elasticities for both wild and

⁹ The authors are unaware of similar studies for the German fish market.

farmed fish, and seafood product types in the same demand system. In this study, we use the Quadratic Almost Ideal Demand System (QUAIDS) model proposed by Banks et al., (1997) for the specification of a demand system and for calculating price and income elasticities. The advantage of the QUAIDS is that it is of rank three and allows more flexibility in modelling the curvature of Engel curves, thus characteristics of goods (i.e., luxuries, necessities) can vary at different levels of total expenditure (Xie et al., 2004).

The outline of the article is as follows: The next section describes fish and seafood production and consumption in Germany over time. The modeling procedures are presented in the following section. Then the dataset and the data management process are described. Estimation results are presented and discussed afterwards. Finally, the paper is summarized and some concluding remarks are drawn.

3.2 Fish Production and Consumption in Germany

According to the German Federal Statistical Office the fish and seafood market in Germany heavily relies on foreign suppliers (Destatis, 2015). In 2013, the total supply of fish and seafood products in Germany amounted to 2 million tons (catch weight), of which around 88 % was imported. Germany's seafood imports included mainly frozen fish fillets but also smoked salmon, fresh salmon, frozen shrimp, and other fresh fish. In 2013, fish imports reached a volume of 1.79 million tons with a value of 3.65 billion Euros. The largest supplying countries were Poland, China, Norway, and Denmark. Currently, Norway supplies nearly 11 % of the market value. Moreover, a large amount of low-price fish such as preserves of fish and marinades are imported from Poland (nearly 17 % of the imported values). On the other hand, in 2013 fish export volumes by German companies totaled approximately 949,651 tones (Destatis, 2015).

Within the last few years, a variety of seafood entered the German market and the fish market shows a high degree of product differentiation. Nonetheless, per-capita consumption of fish in Germany has been stagnant since 2000, while global per-capita consumption is increasing steadily. In 2013, per-capita consumption fell slightly from 14.8 kg in 2012 to 13.7 kg (FAO, 2014; Destatis, 2015). This is in contrast to the increasing global trend in per-capita consumption that averaged 19.7 kg in 2012 (FAO, 2014).

One major characteristic of the German fish market is the high demand for frozen fish (31 % of per-capita consumption) compared to preserves and marinades of fish (25 %), crustaceans and mollusks (17 %), fresh fish (9 %), smoked fish (9 %), fish salad (2 %) and other fishes (7 %). The five main types of seafood consumed in Germany are Alaska pollock, herring, salmon, tuna, and pangasius. While fresh fish is purchased mostly in specialized fish shops, more than half of seafood purchases are from supermarkets. Frozen fish is widely, available as most supermarkets do not have fresh fish departments (Destatis, 2015).

3.3 The QUAIDS Framework

In this article, the QUAIDS model proposed by Banks et al., (1997) is used for the specification of the fish and seafood demand system in order to derive income as well as own-price and cross-price elasticities. The QUAIDS model is an extended form of the Almost Ideal Demand System (AIDS), developed by Deaton and Muellbauer (1980), as the AIDS approach has been criticized for yielding biased and inconsistent estimates (Asche and Wessells, 1997). Since empirical research indicated that Engel curves are not always linear (Lewbel, 1991; Blundell et al., 1993), Banks et al. (1997) improved the AIDS by adding a quadratic expenditure term to the model, which led to the QUAIDS model. It is an acknowledged model in fisheries demand studies (e.g., Dey, 2000; Kumar and Dey, 2004; Dey et al., 2008; Dey et al., 2011) and is described by:

$$w_i^h = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln(p_j) + \beta_i \ln \left\{ \frac{E}{a(p)} \right\} + \frac{\theta_i}{b(p)} \ln \left\{ \frac{E}{a(p)} \right\}^2 + \varepsilon_i, \quad (3.1)$$

where

$$\ln a(p) = \alpha_0 \sum_{i=1}^n \alpha_i \ln(p_i) + \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n \gamma_{ij} \ln(p_i) \ln(p_j) \quad (3.2)$$

and

$$b(p) = \prod_{i=1}^n p_i^{(\theta_i)}, \quad (3.3)$$

where w_i^h denotes the budget share of the h^{th} household for the i^{th} commodity, resulting in six budget share equations for each species under study. p_j is the price of seafood group j . E is the total consumption expenditure of the German households on seafood; $\alpha_0, \alpha_i, \beta_i, \theta_i$,

and γ_{ij} are parameters to be estimated. β_i measures the linear income effect and γ_{ij} measures the non-linear effect of income. $\ln(p_i)$ is calculated as the Stone price index ($\ln(p_i) = \sum_{i=1}^n w_i \ln(p_i)$), with the prices p_i of the good i .

In order to reduce the number of parameters to be estimated and for theoretical consistency (i.e. that the consumer is a utility maximizer), we impose the following restrictions.

Adding up, this imposes that the budget shares sum up to unity, implying the following:

$$\sum_{i=1}^n \alpha_i = 1, \quad \sum_{i=1}^n \beta_i = 0, \quad \sum_{i=1}^n \gamma_{ij} = 0. \quad (3.4)$$

Homogeneity of degree zero in prices and total expenditure requires:

$$\sum_{j=1}^n \gamma_{ij} = 0, \quad \sum_{j=1}^n \theta_i = 0, \quad \forall i, \quad (3.5)$$

and

the Slutsky symmetry, which deals with the substitution effect between commodities, is satisfied by:

$$\gamma_{ij} = \gamma_{ji}, \quad \forall i \neq j \quad (3.6)$$

and restricts the matrix of substitution effects to be symmetric. This means that the coefficient of the price of good i ($\ln p_i$) has the same value in the budget share equation of good j (w_j) as the coefficient of ($\ln p_j$) in w_i (Deaton and Muellbauer 1980). To account for household heterogeneity, we add socioeconomic variables (hc_h) and a trend to each equation. This is common with household data and can be found in several studies estimating food (i.e. Abdulai, 2002; Schröck, 2012) and seafood demand (i.e., Salvanes and DeVoretz, 1997; Garcia et al., 2005; Xie et al., 2009; Dey et al., 2011).

The equation to be estimated with the demographic variables and the trend incorporated is then given as:

$$w_i^h = \alpha_i + \sum_{j=1}^J \gamma_{ij} \ln(p_j) + \beta_i \ln \left\{ \frac{E}{a(p)} \right\} + \frac{\theta_i}{b(p)} \ln \left\{ \frac{E}{a(p)} \right\}^2 + \sum_{h=1}^H \tau_{ih} hc_h + \delta_i trend + \varepsilon_i. \quad (3.7)$$

3.4 Data and Empirical Specification

The data used in this study are taken from a German homescan panel dataset on food purchases of households (ConsumerScan, which was provided by the ‘Gesellschaft für Konsumforschung’ (GfK) in Germany (the largest consumer research company in Germany) and covers the period 2006 to 2010. The ‘ConsumerScan’ Panel is representative with respect to households in Germany.¹⁰ On a daily basis households scan their food purchases, the point and date of purchase, several product characteristics (e.g., brand), as well as the European Article Number Code (EAN-Code) at home, using a handheld scanner. In other words, the households record the total amount (EUR) spent on a specific EAN in one purchase trip and add the number of units purchased of each item. Furthermore, the dataset includes information on various sociodemographic information, such as household net income, age of the household head, and household size.

The seafood species under study can clearly be identified by means of the EAN codes, which also distinguish between farmed (aquaculture) and wild harvested.¹¹ In this study, we aggregated the purchase data to the household level; the EANs are aggregated with reference to the fish species. For each household, seafood consumption is aggregated monthly within six subgroups. Only those households with at least one observation per year are considered. The final sample consists of 4,207 households and 43,540 purchases.¹² To reiterate, the data we are using in estimation is monthly household purchases of farmed salmon, wild salmon, farmed shrimp, wild shrimp, redfish, and pangasius.

Aggregating to the monthly household level does not allow us to avoid the problem of zero consumption of a particular commodity. This represents a sample selection problem and we deal with this potential bias using a two-step estimation procedure based on Shonkwiler and Yen (1999). Further, a hedonic price function based on Cox and Wohlgenant (1986) is used to overcome the problem of missing and insufficient price information.

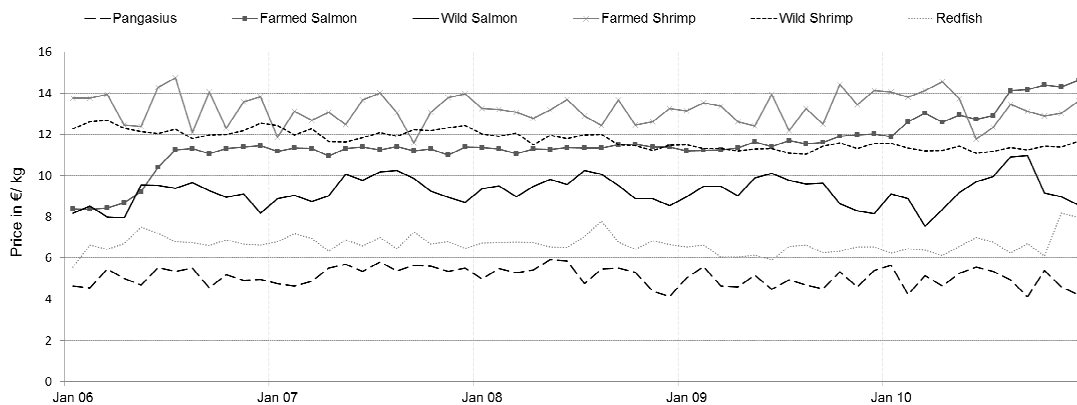
¹⁰ The households in the GfK ConsumerScan panel consist of a stratified random sample, based on a geographical and demographic objective. Satisfaction ensures that the sample represents the sociodemographic profile of consumers in Germany according to the German micro census.

¹¹ This information was not given for all products in the data. When not included, we obtain information about the origin of the seafood from specific manufacturers. Products are only included if we have specific information regarding its source.

¹² During the period under study some households entered and others left the panel. In 2006 the panel included 2,886 households, in 2007 3,172, in 2008 3,058, in 2009 2,956, and in 2010 the panel consisted of 2,397 households.

The study analyzes frozen fillets of salmon, redfish, and pangasius as well as frozen wild and farmed shrimp, as this is the most consumed product form on the German fish market (Destatis, 2015). In Germany, packaged and processed frozen fish is more widely available than fresh fish (FIZ, 2012). Due to convenience, demand for frozen fish fillets has increased significantly. The selected fish species make a significant share of the German market (FIZ 2012). Figure 3.1 shows the average monthly nominal fish prices in Germany from January 2006 to December 2010.

Figure 3.1: Monthly Fish Prices from 2006-2010 in € per kg



Source: Own representation based on GfK (2011).

Figure 3.1 shows relatively stable prices of around 4 Euro per kg for pangasius and around 6 Euro per kg for redfish. Prices for salmon and shrimp are higher at above 10 Euro per kg. Farmed salmon and shrimp are priced above wild salmon and shrimp. At the beginning of 2006, farmed and wild salmon prices were around 8 Euro per kg. Since mid-2010, the price for farmed salmon has been higher than that of farmed shrimp, at about 14 Euro per kg.

Farmed shrimp is the most expensive and most volatile product under study with price varying from 12 to 14 Euro per kg and a standard deviation of 5.76. The price of wild shrimp shows far less variation with a standard deviation of 2.32 and a decrease of 5 % over time.

3.5 Unit Values and Zero Observations

GfK provides purchases (of products) and total expenditures (E) for each household and each EAN-product; thus commodity prices are not provided by the data and are calculated

by dividing the value by the volume (q) (unit values $UV = \frac{E}{q}$). The price calculated this way is household specific, representing household purchase decisions. Thus, each price of the seafood groups under study is a weighted average price on specific items faced by the household. All prices for the six categories are converted to Euro per kg and aggregated on a monthly basis. Products within the six categories may show quality differences. In accordance to Cox and Wohlgenant (1986), we therefore adjust prices for quality differences by using the following hedonic price function to account for endogeneity, which is calculated for each of the goods $i = 1, \dots, n$:

$$UV_i = \delta_i + \sum_{c=1}^n C_{ic} + \varepsilon_i, \quad (3.8)$$

where UV_i is the unit value of the i^{th} commodity, δ_i denotes the mean unit value reflecting unit value differences due to supply factors, C_{ic} are several quality characteristics of good i ($c = 1, \dots, n$), and the error term ε_i is linked with the i th unit value equation. Instead of quality characteristics, selected sociodemographic characteristics are used as proxy variables (Cox and Wohlgenant, 1986). This procedure is commonly found in the literature to generate quality adjusted prices (e.g., Park et al., 1996; Park and Capps, 1997; Fourmouzi et al., 2012).

In our analysis we use the variables income, household size (HHSIZE), age of the household head (AGE), as well as the following dummy variables, if kids are living in the household (FAMILY KIDS), if it is a single household (SINGLE), if the household head is employed (EMPLOYED), if the region where the household is located is rural (RURAL) and to which area of Germany the location belongs (EAST, WEST, NORTH), and in which quarter of the year the purchase was made (Q1, Q2, Q3). The descriptive statistics of the variables are summarized in table 3.1. The geographical location of the households is calculated with the help of postal codes. In figure A3.1 the postal codes are shown graphically.

The average household has two members and a monthly income of 2,558 Euro. Twenty-five percent of the households live in Northern regions, 12 % live in Eastern regions, 32 % live in Western regions and 31 % in Southern regions. Most of the households (71 %) live in rural areas with less than 100,000 inhabitants. More than half (60 %) of the households live

together as a family, where 18 % are singles and 22 % have no children. The percentage of unemployed people, including retired persons, is 35 % in the dataset under study.

Table 3.1: Variables and their Descriptive Statistics

Variable	Description	Mean	Std. Dev
Farmed salmon	Price €/kg (quality adjusted (QA))	9.04	2.85
	Expenditure share	0.36	0.47
Wild salmon	Price €/kg (QA)	6.14	1.31
	Expenditure share	0.22	0.41
Farmed shrimp	Price €/kg (QA)	11.99	2.79
	Expenditure share	0.19	0.38
Wild shrimp	Price €/kg (QA)	10.49	1.36
	Expenditure share	0.13	0.33
Redfish	Price €/kg (QA)	6.40	0.72
	Expenditure share	0.08	0.27
Pangasius	Price €/kg (QA)	4.58	0.19
	Expenditure share	0.02	0.13
Income	Monthly household net income	2558.38	890.66
Hhsize	Number of persons living in the household	2.63	1.1
Age	Age of the household head	49.96	13.69
Couples no kids (base)	Dummy variable, 1= couple, married without kids	0.22	0.41
Family kids	Dummy variable, 1= couple, married with kids	0.60	0.50
Single	Dummy variable, 1= single	0.18	0.40
Unemployed (base)	Dummy variable, 1= household head is unemployed	0.35	0.48
employed	Dummy variable, 1= household head is employed	0.65	0.48
Urban (base)	Dummy variable, 1=household living in an area > 10,000 inhabitants	0.30	0.46
	Dummy variable, 1=household living in an area < 10,000 inhabitants	0.71	0.46
south (base)	Dummy variable, 1= the South of Germany, postal codes 8,9	0.31	0.46
East	Dummy variable, 1= the East of Germany, postal codes 0,1	0.12	0.32
West	Dummy variable, 1= the West of Germany, postal codes 5,6,7	0.32	0.43
North	Dummy variable, 1=the North of Germany, postal codes 2,3,4	0.25	0.43
Q1	Dummy variable, 1=first quarter (Jan.-March)	0.27	0.45
Q2	Dummy variable, 1= second quarter (April-June)	0.25	0.43
Q3	Dummy variable, 1= third quarter (July-Sept.)	0.22	0.42
Q4 (base)	Dummy variable, 1= fourth quarter (Oct.-Dec.)	0.26	0.44

Source: Own calculations based on GfK (2011).

The quality adjusted price, \hat{p}_i , for each seafood species, which is used in the estimation of the QUAIDS, is then generated by adding the constant δ_i to the error term derived from each commodity regression:

$$\hat{p}_i = \delta_i + \hat{\varepsilon}_i \quad (3.9)$$

where $\hat{\varepsilon}_i$ are the residuals from the regression of the unit value equations. The regression results from the unit value equations are presented in table A3.1.¹³

In case of zero consumption the dependent variable (budget share) is zero as well. A zero may result from an income restriction or a non-preference (corner solution) (Park et al., 1996; Gibson and Kim, 2011). For the data set used here, zero observations are frequent and not uniformly distributed across species. Household aggregates show 85 % purchased farmed salmon at least once per year, 45 % purchased wild salmon, 52 % purchased wild shrimp, 41 % purchased farmed shrimp, 32 % purchased redfish, and only 5 % purchased pangasius. To tackle this issue, an approach by Shonkwiler and Yen (1999) is employed. The consistent-two-step-estimation (CTS) is a further development of the estimation procedure of Heien and Wessells (1990), which is frequently used in empirical studies (e.g., Yen et al. 2002; Yen and Lin 2003; Lambert et al. 2006; Akbay et al. 2007).

In the first step, a probit model is used to predict household propensity to purchase a particular seafood species. The model is based on a probit link and written:

$$\Pr(Y_{iht} = 1 | (p_{iht}, p_{jht}, Z_i)) = \Phi(p_{iht}, p_{jht}, Z_i, \beta), \quad (3.10)$$

where Y_{iht} is 1 if household h consumes good i within each year and 0 otherwise. The vector Z_i includes household variables that affect the buying decision, p_{jht} are cross prices, and Φ is the CDF of the normal distribution. β is a vector of parameter estimates. In the probit regressions, the same variables are included in the regression for the quality adjustment of the prices. The estimated parameters are shown in table A3.2.

¹³ The R^2 of the regressions are very low. However, small magnitudes are also found in Cox and Wohlgenant (1986), Abdulai (2003), and Fourmouzi, Genius, and Midmore (2012). In general, quality adjusting has only a small impact on the prices of the goods in the unit value regression (Cox and Wohlgenant 1986).

The results of the first step, the probability density function of the standard normal distribution $\phi(z_i\rho_i)$ and the cumulative density function of the standard normal distribution $\Phi(z_i\rho_i)$, are now included in the final specification of the demand system:

$$w_i^h = \Phi(z_i\rho_i) \left[\alpha_i + \sum_{j=1}^n \gamma_{ij} \ln(p_j) + \beta_i \ln \left\{ \frac{E}{a(p)} \right\} + \frac{\theta_i}{b(p)} \left\{ \frac{E}{a(p)} \right\}^2 \right] + \sigma\phi(z_i\rho_i) + \sum_{h=1}^n \tau hc_h + \delta_i trend + \varepsilon_i, \quad (3.11)$$

where ρ_i is the vector of coefficients estimated by the probit analysis and σ_i is a parameter to be estimated and indicates if the estimation of the demand system without the correction factor for treating zero observations would have been biased.

To derive the budget elasticities, e_i , and price elasticities, e^u and e^c , from CTS estimation, we employ the following calculations:

$$e_i = \Phi(z_i\rho_i) * \mu_i/w_i + 1, \quad (3.12)$$

$$e_{ij}^u = \Phi(z_i\rho_i) * \mu_{ij}/w_i - \delta_{ij} \quad \text{where: } \begin{pmatrix} \delta_{ij} = 1 & \text{if } i = j \\ \delta_{ij} = 0 & \text{if } i \neq j \end{pmatrix}, \quad (3.13)$$

$$e_{ij}^c = e_{ij}^u + e_i w_j. \quad (3.14)$$

The error term in equation 11 may indicate heteroskedasticity due to the incorporation of Φ and ϕ (Shonkwiler and Yen, 1999). In this case we calculate heteroskedastic-robust standard errors for the parameters and elasticities. The n equations of the QUAIDS are estimated simultaneously with the nonlinear seemingly unrelated regression (SUR) procedure developed by Poi (2008). The SUR procedure adjusts for cross-equation contemporaneous correlation and takes the optimization process that underlies the demand system into consideration (Gallagher and Eakins, 2003). Imposed by the adding up restriction (4), the budget shares, w_i^j , sum up to one for each observation period, t . Thus, one of the six budget shares is omitted in the estimation model. The estimator is invariant to which of the equations is dropped since no information will be lost due to linear dependency (Barten, 1968). In this study, we exclude the equation for ‘pangasius’. The parameters for the ‘pangasius’ equation are calculated using the adding-up restriction (equation 4).

In the QUAIDS, the household size (HHSIZE) as well as the age of the household head (AGE) is included (table 3.1).

3.6 Results

The estimation results of the demand system are reported in table 3.2. First, almost all of the estimated parameters are statistically different from zero. Additionally, the significant sigma-coefficient, σ_i , indicates that we correctly use CTS to prevent biased estimates in all instances of the demand system.

Table 3.2: Estimation Results of the QUAIDS from 2006 to 2010

		Farmed salmon	Wild salmon	Farmed shrimp	Wild shrimp	Redfish	Pangasius
Constant	α_i	-1.859*** (-7.82)	-2.348*** (-10.84)	-2.940*** (-12.34)	-2.671*** (-5.62)	25.369*** (-16.3)	-14.553*** (-9.76)
Expenditures	β_i	-14.553*** (-9.76)	-0.146*** (-9.61)	-0.272*** (-11.94)	-0.067* (-13.36)	-0.019 (-0.25)	0.707*** (-10.56)
Price farmed salmon	γ_{i1}	-0.226*** (-6.10)	0.378*** (8.99)	0.428*** (7.44)	0.445*** (8.13)	-0.565*** (-3.13)	-0.460*** (-3.79)
Price wild salmon	γ_{i2}		-0.020 (-0.27)	0.313*** (7.01)	0.595*** (6.89)	-3.034*** (-12.83)	1.768*** (-7.77)
Price farmed shrimp	γ_{i3}			-0.074 (-0.72)	0.457*** (4.08)	-2.104*** (-6.55)	0.981*** (-3.94)
Price wild shrimp	γ_{i4}				-1.809*** (-9.65)	0.126 (-0.26)	0.185 (-0.51)
Price redfish	γ_{i5}					0.171 (-0.10)	5.407*** (-5.55)
Price pangasius	γ_{i6}						-8.801*** (-8.95)
Quadr. Expenditures	λ_i	0.021*** (6.70)	0.001*** (2.82)	0.031*** (8.35)	0.030*** (2.88)	0.050*** (-5.04)	0.012*** (-8.88)
Demographics	τ_{1i}	0.009*** (3.13)	0.002 (0.72)	-0.130*** (-2.52)	-0.071*** (-5.80)	-0.795*** (-15.16)	0.868*** (-17.23)
phi	σ_i	1.013*** (13.24)	0.990*** (25.38)	1.417*** (44.63)	2.636*** (20.68)	-1.592*** (-4.65)	-4.436*** (-12.16)

*** p<0.01; ** p<0.05; * p<0.10.

z-statistics in parentheses

Source: Own estimations based on GfK (2011).

The goodness-of-fit statistics, as well as their associated p-values, are presented in table 3.3. The fitted model explains 19 to 43 % of the variance. Compared to other studies using scanner data, we calculated a smaller R^2 for some of the equations in this study, which may

be explained partly by the large number of zero observations. The model in the study of Nguyen et al. (2013) reports an R^2 of 44 to 57 % for shrimp and crab and an R^2 ranging from 30 to 44 % for crawfish and lobster. In Singh et al. (2014) the fitted model explains 49 to 89 % variation in the share equations.

Table 3.3: Standard Errors and Goodness-of-fit Statistics for the QUAIDS

Equation	RMSE	R^2	p-value
Farmed salmon	0.447	0.430	0.000
Wild salmon	0.369	0.363	0.000
Farmed shrimp	0.354	0.317	0.000
Wild shrimp	0.309	0.233	0.000
Redfish	0.253	0.187	0.000
Pangasius	Omitted	-	-

Source: Own estimations based on GfK (2011).

To address the economic interpretation of the estimated parameters, we derive expenditure, uncompensated, and compensated price elasticities. Table 3.4 shows the results. The expenditure elasticities for the six seafood species are positive and significant ($p < 0.01$). The magnitude varies from 0.837 for farmed shrimp to 1.015 for pangasius. Thus, salmon, shrimp, redfish, and pangasius appear to be normal goods. These findings indicate increasing consumption with higher expenditure on seafood. The expenditure elasticities for all seafood species give a result close to one. The expenditure elasticity obtained for farmed and wild shrimp is consistent with reported results in Nguyen et al. (2013) (a reported value of 0.823).

The own-price elasticities (uncompensated and compensated) show the expected negative signs and are statistically significant, indicating a negative relationship between the prices of a normal good and its demand. The demand for wild shrimp indicates the highest price elasticity in absolute terms (-2.051), and redfish shows the least responsiveness (-0.751) to price changes. Except for redfish, demand is found to be price elastic ($|\epsilon| > 1$). Demand for most seafood species in other studies is also found to be elastic (Asche et al., 2005). In general, salmon received the most attention in various demand studies for different markets. Following Asche et al. (2005), the demand elasticity for salmon varies. However, most estimates are close to -1. The present study shows an uncompensated own-price elasticity of -1.350 for farmed salmon and -1.359 for wild salmon, which is higher than in other studies.

3. Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood

Even though the price for farmed salmon is higher than for wild salmon, the demand elasticities for wild and farmed salmon do not vary.

Table 3.4: Expenditure Elasticities and Price Elasticities of Fish Species, 2006 to 2010

	Farmed Salmon	Wild Salmon	Farmed Shrimp	Wild Shrimp	Redfish	Pangasius
<i>Expenditure Elasticities</i>	0.875 ***	0.852 ***	0.837 ***	0.963 ***	0.990 ***	1.015
Uncompensated Price Elasticities						
Farmed salmon	-1.350 ***	0.020 **	-0.019	-0.035	2.329 ***	-1.995 ***
Wild salmon	0.077 ***	-1.359 ***	-0.215 ***	-0.047	1.118 ***	-0.634 **
Farmed shrimp	0.034 ***	-0.198 ***	-1.526 ***	-0.257 ***	2.407 ***	-1.526 ***
Wild shrimp	0.181 ***	0.221 ***	0.126 ***	-2.051 ***	0.889 **	-0.381
Redfish	-0.168 ***	-0.860 ***	-0.060 ***	0.006	-0.751 ***	1.379 ***
Pangasius	0.009 ***	0.078 ***	0.069 ***	0.055 ***	-0.224 ***	-1.004 ***
Compensated Price Elasticities						
Farmed salmon	-1.035 ***	0.212 ***	0.145 ***	0.080 **	2.401 ***	-1.879 ***
Wild salmon	0.384 ***	-1.172 ***	-0.054 **	0.064	1.188 ***	-0.361 **
Farmed shrimp	0.335 ***	-0.014	-1.367 ***	-0.147 ***	2.477 ***	-1.210 ***
Wild shrimp	0.528 ***	0.433 ***	0.308 ***	-1.924 ***	0.980 **	-0.363
Redfish	0.189 ***	-0.642 ***	-0.421 ***	0.137	-0.669 ***	1.397 ***
Pangasius	0.375 ***	0.301 ***	0.261 ***	0.188 ***	-0.141 ***	-0.984 ***

***p< 0.01, **p< 0.05, *p< 0.10. (All elasticities are computed at the mean of the data.)

Source: Own estimations based on GfK (2011).

The demand for farmed shrimp is -1.526 and similar to elasticities in other markets. Doll (1972); Singh et al. (2011), and Singh et al. (2012) find an own-price elasticity of almost -1 for shrimp in the US Nguyen et al. (2013) estimated an own-price elasticity of -1.585. The calculated demand for wild shrimp is slightly higher (-2.051) and accordingly German consumers are more sensitive to changes in prices of wild shrimp. The finding for shrimp is in line with previous studies, indicating that more valuable seafood has more elastic demand (Asche et al., 2009).

The estimated demand for redfish is inelastic (-0.751) and similar to the finding of Tsoa et al. (1982), who estimated an own-price elasticity for redfish fillets of -0.70 in the US market. For pangasius, which is a relative new aquaculture species, the estimated own-price elasticity is nearly one. This is not surprising, because pangasius is a low-valued fish (Xie et al., 2009). The overall decline in prices is consistent with this finding. Also, low prices for pangasius

are used to achieve access to this important international market (Asche et al., 2009). In this study, both high-price products (salmon and shrimp) indicate an elastic demand.

The compensated cross-price elasticities provide the pure substitution effect. Seafood species compete in the same market when the commodities are substitutable for the consumer. The identification of potential substitutes or complements is based on the sign of compensated price elasticities, which for the most part are positive and, indicate substitution relationships. One third of the cross-price elasticities are negative indicating complementary relationships. This implies that seafood is not a homogenous commodity in the German market; therefore, there is some potential of market growth.

For farmed salmon, wild product is a close substitute. Wild shrimp and pangasius have the largest number of substitutes (competitors). The weakest relationship is shown between redfish and wild shrimp (0.006). There also exist complementary relationships between some of the modeled groups. Wild shrimp and pangasius have the fewest complements. Consumers who eat more salmon will eat more farmed and wild shrimp as well as more pangasius.

3.7 Concluding Remarks

Following the increasing importance of aquaculture to satisfy a worldwide growing food demand, the number of studies analyzing the demand of fish and seafood products has increased during the last decade. However, only a few studies have analyzed the demand for seafood at the individual household level, and none have investigated the German market in particular. Also, only a few studies have considered different production technologies. The present study contributes to the literature by analyzing the impact of the seafood's source (wild versus farmed fish production), employing a detailed household-level scanner dataset for the German market. The German fish and seafood market is highly dependent on imports of mostly frozen fish. We model a demand system for six frozen seafood product groups and employ a QUAIDS demand model specification. The data under study were collected by GfK ConsumerScan for the period 2006 to 2010. The results of this study show that the estimated elasticities of demand for fish and seafood in Germany vary across the species and production technologies. Farmed and wild seafood are differentiated products with a good level of interchangeability in demand. We find a significant price dispersion, but also many

positive and significant cross-price elasticities. Prices of farmed salmon and shrimp are higher than prices of their wild counterparts.

These unique features may be explained by domestic stock shortages and the rising demand for fish in Germany, which have led suppliers to import larger quantities of fish mainly from aquaculture. The additional transport costs may have resulted in higher prices for this product category.

We find consumers to be price sensitive, particularly with regard to the high-valued seafood species salmon and shrimp. Interestingly, we could not find large differences between the elasticities of aquacultured and wild salmon, even though farmed salmon is more expensive. For shrimp, we found that the demand for wild shrimp is more elastic than the demand for farmed shrimp. A price elastic market implies that the seafood industry [in Germany] still has the potential for growing revenues if production increases (Asche et al., 2005). This may lead to the conclusion that the market potential of farmed fish (shrimp) in Germany is not yet fully developed. The estimated elasticities are close to results reported in the literature (see, among others, Asche et al., 2005).

3.8 A Critical Assessment

In this study household scanner data from the GfK research company are employed. In general, the advantage of this type of data is that it provides detailed, highly disaggregated weekly information on quantities sold and values of a wide range of products within one category. Thus, the purchasing pattern of households can be analyzed on a detailed level and due to the large number of participating households, conclusions can be drawn based upon a large representative sample.

However, to obtain an unbiased estimation we aggregate the household purchases to a monthly basis in order to reduce the number of zero observations. Doing this, we lose some data variance. On the other hand, too many zero observations would lead to estimation bias. Further, to analyze differences between aquaculture and wild fisheries, this study is focused on different types of seafood; i.e., redfish, pangasius, salmon, and shrimp. By means of the EAN code we aggregate all natural products for each of the finfish species under study. Other information like package size, product forms or process forms of the seafood, which is also

included in the original dataset, are inevitably neglected. In future research it would be interesting to estimate demand systems for different product forms of the seafood.

Heterogeneity of consumers presents a limitation of this study, which we do not take into account. Further research must consider that price sensitivity regarding wild and farmed seafood is not the same for all consumer groups and thus estimate a differentiated demand system.

Moreover, we do not distinguish between different price setting strategies like promotional prices and normal prices, which may lead to biased results.

To verify the robustness of the results, it would be useful to calculate the demand and price elasticities using another empirical approach like the mixed logit model. Thus, conclusions drawn have to be discussed carefully.

References

- Abdulai, A. (2002). Household Demand for Food in Switzerland. A Quadratic Almost Ideal Demand System. *Swiss Journal of Economic Statistics*, Vol. 138, 1-18.
- Abdulai, A. (2003). Economics of scale and the demand for food in Switzerland: Parametric and non-parametric analysis. *Journal of Agricultural Economics*, Vol. 54, 247-267.
- Akbay, C., Boz, I., & Chern, W. S. (2007). Household Food Consumption in Turkey. *European Review of Agricultural Economics*, Vol. 34, 209-222.
- Anderson, J. (2002). Aquaculture and the Future: Why Fisheries Economists Should Care. *Marine Resource Economics*, Vol. 17, 133-151.
- Asche, F. (2008). Farming the sea. *Marine Resource Economics*, Vol. 23, 527-547.
- Asche, F., & Wessells, C. (1997). On Price Indices in the Almost Ideal Demand System. *American Journal of Agricultural Economics*, Vol. 79, 1182-1185.
- Asche, F., Benneer, L., Oglend, A., & Smith, M. (2012). U.S. Shrimp Market Integration. *Marine Resource Economics*, Vol. 27, 181-192.
- Asche, F., Bjørndal, T., & Gordon, D. V. (2005). *Demand Structure for Fish*. SNF Working Paper No. 37/05, Institute for Research in Economics and Business Administration. Bergen.
- Asche, F., Gordon, D. V., & Hannesson, R. (2004). Tests For Market Integration and the Law of One Price: The Market For Whitefish in France. *Marine Resource Economics*, Vol. 19, 195-210.
- Asche, F., Nellesmare, M., Roheim, C., Smith, M., & Tveterås, S. (2015). Fair Enough? Food Security and the International Trade of Seafood. . *World Development*, Vol. 67, 151-160.
- Asche, F., Roll, K., & Trollvik, T. (2009). New Aquaculture Species- Entering the Whitefish Market. *Aquaculture Economics and Market*, Vol. 13, 76-93.

- Asche, F., Roll, K., & Tveterås, R. (2007). Productivity Growth in the Supply Chain – Another Source of Competitiveness for Aquaculture. *Marine Resource Economics*, Vol. 22, 329-334.
- Banks, J., Blundell, R., & Lewbel, A. (1997). Quadratic Engel Curves and Consumer Demand. *The Review of Economics and Statistics*, Vol. 79, 527-539.
- Barten, A. P. (1968). Estimating Demand Equations. *Econometrica*, Vol. 36, 213-251.
- Blundell, R., Pashardes, P., & Weber, G. (1993). What do we learn about Consumer Demand Patterns from Micro Data? *American Economic Review*, Vol. 83, 570-597.
- Capps, O., & Lambregts, J. (1991). Assessing Effects of Prices and Advertising on Purchases of Finfish and Shellfish in Local Market in Texas. *Southern Journal of Agricultural Economics*, Vol. 23, 181-194.
- Chidmi, B., Hanson, T., & Nguyen, G. (2012). Substitutions between Fish and Seafood Products at the US National Retail Level. *Marine Resource Economics*, Vol. 27, 359-370.
- Cox, T. L., & Wohlgenant, M. K. (1986). Prices and Quality Effects in Cross-Sectional Demand Analysis. *American Journal of Agricultural Economics*, Vol. 68, 908-919.
- Deaton, A. S., & Muellbauer, J. (1980). An Almost Ideal Demand System. *American Economic Review*, Vol. 70, 359-368.
- Destatis. (2015). *Statistisches Bundesamt Wiesbaden*. Retrieved from <https://www-genesis.destatis.de/genesis/online/>
- Dey, M. M. (2000). Analysis of Demand for Fish in Bangladesh. *Aquaculture Economics and Management*, Vol. 4, 63-79.
- Dey, M. M., Alam, M. F., & Paraguas, F. (2011). A Multistage Budgeting Approach to the Analysis of Demand for Fish: An Application to Inland Areas of Bangladesh. *Marine Resource Economics*, Vol. 26, 35-58.
- Dey, M. M., Yolanda, T. G., Kumar, P., Piumsombun, S., Haque, M. S., Luping, L., . . . Koeshendrajana, S. (2008). Demand for Fish in Asia: A Cross-Country Analysis. *The Australian Journal and Resource Economics*, Vol. 52, 321-338.

- Doll, J. (1972). An Econometric Analysis of Shrimp Ex-Vessel Price 1950-68. *American Journal of Agricultural Economics*, Vol. 54, 431-440.
- FAO. (2014). *The State of World Fisheries and Aquaculture 2014*. Rome: Food and Agriculture Organization of the United Nations.
- FIZ. (2012). *Fischinformationszentrum e.V.* <http://www.fischinfo.de> abgerufen
- Forsberg, O. I., & Guttormsen, A. (2006). A Pigmentation Model for Farmed Atlantic Salmon: Nonlinear Regression Analysis of Published Experimental Data. *Aquaculture*, Vol. 253, 415-420.
- Fourmouzi, V., Genius, M., & Midmore, P. (2012). The Demand for Organic and Conventional Products in London, UK: A System Approach. *Journal of Agricultural Economics*, Vol. 63, 677-693.
- Gallagher, L., & Eakins, J. M. (2003). Dynamic Almost Ideal Demand Systems: An Empirical Analysis of Alcohol Expenditure in Ireland. *Applied Economics*, Vol. 35, 1025-1036.
- Garcia, Y. D., & Navarez, S. (2005). Demand for Fish in the Philippines: A disaggregated Analysis. *Aquaculture Economics and Management*, Vol. 9, 141-168.
- Gibson, J., & Kim, B. (2011). Testing the Infrequent Purchase Model Using Direct Measurement of Hidden Consumption from Food Stocks. *American Journal of Agricultural Economics*, Vol. 94, 257-270.
- Guttormsen, A. (1999). Forecasting Weekly Salmon Prices: Risk Management in Fish Farming. *Aquaculture Economics & Management*, Vol. 3, 159-166.
- Haller, L. (1994). Branded Product Pricing Strategies in the Catsup and Cottage Cheese Industries. *University of Connecticut, Ph.D. Dissertation*.
- Heien, D., & Wessells, C. (1990). Demand Systems Estimation with Microdata: A Censored Regression Approach. *Journal of Business & Economic Statistics*, Vol. 8, 365-371.
- Hoffmann, C. (2003). Die Nachfrage nach Nahrungs- und Genußmitteln privater Haushalte vor dem Hintergrund zukünftiger Rahmenbedingungen. In *Studien zur Haushaltsökonomie* 28. Frankfurt on the Main: Peter Lang.

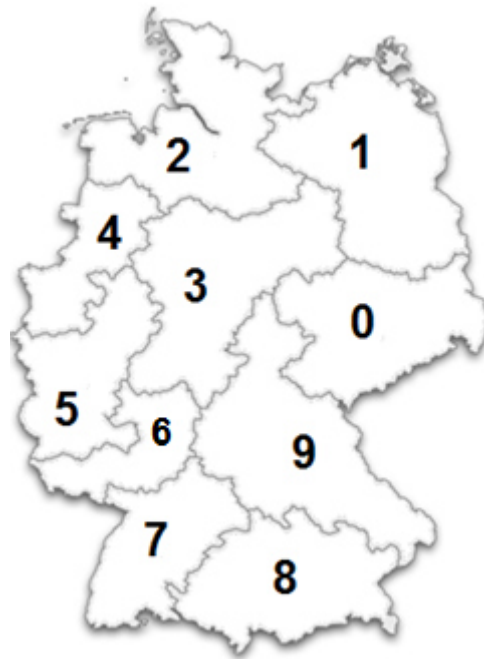
- Knapp, G., Roheim, C., & Anderson, J. (2007). *The Great Salmon Run: Competition between Wild and Farmed Salmon. Report prepared for TRAFFIC North America, Washington, DC, 345 pp.* Retrieved from http://www.iser.uaa.alaska.edu/people/knapp/personal/pubs/TRAFFIC/The_Great_Salmon_Run.pdf
- Kumar, P., & Dey, M. (2004). A Study on Modelling of Household Demand for Fish in India. *Indian Journal of Agricultural Economics, Vol. 59*, 465-475.
- Kvaløy, O., & Tveterås, R. (2008). Cost Structure and Vertical Integration between Farming and Processing. *Journal of Agricultural Economics, Vol. 59*, 296-311.
- Lambert, R., Larue, B., Yélou, C., & Criner, G. (2006). Fish and Meat Demand in Canada: Regional Differences and Weak Separability. *Agribusiness, Vol. 22*, 175-199.
- Lewbel, A. (1991). The Rank of Demand Systems: Theory and Nonparametric Estimation. *Econometrica, Vol. 59*, 711-730.
- Nguyen, G., Hanson, T., & Jolly, C. (2013). A Demand Analysis for Crustaceans at the U.S. Retail Store Level. *Aquaculture Economics and Management, Vol. 17*, 212-227.
- Nielsen, M., Smit, J., & Guillen, J. (2009). Market Integration of Fish in Europe. *Journal of Agricultural Economics, Vol. 60*, 367-385.
- Norman-López, A., & Asche, F. (2008). Competition between Imported Tilapia and US Catfish in the US Market. *Marine Resource Economics, Vol. 23*, 199-214.
- Park, J., & Capps, O. (1997). Demand for Prepared Meals by U.S. Households. *American Journal of Agricultural Economics, Vol. 79*, 814-824.
- Park, J., Holcomb, R., Raper, K. C., & Capps, O. (1996). A Demand System Analysis of Food Commodities by U.S. Households Segmented by Income. *American Journal of Agricultural Economics, Vol. 78*, 290-300.
- Poi, B. P. (2008). Demand System Estimation: Update. *The Stata Journal, Vol. 8*, 554-556.
- Roheim, C., Gardiner, L., & Asche, F. (2007). Value of Brands and other Attributes: Hedonic Analysis of Retail Frozen Fish in the UK. *Marine Resource Economics, Vol. 22*, 239-253.

- Roheim, C., Sudhakaran, P. O., & Durham, C. (2012). Certification of Shrimp and Salmon for best Aquaculture Practices: Assessing Consumer Preferences in Rhode Island. *Aquaculture Economics and Management*, Vol. 16, 266-286.
- Ryll, E. (1984). Bestimmungsgründe und Elastizitäten der Nachfrage nach Fisch und Fischwaren in der Bundesrepublik Deutschland. In *Berichte über Landwirtschaft* 62 (pp. 208-221). Hamburg, Berlin: Paul Parey.
- Salvanes, K., & De Voretz, D. (1997). Household Demand for Fish and Meat Products: Separability and Demographic Effects. *Marine Resource Economics*, Vol. 12, 37-55.
- Schröck, R. (2012). The Organic Milk Market in Germany is Maturing: A Demand System Analysis of Organic and Conventional Fresh Milk Segmented by Consumer Groups. *Agribusiness*, Vol. 28, 274-292.
- Shonkwiler, J. S., & Yen, S. T. (1999). Two-Step Estimation of a Censored System of Equations. *American Journal of Agricultural Economics*, Vol. 81, 972-982.
- Singh, K., Dey, M. M., & Surathkal, P. (2012). Analysis of a Demand System for Unbreaded Frozen Seafood in the United States Using Store-level Scanner Data. *Marine Resource Economics*, Vol. 27, 371-387.
- Singh, K., Dey, M., & Surathkal, P. (2014). Seasonal and Spatial Variations in Demand for and Elasticities of Fish Products in the United States: An Analysis based on Market-Level Scanner Data. *Canadian Journal of Agricultural Economics*, Vol. 62, 343-363.
- Singh, K., Dey, M., & Thapa, G. (2011). An Error Corrected Almost Ideal Demand System for Crustaceans in the United States. *Journal of International Food and Agribusiness Marketing*, Vol. 23, 271-284.
- Smith, M., Roheim, C., Crowder, L., Halpern, B., Turnipseed, M., Asche, F., Bourillón, L., Guttormsen, A., Khan, A., Liguori, L., McNevin, A., O'Connor, M., Squires, D., Tyedmers, P., Brownstein, C., Carden, K., Klinger, D., Sagarin, R., & Selkoe, K. (2010). Sustainability and Global Seafood. *Science*, Vol. 327, 784-786.
- Sommer, U. (1985). Quantitative Analyse der Nachfrage nach Fisch und Fischwaren in der Bundesrepublik Deutschland 1965-1981. In *Berichte über die Landwirtschaft* 63 (pp. 82-101). Hamburg, Berlin: Paul Parey.

- Thong, N. T. (2012). An Inverse Almost Ideal Demand System for Mussels in Europe. *Marine Resource Economics, Vol. 27*, 149-164.
- Tsoa, E., Schrank, W., & Roy, N. (1982). U.S. Demand for Selected Groundfish Products. *American Journal of Agricultural Economics, Vol. 64*, 483-489.
- Valderrama, D., & Anderson, J. (2009). Market Interactions between Aquaculture and Common-Property Fisheries: Recent Evidence from the Bristol Bay Sockeye Salmon Fishery in Alaska. *Journal of Environmental Economics and Management, Vol. 59*, 115-128.
- Wessells, C., & Wallstrom, P. (1999). Modelling Demand Structure using Scanner Data: Implications for Salmon Enhancement Policies. *Agribusiness, Vol. 15*, 449-461.
- Wessells, C., Johnston, R., & Donath, H. (1999). Assessing Consumer Preferences for Ecolabeled Seafood: The Influence of Species, Certifier and Household Attributes. *American Journal of Agricultural Economics, Vol. 81*, 1084-1089.
- Wildner, S. (2001). Quantifizierung der Preis- und Ausgabenelastizität für Nahrungsmittel in Deutschland: Schätzung eines LA/AIDS. *Agrarwirtschaft, Vol. 50*, 275-285.
- Xie, J., & Myrland, Ø. (2011). Consistent Aggregation in Fish Demand: A Study of French Salmon Demand. *Marine Resource Economics, Vol. 26*, 267-280.
- Xie, J., Kinnucan, H., & Myrland, Ø. (2008). The Effects of Exchange Rates on Export Prices of Farmed Salmon. *Marine Resource Economics, Vol. 23*, 439-457.
- Xie, J., Kinnucan, H., & Myrland, Ø. (2009). Demand Elasticities for Farmed Salmon in World Trade. *European Review of Agricultural Economics, Vol. 36*, 425-445.
- Xie, J., Mittelhammer, R., & Heckeley, T. (2004). A QUAIDS model of Japanese meat demand. <http://ageconsearch.umn.edu/bitstream/20120/1/sp04xi02.pdf>
- Yen, S. T., & Lin, B. H. (2003). Quasi- and Simulated- Likelihood Approaches to Censored Demand systems: Food Consumption by Food Stamp Recipients in the United States. *American Journal of Agricultural Economics, Vol. 85*, 458-478.
- Yen, S., Kan, K., & Su, S. J. (2002). Household Demand for Fats and Oils: Two Step estimation of a Censored Demand System. *Applied Economics, Vol. 34*, 1799-1806.

Appendix

Figure A3.1: Postal Code Areas Germany



Source: Own representation.

Table A3.1: Parameter Estimation Quality Adjusted Prices

	Farmed Salmon		Wild Salmon		Farmed Shrimp		Wild Shrimp		Redfish		Pangasius	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
hhsz	-0.217***	0.031	-0.152***	0.014	-0.050	0.031	-0.013	0.013	-0.018**	0.008	0.001	0.002
Age	0.005*	0.003	0.001	0.001	0.000	0.003	0.000	0.001	0.001	0.001	0.000	0.000
Income	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000	0.000	0.000	0.000	0.000	0.000
West	-0.191**	0.076	-0.119***	0.031	-0.139*	0.073	-0.045	0.029	0.011	0.022	0.005	0.005
North	-0.075	0.076	0.106***	0.031	-0.498***	0.073	0.003	0.029	-0.512**	0.022	0.004	0.005
East	-0.395***	0.096	0.186***	0.040	-0.512***	0.093	0.034	0.037	-0.026**	0.027	-0.001	0.006
Q1	-0.132***	0.032	-0.039**	0.017	-0.026	0.035	0.035*	0.018	0.001	0.008	-0.001	0.002
Q2	-0.103***	0.032	-0.066***	0.017	-0.100***	0.035	-0.018	0.019	0.008	0.008	0.001	0.002
Q3	0.068**	0.033	-0.044**	0.017	-0.097***	0.036	-0.017	0.019	0.020**	0.008	0.004	0.002
Trend	0.017***	0.001	-0.003***	0.000	-0.002***	0.001	-0.004***	0.000	0.000	0.000	0.000	0.000
Family kids	0.030	0.062	0.039	0.029	-0.117*	0.064	0.052*	0.029	0.055***	0.016	0.000	0.004
Employed	-0.241***	0.065	-0.039	0.030	-0.017	0.067	-0.049	0.030	0.007	0.017	0.002	0.004
Single	-0.048	0.080	-0.022	0.037	0.000	0.081	0.067*	0.036	0.023	0.021	0.008	0.005
Rural	-0.044	0.062	-0.018	0.026	0.051	0.060	-0.045*	0.025	-0.019	0.017	-0.002	0.004
Intercept	9.027***	0.215	6.145***	0.097	11.981***	0.217	10.501***	0.095	6.404***	0.058	4.586***	0.014
R²	0.048		0.066		0.024		0.007		0.007		0.004	

***p < 0.01, **p < 0.05, *p < 0.10.

Source: Own estimations based on GfK (2011).

Table A3.2: Estimation Results of the Probit Analysis

	Farmed Salmon		Wild Salmon		Farmed Shrimp		Wild Shrimp		Redfish		Pangasius	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Intercept	1.887***	0.173	1.047***	0.173	0.210***	0.202	1.019***	0.207	-0.701**	0.280	-2.054***	0.417
Price QA	-0.821***	0.030	-0.863***	0.037	-0.846***	0.039	-1.050***	0.052	-1.472***	0.093	-1.120***	0.153
Hhsize	-0.081***	0.023	0.117***	0.022	-0.045*	0.025	-0.029	0.024	0.065**	0.030	0.078*	0.045
Age	-0.003	0.002	-0.010***	0.002	0.001	0.002	-0.004*	0.002	0.022***	0.003	0.002	0.004
Income	0.001***	0.000	-0.001***	0.000	0.001***	0.000	0.001*	0.000	0.001	0.000	0.001	0.000
West	-0.064	0.057	0.066	0.053	0.030	0.063	-0.084	0.053	-0.089	0.070	-0.075	0.103
North	-0.255***	0.057	-0.439***	0.055	0.832***	0.061	-0.596***	0.056	0.187***	0.068	-0.006	0.101
East	0.116	0.072	-0.220***	0.068	0.423***	0.079	-0.788***	0.075	0.050	0.087	0.163	0.125
Q1	0.138***	0.024	-0.125***	0.025	-0.129***	0.028	-0.068**	0.028	0.162***	0.036	0.243***	0.064
Q2	0.066***	0.024	-0.281***	0.026	0.100***	0.028	-0.013	0.029	0.089**	0.037	0.117*	0.068
Q3	0.025	0.025	-0.263***	0.027	0.086***	0.029	-0.006	0.029	0.138***	0.037	0.258***	0.067
Trend	-0.011***	0.001	0.004***	0.001	-0.001	0.001	0.007***	0.001	-0.005***	0.001	-0.004**	0.002
Family kids	-0.013	0.047	-0.016	0.048	0.035	0.052	-0.026	0.051	-0.009	0.060	-0.146	0.096
Employed	-0.142***	0.048	0.050	0.049	0.182***	0.054	0.140***	0.052	-0.218***	0.065	-0.130	0.104
Single	-0.289***	0.060	0.052	0.060	0.221**	0.066	0.148**	0.063	-0.096	0.081	-0.061	0.128
Rural	0.01	0.047	0.020	0.045	-0.146***	0.050	-0.073	0.046	0.065	0.058	0.072	0.086
Log likelihood	-19,230.89		-16,096.37		-14,085.270		-12,661.830		-8,577.530		-2,873.010	

***p< 0.01, **p< 0.05, *p< 0.10.

Source: Own estimations based on GfK (2011).

4. Kapitel

Assessing Consumer Preferences and Willingness to Pay for Fish from Aquaculture and Eco-labeled Fish: Insights from a Discrete Choice Experiment in Northern Germany

Autoren:

Julia Bronnmann

Working Paper

Assessing Consumer Preferences and Willingness to Pay for Farmed and Eco-labeled Fish: Insights from a Discrete Choice Experiment in Northern Germany

JULIA BRONNMANN

Abstract

A choice experiment is used to examine the value of seafood attributes including farmed and wild caught on the German market as well as consumers' willingness to pay for these attributes. The empirical analysis is based upon discrete choice experiments with 485 participants from Northern Germany. A mixed logit estimation reveals a strong positive effect of eco-labelled seafood and the results indicate that respondents are willing to pay more for wild caught fish than farmed fish. The analysis provides more interesting results: Consumers' attitudes towards frozen fish are quite negative despite the fact that this is the best-selling processed form on the German fish market. Furthermore, socioeconomic characteristics have limited influence on the purchase decision of respondents. Providing information to the consumers enhances the effect of the seafood attributes and the resulting probability to purchase the product.

Keywords: aquaculture, consumer heterogeneity, discrete choice experiment, ecolabel, mixed logit model, seafood, willingness to pay

JEL Classification Codes: Q13, Q19, Q22, C39

4.1 Introduction

Due to the fact that food markets in developed countries are increasingly saturated, product differentiation is an increasingly important strategy to stimulate consumers' demand for specific products (Wirthgen, 2005). More and more producers as well as retailers make use of different product attributes to differentiate their products also in the seafood market. Therefore, knowledge about consumers' perceptions regarding various product attributes like species, product form, production mode, process form, color and convenience is essential. During the last two decades revealed preferences and stated choice data have been used to increase the understanding of the role of product attributes in purchase decisions for food in general and seafood in particular (Wessells et al., 1999; Johnston et al., 2001; Jaffry et al., 2004; Roheim, 2008; Quagraine et al., 2008; Roheim et al., 2012).

The existing literature provides substantial evidence that the consumers' willingness to pay (WTP) for wild fish is higher than for farmed fish (Roheim et al., 2012), and that they are willing to pay a price premium for sustainable harvested seafood (Roheim et al., 2011). However, the inferred valuation of each attribute depends on the consumer's experience, knowledge and beliefs, which can vary significantly from one individual to another as well as between countries (Johnston et al., 2001). The present study aims to investigate attitudes and perceptions for German consumers regarding farmed, eco-labeled as well as frozen fish products. We quantify the WTP for the product attributes using a mixed logit approach to account explicitly for consumers' heterogeneity. The mixed logit obviates three limitations of the standard multinomial logit model by allowing for random taste variation, unrestricted substitution pattern and correlation in unobserved factors over time (Hensher et al., 2005). The empirical analysis of this study is based on discrete choice experiments (DCE) with 485 respondents carried out in November 2015. In our study, we focus on salmon and turbot, as these species are available from both wild and farmed sources. Furthermore, it is of interest to compare consumers' preferences and WTP for a frequently purchased and a niche species. Both species have in common that they rank among high value seafood, whereas salmon is a common consumed species also available in discounters, turbot is in particular much favored in fine restaurants.

In 2013, aquaculture overtook the wild catches as a source of fish for human consumption (FAO, 2015). The growing market share of farmed seafood in particular results from reduced

production costs due to productivity growth, control of the production process (Asche et al., 2013) and improved logistics and sales (Larsen and Asche, 2011).

Looking at the considered species, salmon is one of the leading aquaculture species and accounts for 70 % of the salmon markets (Marine Harvest, 2015). Farmed salmon is mainly produced in Norway, Chile, Scotland and Canada whereas wild salmon is harvested primarily in the USA, Russia, Japan and Canada (Asche and Bjørndal, 2011; Marine Harvest, 2015). A substantial share of salmon is exported, with the European Union (EU) as the most important market (Asche and Bjørndal, 2011).

Whereas salmon is the second most consumed fish species on the German market (FIZ, 2015), turbot is rather a niche product. Farmed production of turbot essentially takes place in Spain, with over 71 % of the output, but it is also cultured in France, Portugal, the Netherlands and the United Kingdom. Outside the EU, small quantities are farmed in Iceland and China. Within the EU, the principle catches are made by the Netherlands, the United Kingdom, Denmark, France, Belgium, Italy and Spain. Outside the EU, Turkey is by far the most important country harvesting turbot, followed by Ukraine, Norway and Morocco. However, the EU catches account for 90 % of global catches. Overall, the prospects for increased landings are limited, so any expansion in quantity must come from aquaculture. However, when comparing turbot farming to salmon farming, turbot has to be produced in land-based tanks or raceways and cannot be produced in sea pens. This requirement in production technology increases production costs and limits growth in farmed quantity. Moreover, turbot is rather a luxury product compared to salmon and if production increases so much that it must compete on price, the species will likely lose its luxury image (Fernández-Polanco and Bjørndal, 2013).

Traditionally, fishery management aims to control wild fish catches through catch quotas, catch limits or restricted access. In recent years, consumers in many countries have obtained an increasing awareness for environmental issues as well as food quality (Onozaka and McFadden, 2011). In response to this development, seafood eco-labels like the Marine Stewardship Council (MSC) label and the counterpart for farmed fish, the Aquaculture Stewardship Council (ASC) label, have been established on the seafood market. The MSC label certifies fisheries to improve their management with regard to sustainability. The ASC

label sets standards besides environmental sustainability for best aquaculture practice, which include food safety, community and animal welfare.

The remainder of the paper is as follows: The following section describes the survey design. The generated data are presented in section 3, followed by the methodology background. Section 5 presents the results of the Mixed Logit Model as well as the estimated willingness to pay for the product attributes under study. The results are summarized and discussed in section 6.

4.2 Survey design

A four-part questionnaire was designed to determine the consumers' preferences for salmon and turbot, with particular focus on aquacultured and eco-labeled fish products. The first section of the survey is a DCE with no information given to the respondents. The consumers choose their preferred salmon and turbot product. The second part of the survey contains questions about some sociodemographic characteristics of the respondents. The third section of the survey identifies general seafood consumption habits, species purchased, beliefs and perceptions towards aquaculture and sustainable fish production, environmental concerns and attention to seafood labeling. In the last section the respondents get some background information (cheap talk) regarding the production methods of salmon and turbot as well as the certification criteria of the MSC and ASC eco-label. After providing this information the respondents are confronted with a second DCE.

The empirical analysis of this study is based on primary data, collected at three different retail stores in northern Germany (Kiel and Kaltenkirchen) within two weeks in November 2015 using a paper-based questionnaire. The region of the survey is suited for analyzing consumers' preferences for fish because the majority of fish consumers in Germany are located in the northern states (FIZ, 2015). Prior to the actual DCE survey, the questionnaire and the choice experiment were developed and pre-tested using a 10 person focus-group discussion to ensure the comprehensibility of the questions and the choice sets. The literature advocates using focus group discussions for the choice of attributes and attribute levels (Hensher et al., 2005). A total of 776 survey responses are collected. 485 questionnaires are filled out completely with no information missing, giving 63 % useable observations.

93.81 % (455) of the survey respondents eat seafood, in other words there are 30 respondents in the sample who do not consume any seafood.

The experimental design included the four attributes: price, production process, sustainable certification and processing. Table 4.1 displays both attributes and levels of attributes.

Table 4.1: Selected Attributes and Attribute Levels


Attributes	Attribute Level	
	Salmon	Turbot
Price	€2.76/250g	€3.21/250g
	€3.31/250g	€3.86/250g
	€3.68/250g	€4.29/250g
	€4.06/250g	€4.72/250g
	€4.60/250g	€5.36/250g
Production process	wild	wild
	farmed	farmed
Sustainable certification	no certification	no certification
	certification (MSC or ASC)	certification (MSC or ASC)
Processing	frozen fillet	frozen fillet
	fresh fillet	fresh fillet

Source: Own representation.

The attributes and levels are chosen based on the previous literature (Jaffrey et al., 2004; Johnston and Roheim, 2006; Roheim et al., 2012; Davidson et al., 2012; Fernández-Polanco et al., 2013) and the focus-group discussions, but with the addition of the ASC label, which became available only recently. Attribute levels must be varied in any DCE to enable estimating the effects of individual attributes on respondents' choices. Prices of salmon and turbot are determined based on an average current market price as of November 2015 in local supermarkets. From this market price we specified plus/minus 10 % and 25 % for price levels above and below that respective price. The production process levels are wild or farmed, as both fish species are available in both production modes. The sustainable certification levels are certified with an MSC or ASC label (depending on the production mode), and the processing are frozen or fresh fillets.

The attributes are used to design a fractional factorial and balanced orthogonal design generated by SPSS which identifies a subset of 24 charts of all possible 40 (5x2x2x2) combinations of the attribute levels for salmon and turbot, respectively. The D-efficiency value is 94 for both the salmon and the turbot design, which is sufficiently close to the maximum value of 100 for a perfectly orthogonal and perfectly balanced design (Kuhfeld et al., 1994). Following Loureiro and Umberger (2007) the 24 choice sets are randomly allocated between four different questionnaires to mitigate any potential ordering impacts. Each questionnaire contains six choice sets for the two fish species, respectively. Three of them are presented in the first section and three of them in the last section of the questionnaire. Each choice set presents two alternative fish (salmon or turbot) products of different price and levels of attributes (trade off). A third alternative (neither of the two alternative product schemes) is provided to set the origin of the utility scale. An example of a choice set is presented in Figure 4.1.

Figure 4.1: Example of a Choice Set for Salmon

	Product 1	Product 2	
Price in € pro 250 g	€4.60	€2.76	Neither of these products
Production process	farmed	wild	
Sustainable Certification	no label		
Processing	frozen fillet	fresh fillet	
I prefer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Source: Own representation.

4.3 Data

The summary statistics of the survey respondents are presented in table 4.2. As one can see, a somewhat larger share of the respondents is female (58.35 %) and the average household size consists of 2.4 family members including 0.4 kids. The mean age of the respondents is 44.51 years. Less than one third of the respondents have a low monthly net income between €500 and €1499 (30.32 %) and a high monthly net income between €3500 and more than €5000 (24.33 %). Most of the people (45.37 %) have a middle monthly net income between €1500 and €3499.

Table 4.2: Sociodemographic Characteristics of the Sample

Variable	Description	Mean/Percentage
Gender	Female	58.35
Household size	Mean of the household size	2.4
Kids	Mean of kids	0.4
Age	Mean of age	44.51
Income (monthly net income in €)	<500	8.46
	500-1499	21.86
	1500-2499	27.02
	2500-3499	18.35
	3500-4499	11.55
	>5000	12.78
Highest education	University degree	40.82
	Apprenticeship	23.92
	High School degree	21.44
	Secondary School degree	9.69
	Primary School degree	2.06
	Other	2.06
Employment	Full time	33.61
	Part time	20.82
	Retired	19.59
	Student	13.40
	Self-employed	3.71
	Unemployed	2.89
	Trainee	1.65
	Full-time Homemaker	1.65
Marital status	Married	46.59
	Single	26.60
	Partnership	16.70
	Separated/widowed/divorced	10.11
Housekeeper	Yes	61.24
	Partly	33.40
	No	5.36

Source: Own calculations.

Looking at the education, just 2 % of the respondents have a low education, namely a primary school degree. More than half of the consumers are high-educated 62.26 % (high school degree and university degree) and one third has a middle education (secondary school and apprenticeship). The sample consists of 33.61 % of people who have a full time job, 20.82 % have a part time job and 2.89 % are unemployed. Furthermore, about 20 % of the respondents are retired and 15.05 % are trainees or students. Most of the people are married or in a partnership (63.29 %) and there are 26.60 % single households in the sample. The predominant part of the respondents is the housekeeping person and is therefore responsible for purchasing seafood. The effect of consumers' socioeconomics characteristics regarding

the seafood attribute preferences is analyzed in this study by creating interacted terms between the consumer characteristic variables and a ‘do buy’ variable.

In the sample, 367 respondents or 75.7 % of the sample are frequent salmon consumers, 153 (31.5 %) eat herring on a regular basis and the third most eaten species are saithe and cod (128 (26.4 %); 123 (25.4 %)). Furthermore, these species are also the three favorite species of the respondents. Only 18 respondents (3.7 %) stated that they often eat turbot. Table 4.3 displays seafood consumption trends, where 93.81 % of the respondents eat seafood and most of them on a weekly basis.

Table 4.3: Seafood Consumption and Purchase Pattern, Fish Consuming People (n=455)

	Seafood consumption and purchase pattern	Number of Respondents	Percent
Frequency	Weekly	204	42.47
	Several times a month	111	22.89
	Monthly	83	17.11
	Several times a year	55	11.34
	Not at all	30	6.19
	Daily	2	0.41
Location (Multiple answers possible)	At home	412	90.55
	At restaurants	197	43.30
	Fast Food	85	18.68
Retailer (Multiple answers possible)	Supermarket	208	45.71
	Hypermarket	169	37.14
	Market stall	133	29.23
	Fishmonger	135	29.67
	Discounters	115	25.27
	Fisherman	144	31.65
Process form (Multiple answers possible)	Fresh fillet	293	64.40
	Frozen fillet	231	50.77
	Processed	194	42.64
	Whole fresh fish	193	42.42
	Whole frozen fish	48	10.55
	Ready made meal	19	4.18

Source: Own calculations.

90.55 % of respondents purchase seafood for home consumption and the favorite retail outlet is the supermarket (45.71 %) followed by hypermarkets (37.14 %). The survey respondents purchase fresh fillets and frozen fillets.

In addition, in the survey consumers are also asked questions about their beliefs and preferences related to sustainable seafood and farmed seafood using a 7-point Likert scale that they consider important for the buying decision of seafood. The results are displayed in table 4.4.

Table 4.4: Important buying Criteria regarding Seafood (Fish Consuming People; n=455)

Criteria	Strongly disagree	Mostly disagree	Rather disagree	Neutral/ don't know	Rather agree	Mostly agree	Strongly agree
Price	7.25% (33)	8.13% (37)	18.02% (82)	10.11% (46)	27.69% (126)	17.36% (79)	11.43% (52)
Taste	1.10% (5)	0.22% (1)	0.44% (2)	3.74% (17)	12.09% (55)	29.23% (133)	53.19% (242)
Freshness	0.88% (4)	0.66% (3)	2.42% (11)	6.15% (28)	13.41% (61)	21.54% (98)	54.95% (250)
Health	5.05% (23)	4.18% (19)	8.35% (38)	14.73% (67)	21.10% (96)	22.20% (101)	24.40% (111)
Environment	3.08% (14)	4.18% (19)	11.87% (54)	14.73% (67)	20.22% (92)	23.96% (109)	21.98% (100)
Origin	3.74% (17)	5.49% (25)	8.79% (40)	12.97% (59)	21.98% (100)	23.30% (106)	23.74% (108)
Species	1.10% (5)	1.10% (5)	2.20% (10)	5.05% (23)	12.31% (56)	35.38% (161)	42.86% (195)
Method	5.93% (27)	7.25% (33)	8.35% (38)	13.85% (63)	20.22% (92)	21.10% (96)	23.30% (106)

The number of observations is in parentheses.

Source: Own calculations.

As the table 4.4 shows, taste and freshness of seafood are the most important buying criteria. Interestingly, the respondents state that the price of seafood is one factor that does not strongly determine the purchase decision of seafood.

Respondents were also asked questions related to their beliefs and perceptions about aquacultured seafood production relative to wild caught seafood and about their attitudes concerning sustainable fishing. Answers to these questions are presented in tables 4.5 and 4.6. A total of 18 statements are scored on a 7 point Likert scale with categories ranged from “strongly disagree” to “strongly agree”. In general, the respondents have a more negative perception regarding farmed fish. The respondents disagree with the statement that farmed fish is healthier, more delicious or of higher quality than wild caught fish. In addition, the sample disagrees with the statement that farmed fish contains no traces of chemical elements (62.06 %).

On the other hand, the respondents believe (67.83 %) that farmed fish is a good possibility to protect the wild fish stocks from overfishing. Furthermore, half of the respondents (50.31 %) say that farmed fish is available in a wide assortment.

Table 4.5: Respondents' Beliefs about Aquaculture (n=485)

No.	Beliefs: Farmed fish...	Strongly disagree	Mostly disagree	Rather disagree	Neutral/ don't know	Rather agree	Mostly agree	Strongly agree
A1	is environmental friendlier	12.16 % (59)	6.80 % (33)	16.29 % (79)	31.75 % (154)	17.53 % (85)	10.10 % (49)	5.36 % (26)
A2	is healthier	17.94 % (87)	12.99 % (63)	21.24 % (103)	36.70 % (178)	5.98 % (29)	3.51 % (17)	1.65 % (8)
A3	is more delicious	17.53 % (85)	10.10 % (49)	20.82 % (101)	44.33 % (215)	3.51 % (17)	1.65 % (8)	2.06 % (10)
A4	contains no traces of chemical elements	24.12 % (117)	16.91 % (82)	21.03 % (102)	27.01 % (131)	5.57 % (27)	4.12 % (20)	1.24 % (6)
A5	looks better	14.23 % (69)	11.75 % (57)	14.23 % (69)	40.82 % (198)	11.96 % (58)	4.54 % (22)	2.47 % (12)
A6	is of higher quality	17.11 % (83)	14.43 % (70)	19.79 % (96)	37.94 % (184)	5.98 % (29)	3.51 % (17)	1.24 % (6)
A7	is available in a wide assortment	2.06 % (10)	1.86 % (9)	6.60 % (32)	39.18 % (190)	23.71 % (115)	18.76 % (91)	7.84 % (38)
A8	is cheaper	2.68 % (13)	3.09 % (15)	10.10 % (49)	36.08 % (175)	26.19 % (127)	17.32 % (84)	4.54 % (22)
A9	is a good possibility to protect the stock of wild species from overfishing	2.89 % (14)	3.30 % (16)	5.98 % (29)	20.00 % (97)	25.77 % (125)	22.68 % (110)	19.38 % (94)

The number of observations is in parentheses.

Source: Own calculations.

Looking at table 4.6, the respondents agree that sustainability is an important issue (89.48 %) and protecting the waters from overfishing is important (94.64 %). Furthermore, almost all of the respondents indicate that fishing methods should be environmental friendly (91.55 %) and sustainable fishing methods should be used more frequently (94.02 %).

Most respondents indicate that they are well informed about fishing methods (59.59 %) and species that are overfished (46.39 %), paying attention to fishing methods when purchasing fish (63.92 %) and that they can help protecting the sea from overfishing when buying sustainable seafood (83.29 %). However, a share of 24.12 % of the sample responds that they do not know if sustainability labels are trustworthy.

Table 4.6: Respondents' Beliefs concerning Sustainable Fishing Methods (n=485)

No.	Statement	Strongly disagree	Mostly disagree	Rather disagree	Neutral/ don't know	Rather agree	Mostly agree	Strongly agree
S1	Sustainability is an important issue for me	1.65 % (8)	0.41 % (2)	3.71 % (18)	4.74 % (23)	21.03 % (102)	29.69 % (144)	38.76 % (188)
S2	I am well informed about fishing methods	6.19 % (30)	7.63 % (37)	16.08 % (78)	10.52 % (51)	26.19 % (127)	19.59 % (95)	13.81 % (67)
S3	Protecting waters from overfishing is important	0.62 % (3)	0.41 % (2)	0.62 % (3)	3.71 % (18)	12.99 % (63)	22.47 % (109)	59.18 % (287)
S4	I pay attention to sustainable fishing methods when shopping	3.92 % (19)	6.19 % (30)	12.16 % (59)	13.81 % (67)	22.27 % (108)	21.86 % (106)	19.79 % (96)
S5	Fishing methods should foremost be environmentally friendly	0.62 % (3)	0.82 % (4)	1.44 % (7)	5.57 % (27)	20.41 % (99)	27.84 % (135)	43.3 % (210)
S6	Sustainable fishing methods should be used more frequently	0.41 % (2)	0.62 % (3)	0.41 % (2)	4.54 % (22)	11.55 % (56)	30.72 % (149)	51.75 % (251)
S7	By buying sustainable products I help protecting the sea from overfishing	2.06 % (10)	1.44 % (7)	3.71 % (18)	9.48 % (46)	16.7 % (81)	31.13 % (151)	35.46 % (172)
S8	I am well informed about which species are overfished	6.6 % (32)	11.13 % (54)	12.99 % (63)	16.91 % (82)	23.92 % (116)	15.46 % (75)	12.99 % (63)
S9	Sustainability labels are trustworthy	4.74 % (23)	8.25 % (40)	16.49 % (80)	24.12 % (117)	22.89 % (111)	16.08 % (78)	7.42 % (36)

The number of observations is in parentheses.

Source: Own calculations.

4.4 Empirical Framework

The theoretical foundation of DCEs draw upon Lancaster's argument that it is the attributes of goods that determine the utility they provide (Lancaster, 1966) and random utility theory (RUT) (McFadden, 1974). Individuals are assumed to compare alternatives according to a utility function that is decomposed into a deterministic (V_n) and a stochastic (ε_n) part, and choose that alternative with the highest level of utility. The utility U of alternative i obtained by respondent n in a choice situation t is therefore given by:

$$U_{nit} = V_{nit} + \varepsilon_{nit} \quad (4.1)$$

The deterministic component can be observed by the analyst and is determined by attributes of the object of choice and socio-economic characteristics of respondents, while the stochastic component consists of information that are not directly measurable.

We note that the specified model is a panel model, where the normally distributed error term for alternative i is the same for all choices made by one individual. In the rest of the discussion we suppress the subscript t . As the overall utility of an alternative includes an unobservable and therefore probabilistic component, the individual's choice behavior is explained in terms of probabilities. With J alternatives ($j = 1, 2, \dots, J$), the probability of alternative i being chosen over alternative j is given by:

$$P(i|J) = \Pr[(V_{nit} + \varepsilon_{nit} \geq V_{njt} + \varepsilon_{njt}) \forall j \in J; i \neq j] \quad (4.2)$$

By rearranging formula (2) the probability can be written as:

$$P(i|J) = \Pr[(\varepsilon_{nit} - \varepsilon_{njt} \geq V_{njt} - V_{nit}) \forall j \in J; i \neq j] \quad (4.3)$$

Since ε is not observable, it is treated as a random variable on which distributional assumptions have to be made. Different discrete choice models are obtained from different assumptions about the distribution of ε . Basic choice models like the multinomial logit model (MNL) or the conditional logit model (CLM) impose important restrictions like independence of irrelevant alternatives (IIA) and homogeneous preferences among respondents. To overcome these restrictive assumptions mixed logit models have been introduced allowing observed attribute coefficients (β) to vary randomly among respondents while the error (ε) is independent and identically distributed (IID) (Ben-Akiva et al., 1997). Hensher and Greene (2003) argue that IID is restrictive in that it implies unobserved influences not to be correlated across alternatives in a choice situation and also across choice situations. The authors suggest to divide the stochastic part into two uncorrelated parts, where one part is correlated over alternatives and the other part is IID over alternatives and individuals.

$$U_{ni} = \beta X_{ni} + [u_{ni} + \varepsilon_{ni}] \quad (4.4)$$

where X_{ni} is a vector of observed attributes of the choice object and consumer characteristics associated with β s capturing coefficients of observable variables. The second part of the term depicts the stochastic components where u_{ni} is a random term with zero mean whose distribution depends on underlying parameters and observed data, ε_{ni} is another part that is IID over alternatives. Several different distributional assumptions for the u 's are possible

like the normal, log-normal, uniform or triangular distribution. The density of γ is denoted by $f(\gamma|\theta)$ where the population parameters θ are the true parameters of the distribution.

Once the parameter estimates are obtained, the WTP compensating variation welfare measure that conforms to demand theory can be derived for each attribute using the formula of Hanemann (1984) and Parsons and Kealy (1992) given by the following equation:

$$WTP = b_y^{-1} \ln \left\{ \frac{\sum_i \exp(V_i^1)}{\sum_i \exp(V_i^0)} \right\} \quad (4.5)$$

where V^0 represents the utility of the initial state and V^1 is the utility of the alternative state, b_y gives the estimated marginal utility for price and is the coefficient of the cost attribute. The formula in equation 5 can be simplified to:

$$WTP = -\left(\frac{b_c}{b_y}\right) \quad (4.6)$$

where b_c is the coefficient to any of the attributes. These ratios are often known as implicit prices. Choice experiments are therefore consistent with utility maximization and demand theory, at least when a status quo or opt out alternative is included in the choice set.

4.5 Empirical Results

To analyze the choice behavior of the consumers from the DCE, we employ a Mixed Logit Model, as described in the previous section. Furthermore, we estimate the willingness-to-pay for the seafood attributes under study.

In the DCE the participants were asked to make six choices between varieties of salmon and turbot products offered at various prices. In the first part of the choice experiment the consumers are not informed about aquaculture and sustainable fisheries. In the second part of the DCE the consumers are provided with information by a cheap talk. We evaluate the two parts of the experiment with separate Mixed Logit Models. Of the 485 decision makers, 40 % of the respondents always chose one of the presented alternatives of the choice sets and 3 % have never chosen a scheme option, 57 % vary their choices.

Four models are estimated, two Mixed Logit Models for each of the two fish species. The random parameters are associated with the aquaculture variable (=1 if production method is farmed), frozen (=1 if the fish fillet is frozen), ASC (=1 if the product carries the ASC label) and MSC (=1 if the product carries the MSC label). The parameter distribution is assumed to be independent normal distributions. The remaining coefficients are fixed. The advantage of having a fixed price variable is that the WTP for each non-price attribute is simply the distribution of that attribute's coefficient.

The estimated models are specified as:

$$\begin{aligned}
 U_{nit} = & \alpha_i + \beta_{price}Price_{nit} + \beta_{1i}Male_n + \beta_{2i}Age18 - 35_n + \beta_{3i}age > 56_n + \\
 & \beta_{4i}low\ income_n + \beta_{5i}high\ income_n + \beta_{6i}high\ education_n + \beta_{7i}low\ education_n + \\
 & \beta_{8i}employed_n + \beta_{9i}singles_n + \beta_{10i}kids_n + \beta_{11i}housekeeper_n + \beta_{12i}hhsiz_e_n + \\
 & \beta_{13i}frequent_n + \beta_{14i}discounter_n + \beta_{15i}supermarket_n + \beta_{16i}fishmonger_n + \\
 & \beta_{17i}goodtoprotect_n + \beta_{18i}wellinformed_n + \beta_{19i}highquality_n + [u_{ni} + \varepsilon_{ni}] \quad (4.7)
 \end{aligned}$$

where α_i is the alternative specific constant ('do buy') capturing the average effect of all unobserved factors associated with the fish product on utility, β_{price} is the price sensitivity parameter, $Price_{nit}$ is the price for alternative i , the term $[u_{ni} + \varepsilon_{ni}]$ represents the deviation from the mean level utility, which captures the effects of the random parameters.

Table A4.1 summarizes the variables entering each of the models. *Price* and household size (HHsize) are the only continuous variables.

The results for Model 1 – Model 4, which represent the DCE with no information given to the respondents are presented in table 4.7. The models of the DCE with information given to the respondents are presented in table 4.8 (Model 5 – Model 8). We show the main effect (product attributes) model and a model which includes the main effects as well as interaction effects between the 'do buy' variable and socioeconomic variables¹⁴. Due to the fact that the estimated parameter coefficients are not directly interpretable, the estimation results also show the marginal effects of infinitesimal changes of the variables for the models with the interaction effects. However, such infinitesimal changes are not appropriate for dummy

¹⁴ The variables entering the model with the interaction effects are selected by comparing different models. We select the statistically superior model in each case, based upon a likelihood ratio test.

variables, which are a main part of the variables entering the model. Thus, we follow Hole (2007) and first calculate the probability at the mean of the sample. Subsequently a discrete change of the variable of interest is simulated that leads to a change in the corresponding probability. The difference between both probabilities represents the marginal effect of the variable. Moreover the WTP of each variable is reported.

For both species and all models, the price effect is negative and significant, indicating that the probability of purchase decreases as the price increases. It is clear from the tables that for salmon the consumers are more price sensitive than for turbot. For salmon, the main effects are statistically significant in both models except aquaculture in the main effect model of the uninformed respondents.

The negative aquaculture variable in all models indicates that consumers are less likely to purchase a salmon or turbot product that is farmed. In addition, the attribute reduce the WTP for the product. The negative values for aquacultured products are higher for salmon and the more informed respondent. The negative WTP for farmed fish confirms the finding of Roheim et al. (2012). The attribute frozen is significantly negative in all models, indicating that the attribute frozen reduces the purchase probability. For the average consumer, the attribute frozen has a negative marginal utility and reduce the WTP in all models. The reduction in WTP is larger for turbot and the informed respondent.

For turbot the product attribute ASC is not significant, meaning even when an aquacultured turbot product carries the ASC label the probability of choice is not affected. However, for salmon the ASC label significantly increases the probability of purchase. The marginal effect shows an increase by one eurocent per 250g of salmon raises the likelihood of purchase by 14 %. The MSC label increases the probability of purchasing a product significantly. In general, the MSC label has a strong impact on the purchase decision of the respondents. The average uniformed consumer is willing to pay €3.00 per 250g more for MSC certified salmon and €0.71 per 250g for certified turbot. After given information about sustainable fisheries and the MSC certification system to the respondents, their WTP for MSC labeled products increase to €4.00 per 250g for salmon and to €3.15 per 250g for turbot. The positive WTP for MSC is consistent with the observed price premiums for this attribute, as found by Bronnmann and Asche (2016).

4. Assessing Consumer Preferences and Willingness to Pay for Fish

Table 4.7: Estimation Results of the Mixed Logit Model, Uninformed Respondents

Variable	Salmon						Turbot					
	Main Effects Only			Interaction Effects			Main Effects Only			Interaction Effects		
	Coefficient	SE	Coefficient	SE	Marginal Eff.	WTP	Coefficient	SE	Coefficient	SE	Marginal Eff.	WTP
Price	-0.555***	0.09	-0.521***	0.09	-0.058		-0.289**	0.10	-0.290**	0.10	-0.036	
Aqua	-0.234	0.20	-0.343*	0.20	-0.030	-0.658	-0.447*	0.19	-0.463*	0.19	-0.040	-1.600
Frozen	-0.724***	0.16	-0.682***	0.15	-0.064	-1.309	-1.009***	0.20	-1.041***	0.20	-0.087	-3.595
ASC	1.490***	0.19	1.448***	0.19	0.136	3.793	0.143	0.33	0.206	0.32	0.040	5.326
MSC	2.221***	0.36	1.975***	0.33	0.206	2.780	1.541***	0.20	1.542***	0.20	0.161	0.711
Male			0.188	0.23	0.021	0.361			0.066	0.20	0.007	0.228
Age 18-35			0.553*	0.28	0.062	1.063			-0.229	0.25	-0.025	-0.792
Age >56			0.208	0.29	0.023	0.399			-0.202	0.27	-0.022	-0.698
Low Income			0.465	0.27	0.052	0.894			-0.031	0.23	-0.003	-0.107
High Income			0.325	0.29	0.036	0.623			-0.194	0.26	-0.022	-0.671
High Edu			-0.823***	0.24	-0.087	-1.581			-0.248	0.22	-0.028	-0.856
Low Edu			0.543	0.97	0.060	1.043			1.358	0.88	0.163	4.689
Employed			-0.270	0.79	-0.029	-0.520			-0.602	0.61	-0.065	-2.078
Singles			0.051	0.26	0.054	0.098			-0.438	0.23	-0.045	-1.511
Kids			0.381	0.36	0.041	0.731			0.007	0.32	0.001	0.024
Housekeeper			-0.575*	0.25	-0.060	-1.105			-0.258	0.22	-0.027	-0.890
Hhsize			0.041	0.15	0.042	0.079			-0.259*	0.13	-0.028	-0.896
Frequent			0.772**	0.24	0.083	1.482			0.792***	0.20	0.085	2.736
Discounter			0.991**	0.32	0.108	1.903			-0.181	0.23	-0.019	-0.626
Supermarket			0.782**	0.24	0.082	1.501			0.612**	0.20	0.064	2.112
Fishmonger			0.323	0.25	0.033	0.619			0.421	0.22	0.044	1.454

4. Assessing Consumer Preferences and Willingness to Pay for Fish

Goodtoprotect		0.002	0.23	0.002	0.004		0.218	0.20	0.022	0.752
Wellinformed		-0.589**	0.22	-0.060	-1.131		-0.333	0.20	-0.034	-1.151
Highquality		0.131	0.35	0.013	0.252		0.033	0.31	0.003	0.115
St.dev. of non-i.i.d.residuals										
Aqua	1.975***	0.27	1.825***	0.27		1.928***	0.30	1.813***	0.29	
Frozen	1.930***	0.23	1.774***	0.23		2.453***	0.41	2.310***	0.41	
ASC	1.621***	0.37	1.495***	0.39		2.841***	0.54	2.772***	0.53	
MSC	3.003***	0.84	2.519**	0.86		2.267***	0.32	2.237***	0.33	
Constant	2.976***	0.35	2.702**	1.00	0.283	1.550***	0.44	2.772**	0.89	0.299
Log-likelihood	-1,346.91		-1,303.940			-1,407.89		-1,38.81		
AIC	2,713.83		2,665.890			2,835.78		2,825.62		
Observation	4,365		4,365			4,365		4,365		
Pseudo R2	0.060		0.048			0.055		0.051		

p***<0.01, p**<0.05, p*<0.10.

Source: Own Estimations.

The statistically significant standard deviation parameters of the product attributes indicate the existence of unobservable preference heterogeneity among the survey sample. This, in turn, gives rise to consideration of the Mixed Logit Model specification as appropriate. The consumers in Northern Germany do have statistically different preferences for these seafood attributes. For salmon MSC has the largest standard deviation and for turbot ASC has the largest standard deviation.

There are few of the socioeconomic variable that are statistically significant. Looking at the uninformed consumer (table 4.7), those respondents who are between 18 and 35 years old are more likely to choose salmon, their WTP is €1.06 per 250g (*ceteris paribus*). Having a high education as well as being the housekeeping person has a negative impact on the probability of choosing salmon. For turbot, an increasing household size decreases the probability of choosing this type of seafood. The result is not unexpected, as turbot is relatively expensive. For both species, those consumers have a positive WTP who regularly purchase seafood in supermarkets. Furthermore, the WTP for salmon is positive among the respondents who purchase seafood mainly in discounters. However, the discounter variable is negative and insignificant for turbot, which can be explained by the fact that turbot is generally not available in discounters. As expected, frequent seafood consumers are more likely to choose salmon and turbot. However, the WTP is slightly higher for turbot (€2.74 per 250g) than for salmon (€1.48 per 250g). Additionally, well informed consumers are less likely to choose salmon.

Notice from table 4.8, that the results for the informed respondent in the most cases just vary in the magnitudes relatively to the uninformed respondents. For salmon, low educated respondents have a conspicuous high WTP (€8.18 per 250g) after being informed. Furthermore, the probability of choosing salmon decreases for persons who mainly buy fish products in discounters. For turbot, the probability of being chosen slightly increases for persons who mainly purchase seafood in supermarkets. Furthermore, the variables fishmonger and 'good-to-protect' become significant for salmon.

Table 4.8: Estimation Results of the Mixed Logit Model, Informed Respondents

Variable	Salmon					Turbot						
	Main Effects Only		Interaction Effects			Main Effects Only		Interaction Effects				
	Coefficient	SE	Coefficient	SE	Marginal Eff.	WTP	Coefficient	SE	Coefficient	SE	Marginal Eff.	WTP
Price	-0.473***	0.09	-0.493***	0.10	-0.052		-0.221*	0.10	-0.242*	0.10	-0.027	
Aqua	-0.878***	0.19	-1.033***	0.20	-0.061	-2.096	-0.616**	0.23	-0.561*	0.22	-0.034	-2.321
Frozen	-0.809***	0.16	-0.872***	0.16	-0.052	-1.768	-0.619**	0.20	-0.625**	0.20	-0.045	-2.584
ASC	1.972***	0.23	2.084***	0.24	0.135	4.503	-0.902	0.69	-0.761	0.63	-0.004	-8.069
MSC	2.298***	0.43	2.220***	0.38	0.159	4.226	1.912***	0.24	1.950***	0.24	0.182	3.147
Male			0.333	0.23	0.035	0.675			0.153	0.21	0.115	0.631
Age 18-35			0.639*	0.29	0.066	1.296			-0.052	0.26	-0.005	-0.213
Age >56			0.052	0.28	0.005	0.105			-0.05	0.28	-0.005	-0.208
Low Income			-0.135	0.26	-0.014	-0.275			0.026	0.24	0.003	0.108
High Income			0.015	0.29	0.002	0.031			-0.141	0.27	-0.014	-0.584
High Edu			-0.192	0.24	-0.020	-0.390			-0.419	0.23	-0.042	-1.735
Low Edu			4.030**	1.39	0.420	8.175			1.168	0.84	0.123	4.831
Employed			-1.540	0.99	-0.099	-3.124			-1.133	0.65	-0.111	-4.690
Singles			0.051	0.25	0.003	0.103			-0.305	0.24	-0.029	-1.263
Kids			-0.138	0.36	-0.009	-0.279			0.182	0.33	0.018	0.755
Housekeeper			-0.606*	0.25	-0.040	-1.229			-0.571*	0.23	-0.054	-2.363
Hhsize			0.064	0.14	0.004	0.130			-0.239	0.12	-0.023	-0.989
Frequent			1.203***	0.23	0.079	2.440			0.867***	0.21	0.084	3.586

4. Assessing Consumer Preferences and Willingness to Pay for Fish

Discounter			0.591*	0.28	0.038	1.199		-0.251	0.24	-0.023	-1.037
Supermarket			0.759***	0.23	0.050	1.540		0.590**	0.21	0.056	2.442
Fishmonger			0.828***	0.24	0.053	1.680		0.087	0.23	0.008	0.358
Goodtoprotect			0.601**	0.22	0.038	1.220		0.234	0.21	0.022	0.966
Wellinformed			-0.410	0.22	-0.026	0.831		-0.051	0.21	-0.050	-0.210
Highquality			0.513	0.36	0.033	1.040		0.116	0.31	0.011	0.481
St.dev. of non-i.i.d.residuals											
Aqua	1.844***	0.28	1.834***	0.29		2.608***	0.38	2.411***	0.37		
Frozen	1.985***	0.22	2.041***	0.25		2.543***	0.46	2.536***	0.46		
ASC	1.518***	0.45	1.461***	0.43		4.709***	1.18	4.638***	1.12		
MSC	3.280**	1.22	3.056**	0.93		2.549***	0.39	2.544***	0.38		
Constant	2.769***	0.38	3.093**	1.15	0.301	0.890*	0.44	2.600**	0.92	0.250	
Log-likelihood	-1,365.74		-1,305.13			-1,397.13		-1,371.34			
AIC	2,751.48		2,668.26			2,814.27		2,800.68			
Observation	4,365		4,365			4,365		4,365			
Pseudo R2	0.058		0.050			0.060		0.057			

p***<0.01, p**<0.05, p*<0.10.

Source: Own Estimations.

4.6 Summary and Conclusion

Based on a randomly selected sample of 485 German consumers, the willingness to pay for seafood attributes including the production mode, process form and eco-labeling is examined. Empirical results from the Mixed Logit Model is generally similar to earlier studies. We show that German consumers have preferences for sustainable seafood from certified wild fisheries resulting from concerns regarding farmed seafood production. On average, the survey participants prefer wild fish over farmed fish and have a high willingness to pay for seafood certified by the MSC. This is in line with the research of Roheim et al. (2012) who indicated price premiums for MSC certified fish on the US market with actual market data. Also several studies for the UK find a higher willingness to pay for MSC certified seafood (Roheim et al., 2011; Sogn-Grundvåg et al., 2014).

A high share of respondents believes that farmed products have a negative environmental impact and are of lower quality than wild seafood. However, for salmon, the recently introduced ASC label mitigate this to a substantial extent. For turbot, even the ASC logo does not invalidate the negative view of aquaculture and the ASC certification has no influence on the purchase decision of the respondents.

Furthermore, the consumers favor fresh fish compared to frozen fish. This finding is a contradiction to actual market behavior of German consumers, as according to FIZ (2015) in 2014 frozen fish has a share of 30 % of the total per-capita consumption¹⁵ of fish in Germany. Roheim et al. (2012) argue that this finding may be a lack of knowledge of the consumers in particular with regard to the state of the art freezing technology.

Giving information to the respondents in most cases leads to an increase in the magnitude of the effect. Thus, we conclude that consumers are sensitive to information. The statistically significant standard deviations of the random parameters verify the need to focus on the mixed logit model which explicitly takes the consumer heterogeneity into account. Often, the variability cannot be captured just by the product attributes and characteristics of the respondents. We show that consumers vary in their preferences.

¹⁵ In 2014 the per-capita fish consumption in Germany amounts to 14 kg.

In general, findings from stated preference studies like DCE may have an influence on the relationship between seafood market and fisheries and aquaculture management (Davidson et al., 2012). There is no reason, why the German consumers may value various seafood attributes similarly to consumers on foreign markets. Due to the fact, that Germany is a large import market for seafood (FAO, 2014) the results are interesting not only for seafood exporters. However, to verify these results in further investigations it would be beneficial to conduct a random coefficient model, which accounts for preference heterogeneity among consumers using actual market data in the context of methodological strengths and weaknesses. The main drawback of DCE is that often respondents are tempted to state a WTP or purchase decision that does not represent their true preferences. There is a variety of reasons for such behavior. For example, there is a risk of stating preferences that are socially desired and thus biased (Lusk et al., 2007).

References

- Asche, F., & Bjørndal, T. (2011). *The Economics of Salmon Aquaculture. -2nd ed.* UK: Wiley-Blackwell.
- Asche, F., Guttormsen, A., & Nielsen, R. (2013). Future challenges for the maturing Norwegian salmon aquaculture industry: An analysis of total factor productivity change from 1996 to 2008. *Aquaculture, Vol. 396*, 43-50.
- Ben-Akiva, M., McFadden, D., Abe, M., Böckenholt, U., Bolduc, D., Gopinath, D., . . . Steinberg, D. (1997). Modeling Methods for Discrete Choice Analysis. *Marketing Letters, Vol. 8*, 273-286.
- Bronnmann, J., & Asche, F. (2016). The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany. *Journal of Agricultural Economics, Vol. 67*, 231-244.
- Davidson, K., Pan, M., Hu, W., & Poerwanto, D. (2012). Consumers' willingness to pay for aquaculture fish products vs. wild-caught seafood- A case study in Hawaii. *Aquaculture Economics and Management, Vol. 16*, 136-154.
- FAO. (2014). *The State of World Fisheries and Aquaculture 2014*. Rome: Food and Agriculture Organization of the United Nations.
- FAO. (2015). *FAO Fisheries and Aquaculture Department*. Retrieved from Online Query Panels: <http://www.fao.org/fishery/topic/16140/en> , accessed 21.12.2015
- Fernandez-Polanco, J., & Bjørndal, T. (2013). Turbot Markets Constrained by Recession, Spanish Demand Dictates Production. *global aquaculture the advocate, Vol. 16*, 56-57.
- Fernández-Polanco, J., Mueller Loose, S., & Luna, L. (2013). Are retailers' preferences for seafood attributes predictive for consumer wants? Results from a choice experiment for seabream (*Sparus aurata*). *Aquaculture Economics and Management, Vol. 17*, 103-122.

FIZ. (2015). *Fischwirtschaft -Daten und Fakten 2014*. Retrieved from Fischinformationszentrum: <http://www.fischinfo.de>.

Hanemann, W. (1984). Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses. *American Journal of Agricultural Economics*, Vol. 66, 332-341.

Hensher, D., Rose, J., & Greene, W. (2005). *Applied Choice Analysis, 1st ed.* Cambridge, UK: Cambridge University Press.

Hole, A. (2007). Estimating mixed logit models using maximum simulated likelihood. *Stata Journal*, Vol. 7, 388-401.

Jaffry, S., Pickering, H., Ghulam, Y., Whitmarsh, D., & Wattage, P. (2004). Consumer Choices for Quality and Sustainability Labelled Seafood Products in the UK. *Food Policy*, Vol. 29, 215-228.

Johnston, R., & Roheim, C. (2006). A Battle of Taste and Environmental Convictions for Ecolabeled Seafood: A Contingent Ranking Experiment. *Journal of Agricultural and Resource Economics*, Vol. 31, 283-300.

Johnston, R., Wessells, C., Donath, H., & Asche, F. (2001). Measuring consumers preferences for ecolabeled seafood: An international comparison. *Journal of Agricultural and Resource Economics*, Vol. 26, 20-39.

Kuhfeld, W., Tobias, R., & Garrat, M. (1994). Efficient experimental design with marketing research applications. *Journal of Marketing Research*, Vol. 33, 243-364.

Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economics*, Vol. 74, 132-157.

Larsen, T., & Asche, F. (2011). Contracts in the salmon aquaculture industry: An analysis of Norwegian salmon exports. *Marine Resource Economics*, Vol. 26, 141-150.

Loureiro, M., & Umberger, W. (2007). A Choice Experiment Model for Beef: What US Consumer Responses Tell Us about Relative Preferences for Food Safety, Country of Origin Labeling and Traceability. *Food Policy*, Vol. 32, 496-514.

Louviere, K., Hensher, D., & Swait, J. (2000). *Stated Choice Methods: Analysis and Application*. Cambridge, UK: Cambridge University Press.

- Lusk, J., Norwood, F., & Prickett, R. (2007). Consumer Preferences for Farm Animal Welfare: Results of a Nationwide Telephone Survey. *Working Paper, Department of Agricultural Economics, Oklahoma State University.*
- Marine Harvest. (2015). *Salmon Farming Industry Handbook*. Retrieved from <http://www.marineharvest.com/globalassets/investors/handbook/2015-salmon-industry-handbook.pdf>
- McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka, *Frontiers of Econometrics*. New York: Academic Press.
- Onozaka, Y., & McFadden, T. (2011). Does local labeling complement or compete with other sustainable labels? A conjoint analysis of direct and joint values for fresh produce claims. *American Journal of Agricultural Economics*, Vol. 93, 693-706.
- Parsons, G., & Kealy, M. (1992). Randomly Drawn Opportunity Sets in a Random Utility Model of Lake Recreation. *Land Economics*, Vol. 68, 93-106.
- Quagraine, K., Hart, S., & Brown, P. (2008). Consumer acceptance of locally grown food: the case of Indiana aquaculture products. *Aquaculture Economics and Management*, Vol. 12, 54-70.
- Roheim, C. (2008). The economics of ecolabeling. In T. Ward, & B. Phillips, *Seafood Ecolabelling Principals and Practice* (S. 38-57). Oxford, UK: Wiley-Blackwell.
- Roheim, C., Asche, F., & Insignares Santos, J. (2011). The elusive price premium for ecolabelled products: Evidence from seafood in the UK market. *Journal of Agricultural Economics*, Vol. 62, 655–668.
- Roheim, C., Sudhakaran, P., & Durham, C. (2012). Certification of shrimp and salmon for best aquaculture practice: Assessing consumers preferences in Rhode Island. *Aquaculture Economics and Management*, Vol. 16, 266-286.
- Sogn-Grundvåg, G., Larsen, T., & Young, J. (2014). Product differentiation with credence attributes and private labels: The case of whitefish in UK supermarkets. *Journal of Agricultural Economics*, Vol. 65 , 368–382.

Wessells, C., Johnston, R., & Donath, H. (1999). Assessing consumer preferences for ecolabeled seafood: the Influence of species, certifier and household attributes. *American Journal of Agricultural Economics*, Vol. 81, 1084-1089.

Wirthgen, A. (2005). Consumer, retailer, and producer assessments of product differentiation according to regional origin and process quality. *Agribusiness*, Vol. 21, 191-211.

Appendix
Table A4.1: Description of the Variables used in the Model

	Description	Salmon Mean (SD)	Turbot Mean (SD)
Price	Price in € per 250 g fillet	1.92 (1.58)	2.21 (1.88)
Aqua	Product is farmed	0.574	0.519
Frozen	Product is frozen	0.578	0.521
ASC	Product carries ASC label	0.466	0.408
MSC	Product carries MSC label	0.392	0.471
Male	Respondent is male	0.416	0.416
Age 18-35	Respondent is between 18-35 years old	0.394	0.394
Age >56	Respondent is over 56 years old	0.274	0.274
Low Income	Respondents income is > €500- €1.499	0.303	0.303
High Income	Respondents income is €3.500 -< €4.500	0.243	0.243
High Edu	Respondent has a high school and/or a university degree	0.623	0.623
Low Edu	Respondent has a primary school degree	0.021	0.021
Employed	Respondent is employed	0.971	0.971
Singles	Respondent lives in a single household (incl. separated/widowed/divorced)	0.367	0.367
Kids	Respondent has children	0.373	0.373
Housekeeper	Respondent is the housekeeping person	0.612	0.612
Hhsize	Household size of the respondent	2.43 (1.08)	2.43 (1.08)
Frequent	Respondent purchases fish at least once a week	0.425	0.425
Discounter	Respondent purchases fish primary in discounters	0.253	0.253
Supermarket	Respondent purchases fish primary in supermarkets	0.457	0.457
Fishmonger	Respondent purchases fish primary at fishmongers	0.297	0.297
Goodtoprotect	Respondent agrees to the statement A9	0.678	0.678
Wellinformed	Respondents agrees to the statement S2 and S8	0.435	0.435

Source: Own calculations.

Fragebogen zu Verbraucherpräferenzen gegenüber Fisch aus Aquakulturanlagen und nachhaltigem Fisch

Herzlich willkommen! Wir freuen uns darüber, dass Sie an unserer Studie teilnehmen. In dieser Studie wollen wir die Verbraucherpräferenzen gegenüber Fischprodukten aus Aquakulturanlagen sowie nachhaltig erzeugten Fischprodukten untersuchen. Dafür ist uns Ihre Meinung wichtig und wir bitten Sie, die folgenden Fragen zu beantworten.

Sie bleiben anonym!

Ihre Antworten werden selbstverständlich vertraulich behandelt. Sie bleiben anonym und Ihre Antworten werden nur im Rahmen des universitären Forschungsprojektes verwendet und nicht an Dritte weitergegeben.

Vielen Dank für Ihre Unterstützung!

Zunächst geht es um Ihre Entscheidung beim Kauf von Lachs- und Steinbuttfilets, die aus Fischen produziert wurden, welche in Aquakulturanlagen gezüchtet oder wild -gefangen wurden. Die Produkte unterscheiden sich außerdem dadurch, dass einige ein Gütesiegel tragen, das nachhaltigen und verantwortungsvollen Fischfang und Aquakulturproduktion kennzeichnet.



**Dabei kennzeichnet das blaue Siegel
Fisch, der nachhaltig gefangen wurde.**




**Das türkise Siegel kennzeichnet Fisch
aus nachhaltiger Aquakultur.**

Weiter unterscheiden sich die Produkte darin, dass sie unterschiedlich verarbeitet sind. Es handelt sich um frische und tiefgekühlte Filets. Im Folgenden werden Ihnen Karten vorgestellt, die zwei alternative Produkte und eine Option des Nicht-Kaufes repräsentieren. Treffen Sie bitte pro Karte eine Entscheidung.



A1. Bitte entscheiden Sie als Erstes, welchen LACHS Sie kaufen würden.

Der Lachs zählt zu den Edelfischen. Er hat einen silbrig glänzenden, dunkelgrauen Rücken und einen hellen Bauch. Charakteristisch ist das orangefarbene Fleisch. Lachse werden maximal 1,50 m lang und 35 kg schwer.



	Produkt 1	Produkt 2	
Preis in € pro 250 g	3,31 €	4,60 €	Keines der Produkte
Produktion	gezüchtet	gezüchtet	
Nachhaltigkeitslabel	nein		
Verarbeitungsform	frisches Filet	frisches Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A2. Bitte entscheiden Sie auch hier, welchen LACHS Sie kaufen würden:

	Produkt 1	Produkt 2	
Preis in € pro 250 g	4,05 €	3,68 €	Keines der Produkte
Produktion	wild gefangen	gezüchtet	
Nachhaltigkeitslabel			
Verarbeitungsform	tiefgekühltes Filet	frisches Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>


A3. Bitte entscheiden Sie auch hier, welchen LACHS Sie kaufen würden:

	Produkt 1	Produkt 2	
Preis in € pro 250 g	2,76 €	3,68 €	Keines der Produkte
Produktion	wild gefangen	wild gefangen	
Nachhaltigkeitslabel	nein	nein	
Verarbeitungsform	frisches Filet	tiefgekühltes Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>


A4. Im Folgenden entscheiden Sie bitte, welchen STEINBUTT Sie kaufen würden.

Der Steinbutt ist ein Plattfisch und zählt wie der Lachs zu den Edelfischen. Seine Unterseite ist weiß, die Oberseite passt sich an die Umgebung an. Der Speisefisch erreicht eine Länge von 50 bis 70 Zentimetern und ein Gewicht von maximal 20 kg. Im Handel wird er auch Turbutt genannt.




	Produkt 1	Produkt 2	
Preis in € pro 250 g	3,86 €	5,36 €	Keines der Produkte
Produktion	gezüchtet	gezüchtet	
Nachhaltigkeitslabel	nein		
Verarbeitungsform	frisches Filet	tiefgekühltes Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A5. Bitte entscheiden Sie auch hier, welchen STEINBUTT Sie kaufen würden:

	Produkt 1	Produkt 2	
Preis in € pro 250 g	4,72 €	4,29 €	Keines der Produkte
Produktion	wild gefangen	gezüchtet	
Nachhaltigkeitslabel		nein	
Verarbeitungsform	tiefgekühltes Filet	frisches Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A6. Bitte entscheiden Sie auch hier, welchen STEINBUTT Sie kaufen würden:

	Produkt 1	Produkt 2	
Preis in € pro 250 g	3,86 €	4,29 €	Keines der Produkte
Produktion	wild gefangen	gezüchtet	
Nachhaltigkeitslabel	nein		
Verarbeitungsform	frisches Filet	frisches Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

B1. Bitte geben Sie Ihr Geschlecht an.

- männlich weiblich

B2. Bitte geben Sie zur räumlichen Zuordnung Ihren Wohnort und Ihre Postleitzahl an.

Bitte nennen Sie uns Ihren Wohnort: _____

Bitte nennen Sie uns Ihre Postleitzahl: _____

B3. In welchem Jahr sind Sie geboren? 19_____

B4. Wie viele Personen leben in Ihrem Haushalt (zählen Sie sich bitte mit)? _____

B5. Wie viele davon sind Kinder unter 18 Jahren? _____

B6. Wie hoch ist Ihr monatliches Nettohaushaltseinkommen?

Bitte kreuzen Sie **ein** Kästchen an.

- unter 500€ 500 – 1499€€ 1500 - 2499€ 2500 - 3499€
 3500 - 4499€ > 4500€

B7. Welches ist Ihr höchster Bildungsabschluss?

- Hauptschulabschluss abgeschlossene Berufsausbildung
 mittlere Reife (Realschulabschluss) Hochschulabschluss (Universität, FH)
 Abitur Sonstiges _____

B8. Welchen Beruf üben Sie aus?

- Vollzeitjob Arbeitsuchend Rentner
 Teilzeitjob Selbstständig Sonstiges _____

B9. Wie ist ihr Familienstand?

- verheiratet/eingetragene Partnerschaft ledig
 zusammenlebend getrennt/verwitwet/geschieden

B10. Sind Sie in Ihrem Haushalt verantwortlich dafür, die Dinge des täglichen Bedarfs einzukaufen?

- Ja Nein teils teils

C1. Wie häufig essen Sie Fisch?

- täglich monatlich
 wöchentlich mehrmals im Monat
 mehrmals im Jahr nie

C2. Wenn nie, warum essen Sie keinen Fisch? (Wenn Sie keinen Fisch essen nach dieser Frage bitte weiter mit Frage C10)

- ich bin Vegetarier/Veganer
- aufgrund der Überfischung
- aufgrund der Schädigung der Umwelt, die mit der Fischproduktion in Verbindung gebracht wird
- aufgrund der hohen Quecksilberanteile im Fisch
- die Zubereitung von Fisch riecht unangenehm
- meine Kinder essen keinen Fisch
- Sonstige _____

C3. Welche drei Fischarten essen Sie am häufigsten?

C4. Welche drei Fischarten schmecken Ihnen am besten?

C5. Gibt es Fischarten die Sie vermeiden zu essen? Wenn ja, welche und warum?

- Ja, _____ weil, _____
- Nein

C6. Wo essen Sie häufig Fisch? (Mehrfachantwort möglich)

- im Restaurant
- Zuhause
- Fast Food/ zum Mitnehmen (z.B. Fischbrötchen)
- Sonstige _____

C7. Bitte geben Sie an, wo Sie in der Regel Fisch einkaufen? (Mehrfachantwort möglich)

- | | |
|---|---|
| <input type="checkbox"/> Supermarkt (z.B. Edeka, Rewe, Sky) | <input type="checkbox"/> Discounter (z.B. Aldi, Lidl, Penny, Netto) |
| <input type="checkbox"/> Verbrauchermarkt (z.B. Metro, Famila, Citti) | <input type="checkbox"/> Wochenmarkt |
| <input type="checkbox"/> spezielles Fischfachgeschäft | <input type="checkbox"/> direkt vom Fischer |
| <input type="checkbox"/> Sonstige _____ | |

C8. Wie ist der Fisch, den Sie häufig essen verarbeitet? (Mehrfachantwort möglich)

- | | |
|---|---|
| <input type="checkbox"/> ganzer frischer Fisch | <input type="checkbox"/> frisches Filet |
| <input type="checkbox"/> ganzer tiefgefrorener Fisch | <input type="checkbox"/> tiefgefrorenes Filet |
| <input type="checkbox"/> verarbeitet (z.B. Fischstäbchen, Fischkonserven, Räucherlachs) | |
| <input type="checkbox"/> vorbereitete Gerichte (z.B. Fischsuppen, Fertigmensüs) | |
| <input type="checkbox"/> Sonstige _____ | |

C9. Wenn ich Fisch einkaufe achte ich insbesondere auf

Nutzen Sie dafür folgende Skala und kreuzen Sie an.

	1	2	3	4	5	6	7
	Stimme überhaupt nicht zu	Stimme fast gar nicht zu	Stimme eher nicht zu	Neutral/weiß nicht	Stimme schon eher zu	Stimme weitgehend zu	Stimme voll zu
den Preis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
den Geschmack	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
die Frische	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
die gesundheitliche Vorteilhaftigkeit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Umwelt- und Nachhaltigkeitsaspekte	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
die Herkunft	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
die Fischart	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
die Produktionsmethode (wildgefangen vs. Aquakultur)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

C10. Bitte geben Sie auch hier an, in welchem Maß Sie folgenden Aussagen zustimmen:

Nutzen Sie dafür folgende Skala und kreuzen Sie an.

	1	2	3	4	5	6	7
	Stimme überhaupt nicht zu	Stimme fast gar nicht zu	Stimme eher nicht zu	Neutral/weiß nicht	Stimme schon eher zu	Stimme weitgehend zu	Stimme voll zu
Gezüchteter Fisch ist umweltfreundlicher	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gezüchteter Fisch ist gesünder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gezüchteter Fisch schmeckt besser	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gezüchteter Fisch enthält keine chemischen Rückstände	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gezüchteter Fisch sieht besser aus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gezüchteter Fisch ist von höherer Qualität	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Die Auswahl an gezüchtetem Fisch im Supermarkt ist reichlich	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gezüchteter Fisch ist preisgünstiger	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fischzucht in Aquakultur ist eine gute Möglichkeit, die Fischbestände vor Überfischung zu schützen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

C11. Welchen Standpunkt vertreten Sie in Bezug auf folgende Statements?

Nutzen Sie dafür folgende Skala und kreuzen Sie an.

	1	2	3	4	5	6	7
	Stimme überhaupt nicht zu	Stimme fast gar nicht zu	Stimme eher nicht zu	Neutral/weiß nicht	Stimme schon eher zu	Stimme weitgehend zu	Stimme voll zu
Nachhaltigkeit ist mir wichtig	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich bin über Fischfangmethoden informiert	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es ist wichtig, Gewässer vor der Überfischung zu schützen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich achte beim Einkaufen auf nachhaltige Fangmethoden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fischfangmethoden sollten vor allem umweltfreundlich sein	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ressourcen-schonende Fischfangmethoden sollten stärker eingesetzt werden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich kann durch den Einkauf nachhaltiger Produkte dazu beitragen, dass Überfischung eingeschränkt wird	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich bin darüber informiert, welche Fischarten von der Überfischung bedroht sind	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich bin der Meinung, dass Nachhaltigkeitssiegel glaubwürdig sind	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Bitte entscheiden Sie sich jetzt noch einmal zwischen Lachs- und Steinbuttprodukten. Vorher wollen wir Ihnen kurz erklären, wie die Fische gezüchtet werden und wofür die Nachhaltigkeitslabel stehen.

Die Aquakultur befasst sich mit der kontrollierten Aufzucht und Haltung von Organismen, die im Wasser leben. Dazu zählen auch der Lachs und der Steinbutt. Es gibt mehrere Möglichkeiten, Fische zu züchten. Wir wollen Ihnen kurz erläutern, welches die gängigsten Verfahren zur Lachs- und Steinbuttzucht sind.

Lachszucht

Lachse werden zumeist in Netzgehegen gezüchtet. Die Netze befinden sich in Fjorden oder in geschützten Buchten in Küstennähe. Die Behälter sind im Meeresboden verankert, so dass sie nicht davonschwimmen können. Ganz neu sind Riesengehege, die unverankert kilometerweit vor der Küste im freien Meer schwimmen. Netzgehege haben den Vorteil, dass sie ständig von frischem Wasser durchspült werden.

Steinbuttzucht

Für die Steinbuttzucht werden derzeit künstliche Wasserbecken eingesetzt. So genannte Kreislaufanlagen machen durch die Verwendung von spezieller Filtertechnik und Wasserbehandlung das genutzte Frischwasser wieder verwendbar. Hier kann Fisch in Seewasser oder Süßwasser erzeugt werden, ohne von einer natürlichen Wasserquelle, von einem Bachlauf oder Fluss gespeist zu werden. Der Zuchtbetrieb ist an eine Wasserleitung angeschlossen. Das Wasser wird mit Mineralstoffen angereichert und auch Temperatur und Licht werden den optimalen Wachstumsbedingungen und dem Biorhythmus des Fisches angepasst.

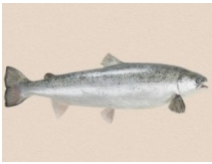


Mit dem blauen Marine Stewardship Council (MSC) Siegel werden Fischprodukte gekennzeichnet, die aus wildgefangenen Fischen hergestellt werden, die von zertifizierten Fischereien stammen. Die Fischereien betreiben ein **effektives und verantwortungsbewusstes Management**. Sie achten insbesondere auf den **Schutz der Bestände (keine Überfischung)** und ihre Fangmethoden haben **minimale Auswirkungen auf das Ökosystem**.



Mit dem türkisen Aquaculture Stewardship Council (ASC) Siegel werden Fischprodukte gekennzeichnet, die aus Fischen hergestellt werden, die aus verantwortungsbewusster Zucht stammen. Die Zuchtbetriebe müssen Maßnahmen ergreifen, um die **Wasserverschmutzung auf ein Minimum** zu reduzieren, **Fischfutter muss aus verantwortungsvollen Quellen stammen, die Nahrungsmittelsicherheit muss gewährleistet** sein, indem der **Einsatz von Medikamenten und Chemikalien kontrolliert** und minimiert wird, **Auswirkungen auf die Umwelt müssen reduziert** werden.

D1. Bitte entscheiden Sie sich zunächst wieder, welchen LACHS Sie kaufen würden:



	Produkt 1	Produkt 2	
Preis in € pro 250 g	2,76 €	4,05 €	Keines der Produkte
Produktion	wild gefangen	wild gefangen	
Nachhaltigkeitslabel	nein		
Verarbeitungsform	tiefgekühltes Filet	tiefgekühltes Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D2. Bitte entscheiden Sie auch hier, welchen LACHS Sie kaufen würden:


	Produkt 1	Produkt 2	
Preis in € pro 250 g	3,68 €	3,68 €	Keines der Produkte
Produktion	wild gefangen	gezüchtet	
Nachhaltigkeitslabel	nein		
Verarbeitungsform	tiefgekühltes Filet	tiefgekühltes Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D3. Bitte entscheiden Sie auch hier, welchen LACHS Sie kaufen würden:

	Produkt 1	Produkt 2	
Preis in € pro 250 g	4,05 €	2,76 €	Keines der Produkte
Produktion	gezüchtet	gezüchtet	
Nachhaltigkeitslabel	nein	nein	
Verarbeitungsform	frisches Filet	tiefgekühltes Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D4. Jetzt entscheiden Sie bitte wieder, welchen STEINBUTT Sie kaufen würden:



	Produkt 1	Produkt 2	
Preis in € pro 250 g	3,21 €	3,86 €	Keines der Produkte
Produktion	wild gefangen	wild gefangen	
Nachhaltigkeitslabel	nein		
Verarbeitungsform	tiefgekühltes Filet	frisches Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D5. Bitte entscheiden Sie auch hier, welchen STEINBUTT Sie kaufen würden:

	Produkt 1	Produkt 2	
Preis in € pro 250 g	4,29 €	3,21 €	Keines der Produkte
Produktion	wild gefangen	gezüchtet	
Nachhaltigkeitslabel	nein	nein	
Verarbeitungsform	tiefgekühltes Filet	tiefgekühltes Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D6. Bitte entscheiden Sie auch hier, welchen STEINBUTT Sie kaufen würden:

	Produkt 1	Produkt 2	
Preis in € pro 250 g	4,72 €	4,29 €	Keines der Produkte
Produktion	gezüchtet	wild gefangen	
Nachhaltigkeitslabel	nein	nein	
Verarbeitungsform	frisches Filet	frisches Filet	
Ich entscheide mich für:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Wir bedanken uns herzlich für Ihre Teilnahme!

5. Kapitel

Preference Heterogeneity in the Demand for Salmon: A Random Coefficients Approach

Autoren:

Julia Bronnmann and Frank Asche

Working Paper

Preference Heterogeneity in the Demand for Salmon: A Random Coefficients Approach

JULIA BRONNMANN AND FRANK ASCHE

Abstract

Seafood consumers face an increasing load of information in the forms of brands and labels when making their purchasing decision. In recent years ecolabeling has received substantial attention in relation to fisheries, and environmental effects related to aquaculture have been shown to make consumers prefer wild-caught fish. This study examines the importance of the attributes farmed and MSC-ecolabeled as well as different brands of frozen salmon in Germany. A household scanner panel dataset, which provides purchase information and socioeconomic variables is analyzed using a mixed logit model. The results indicate that preferences regarding production mode and ecolabeling vary among consumers. We find that 72 % of the households have a higher probability of purchasing farmed salmon over wild salmon while 74 % of the households have a higher probability to avoid ecolabeled salmon. These results are highly interesting, as they deviate substantially from several stated preference studies. Furthermore, in several cases the brand appears to be more relevant for the purchasing decision.

Keywords: aquaculture, consumer choices, random parameter logit, seafood market

JEL Classification Codes: C18, D12, Q22

5.1 Introduction

The information buyers of seafood are facing is becoming increasingly complex with different forms of branding, labeling and consumer information. In this complex environment, sustainability is an important key element. In particular, in recent years ecolabeling and production mode (farmed vs. wild) have become increasingly important due to the perception that many production practices are environmentally unsustainable. However, the fact that consumers face a number of messages with different labels has until recently received little attention in the ecolabeling literature in general (Onozaka and McFadden, 2011) and for seafood in particular (Brécard et al., 2012 ; Uchida et al., 2014).¹⁶ These studies use stated preference data focusing on the ecolabels and consumer characteristics. They do not account for other types of information or choices such as brands and retail chains that the consumers are facing, including the private labels of the retail chains. These matter, as Asche et al. (2015) use a hedonic price function and report that there is substantial variation in the premium associated with the Marine Stewardship Council (MSC) labeled salmon, which varies substantially between retailers. However, Asche et al (2015) do not have any information on consumer characteristics. In this study we have access to a consumer panel of purchases of frozen salmon in Germany. This allows us to investigate the influence of production mode, ecolabel, brand and private label and to account for consumer characteristics for the probability to purchase a seafood product, in this case salmon.¹⁷

The use of the ecolabel of the MSC has increased rapidly in recent years, providing consumers with the opportunity to purchase seafood from fisheries that are certified as sustainable. A number of stated preference studies indicate a preference for products which are sustainably sourced as shown by an ecolabel, as reviewed by Fonner and Sylvia (2015). Moreover, Brécard et al. (2012) and Saladarré et al. (2010) indicate that consumer characteristics influence the willingness to pay (WTP) for sustainably sourced fish and Johnson et al (2001) show that preferences also vary by country. Roheim et al. (2011), Sogn-Gruntvag et al. (2014) and Bronnmann and Asche (2016) use hedonic price functions to show that there is a positive price premium associated with the MSC label. However, Asche et al. (2015) and Blomquist et al. (2015) show that the MSC premium varies with retailer

¹⁶ Roheim (2008) first discussed this issue in relation to seafood.

¹⁷ Hence, our approach is similar to the one used by Chidmi and Lopez (2007) and Zhu et al. (2015).

and supply chain, and in some cases it is zero. Stemle et al. (2016) use a differences-in-differences approach to show that MSC labeling of Alaska salmon increased ex. vessel prices for some but not all species.

The production and consumption of aquaculture products is rapidly growing and is transforming seafood markets. Aquaculture is the world's fastest growing food production technology, with salmon as one of the leading species (Smith et al., 2010). While avoiding overfishing, aquaculture comes with a set of environmental challenges of its own (Naylor et al., 2000; Torrissen et al., 2013). These environmental challenges give the product a negative perception in the eyes of at least some consumers. For instance, Roheim et al. (2012) report a higher WTP for wild salmon for a sample of US consumers. Asche et al. (2015) and Ankamah-Yeboah et al. (2016) report a price premium associated with organic farmed salmon, that is reported to have a more environmentally friendly production process. However, market integration studies report a global market for all salmon with a common price determination process (Asche et al., 1999), and with a higher price for farmed Atlantic than for the wild species that presumably is associated with a higher perceived quality.¹⁸

In recent years, it has been noted that demographic variables are not sufficient to represent the variation in consumer preferences (Baker and Burnham, 2001; Grebitus et al., 2013), suggesting that a random parameter specification better reflects the heterogeneity in consumer preferences. However, it is not a choice between either a random parameter specification or a demographic variable specification when accounting for consumer heterogeneity. By including some standard demographical variables these can be explicitly accounted for, while the residual heterogeneity can be captured by the random parameters. Hence, we will use the Multinomial Mixed Logit Model¹⁹ with random parameters (Train, 2009), allowing for interactions between brands and demographic variables and the ecolabel and production mode, while also allowing for heterogeneity that is not captured by these variables. The random parameter specification is of potential importance when using scanner data, as they typically do not include in-depth questioning of consumers in relation to specific issues. For instance, attitude with respect to the environment has been found to be important for the WTP for an ecolabel (Wessells et al., 1999).

¹⁸ To our knowledge, these studies do not include the highest valued wild species, chinook.

¹⁹ According to Zhu et al. (2015) using the Berry, Levisohn, and Pakes' (1995) (BLP) random coefficient model would also be a specification alternative. However, the BLP model aggregates responds to market level data, using a sample of consumers for each market and therefore results in a loss of efficiency.

This paper is organized as follows. In the next section the data set is presented. In the third section, the methodology background is sketched. The translation of the theoretical model into an empirical model as well as the estimation results are shown in section four. Finally, we summarize our findings and draw some conclusions.

5.2 Data

We employ data for frozen salmon from a German household scanner data set, which was provided by the “Gesellschaft für Konsumforschung” (GfK) for the years 2008-2010 with a monthly frequency. The data contain 10,895 households that purchase salmon, making 33,977 purchases. Using the European Article Number Code (EAN-Code) each specific salmon product can be identified. Socio-demographic information is also collected for the panelists in an annual survey. The data set contains purchases of frozen salmon products from five private label brands (Aldi, Lidl, Edeka, Rewe and other private labels) as well as five traditional brands (Costa, Paulus, Iglo, Deutsche See and other brands). We only include those brands, which have a share over 0.5 % in the data and the remaining brands are aggregated respectively into the variables other brands and other private labels. Moreover, in Germany it is mandatory to inform consumers whether the product is farmed or wild. Which products are carrying the MSC ecolabel was obtained from the Marine Stewardship Council using the EAN codes.²⁰ Thus, we have information about the actual market choice of the households between 40 (10x2x2) scheme alternatives.

In accordance with the literature (Allender and Richards, 2012), we only use households that purchase one brand at time, as the Mixed Logit Model requires that the choices are mutually exclusive. This removes 6,044 observations or 18 % from the data set. Furthermore, only those households that purchased ten or more packages of salmon within the data period are considered. If the household purchases a single product, defining the choice is no problem. However, when they purchase more than one product in one period we have to choose randomly which one is the most representative of the household’s preferences. This reduces the original data set to 4,528 single purchase observations from 351 households, or 13 % of the original data set. We also need to specify the alternative choices that the consumer did not make. The prices of the alternatives are estimated as the mean of the observed purchases

²⁰ This together with store observation is the most common method to obtain information on ecolabeling when using scanner data as that information is not collected (Roheim et al., 2011; Asche et al., 2015).

of other households in the same month and the same region for each product. As a result, our final data set contains a total of 505,440 observations (351 households x 40 alternatives x 36 month).

The data set also contains household's characteristics: Income, household size, age of the household head, and a dummy for the occupation of the household head as well as the family status and place of residence of the household. Table 5.1 presents the descriptive statistics of the households characteristics (n=351).

The average age of the consumer is 52 years and he/she lives in a household with mostly 2.74 family members. The average monthly net income of the household in the analysis is € 2,529. 59 % of the consumers are employed and 63 % live in households with children. The proportion of single households in the study is relatively small (11 %). Furthermore, 70 % of the households are living in areas with less than 100,000 inhabitants.

Table 5.1: Descriptive Statistics for Consumers

Whole sample N=351			
Variable		Mean (SD)	Min Max
Age		52.46 (14.00)	22 70
Household size		2.74 (1.13)	1 8
Income		2529.24 (880.34)	499 4000
Dummy variables (1 =yes)			
		Proportion in %	
Employed		59.01	
Unemployed	base	40.99	
Family kids		63.28	
Family no kids	base	25.19	
Singles		11.08	
Partnership	base	88.92	
Rural	base	70.17	
Urban		29.83	

Source: Own calculations based on GfK ConsumerScan 2008-2010.

The summary statistics of the characteristics of the chosen products are presented in table 5.2. The average price, across all observations, is €2.46 per 250 g frozen salmon. Most of the salmon products are private label products from the discount chain Aldi (60 %), followed by Lidl (17.6 %) and Rewe (4.5 %). The consumers chose a relatively small proportion of

salmon products of the private label brand Edeka (0.9 %) and from other private labels (0.38 %). Looking at the branded salmon products, the majority of the households chose products from the brand Paulus (9.7 %) and Costa (3.5 %). Deutsche See and Costa account for approximately 0.6 % of choices. Furthermore, most of the households purchased products carrying no MSC label (74 %) and aquacultured salmon (70 %).

Table 5.2: Descriptive Statistics, Brands, Labels and Production Mode

		Chosen in %	Mean price in €/250g	Min	Max	SD
Private Label	Aldi	60.00	2.23	0.87	3.39	0.77
	Lidl	17.58	2.80	1.78	3.39	0.25
	Rewe	4.48	2.75	2.49	3.39	0.13
	Edeka	0.86	1.15	1.06	1.24	0.07
	Other_PL	0.38	2.58	0.81	2.69	0.46
Brands	Paulus	9.65	2.61	0.90	4.37	0.42
	Costa	3.53	3.66	1.28	4.99	0.99
	Deutsche See	0.66	5.48	3.89	6.24	0.56
	Iglo	0.62	3.48	2.49	3.99	0.08
	Other brand	2.23	2.19	1.25	2.99	0.37
No MSC		74.07	2.81	0.81	6.24	0.52
MSC		25.93	1.47	1.06	3.99	0.55
Aquaculture		70.21	2.85	0.81	6.24	0.47
Wild		29.79	1.53	1.06	3.99	0.78
Overall average			2.46	0.81	6.24	0.79

Source: Own calculations based on GfK ConsumerScan 2008-2010.

5.3 Model Specification

We follow the literature and use the random utility theory framework in investigating consumer choices (Thurstone, 1927; McFadden, 1974). This is consistent with the consumer theory of Lancaster (1966), where consumers maximize their utility based on product attributes rather than on the product themselves. In our model we consider consumers to be utility-maximizer who choose their most preferred alternative. That is, the indirect utility function of individual i choosing alternative j among J alternatives at a choice occasion t is written as:

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} \quad (5.1)$$

where ε_{ijt} is the random component of latent utility which cannot be measured. V_{ijt} is the deterministic or explainable component which is determined by the attribute levels and individual characteristics that are assumed to take a linear-in-parameters form and can be expressed as:

$$V_{ijt} = \beta_j x_{jt} + \gamma_{ijt} x_{jt} z_i + u_{ijt} \quad (5.2)$$

x_{jt} is the vector of attributes of product j at time t and z_i is the vector of characteristics of individual i . β_j are utility parameters for product j . Furthermore, the model allows including possible interaction effects of the product attributes and individual characteristics (Roheim et al., 2012).

The random utility model is transformed into a choice model by assuming that an individual i will choose alternative j , if and only if (iff) U_{ij} is greater than the utility derived from all the other alternatives in the choice set. We assume that product j is preferred to product k

$$\text{iff } P_{ij} = \text{Prob}(U_{ij} > U_{ik}) \forall k \neq j. \quad (5.3)$$

Therefore, choice can be modeled by estimating the probability P_{ij} of a respondent i choosing a specific product j .

To estimate this model, one must make assumptions about the nature of the random components of the utility model. Different discrete choice models are obtained from different assumptions about the distribution of the random terms. Typically, it is assumed that the random components are independently and identically distributed following a type 1 extreme value distribution (Gumble distribution) (Greene, 2012). This condition implies that the variance of the random component of the utilities is identical and the alternatives are independent (IIA) (Louviere et al., 2000). The strong IIA (independent of irrelevant alternatives) assumption indicates that substitution patterns are not driven by the similarity of products but by market shares. This assumption was relaxed by allowing for consumer heterogeneity by estimating the parameters that drive the distribution of tastes (“random coefficients” models) (McFadden and Train, 2000).

The Mixed Logit Model with random parameters across decision makers shows the advantage of allowing taste heterogeneity unconditional on socioeconomic covariates (Grebitus et al., 2013; Menpance et al., 2008). It solves the three limitations of standard logit models: the model relaxes IIA assumption, allows for random taste variation and the correlation of unobserved factors over time.

The Mixed Logit Model can be derived using the random utility approach. The only difference is that some parameters are allowed to vary over individuals. Thus, the difference is found in the observed part of the utility V_{ij} (compare equation 5.1 and 5.2).

$$V_{ij} = \beta_{ij}x_{jt} + \gamma_{ij}x_{jt}z_i + u_{ij} \quad (5.4)$$

where β_{ij} is the vector of coefficients which are now specific to the decision maker and representing the individual's taste. The β varies over decision makers. For example if the price is observed for each product, the degree of price sensitivity might vary over the individuals. If we assume, that the researcher might observe β_{ij} , the probability of choosing alternative j , conditional on β is standard logit (Revelt and Train, 1999):

$$L_{ij} = (\beta_{ij}) = \frac{e^{\beta_{ij}x_{jt} + \gamma_{ij}x_{jt}z_i}}{\sum_k e^{\beta_{kj}x_{jt} + \gamma_{kj}x_{jt}z_i}} \quad (5.5)$$

However, β_{ij} is unknown and therefore cannot condition on β . The choice probability is therefore the integral of all possible values of β_{ij} , which are described by the distribution that is assumed for β_{ij} (Bonnet and Simioni, 2001):

$$P_i = \int \left(\frac{e^{\beta_{ij}x_{jt} + \gamma_{ij}x_{jt}z_i}}{\sum_k e^{\beta_{kj}x_{jt} + \gamma_{kj}x_{jt}z_i}} \right) f(\beta \setminus \theta) d\beta \quad (5.6)$$

θ are the population parameters for the distribution of β_{ij} , which is a priori decision of the researcher.

Thus, the log-likelihood function is:

$$LL(\theta) = \sum_{i=1}^n \ln[P_i(\theta)] \quad (5.7)$$

Due to the fact that the integral in equation 5.6 does not have a close form, it has to approximate via simulation. The distribution parameters θ (mean and variance) can be obtained by maximizing the simulated log-likelihood function using Halton draws (Revelt and Train, 2000; Train, 2000).

5.4 Empirical Results

Two random coefficient Mixed Logit Models with random and independent parameters to capture variations in preferences for the MSC label and for farmed product are estimated. The first model (M1) contains only the main effects (price, MSC and aquaculture). The second model (M2) includes interaction terms with the socioeconomic variables, the brands and the ecolabel and production mode variable. In both models, the random coefficients associated with the three main variables are assumed to be independently normally distributed. The mixed logit model is estimated using maximum likelihood with 500 Halton draws. The results are reported in table 5.3. The McFadden pseudo R^2 indicates for all models a good model fit. According to McFadden (1974) a R^2 ranging from 0.2 to 0.4 indicates an extremely good model fit. The estimated standard deviations for the price, aquaculture and MSC variables are significant at the 1 % level in both models, indicating that marginal utilities do vary with unobservable household characteristics and employing the Mixed Logit Model is justified, as the IIA property does not hold.

As expected, price has a negative effect on the choice of frozen salmon products in both models, indicating that most consumers are price sensitive. However, we find a significant standard deviation in both models, showing substantial heterogeneity indicating that not all consumers have a negative own-price elasticity. This is a result also found in Zhu et al. (2015). However, as shown in Figure 5.1, there are relatively few consumers with a positive own-price effect, as they make up 4.27 % of the probability mass.

The simple model 1 (M1) shows a higher probability for purchasing farmed salmon relatively to wild and a lower probability for choosing MSC labeled salmon relatively to unlabeled wild. These results are also present in M2, as the mean parameters demonstrate a positive probability of purchasing farmed salmon and a negative probability of buying MSC labeled salmon. However, the standard deviations are quite high, indicating that there is a substantial unobserved heterogeneity in the preferences.

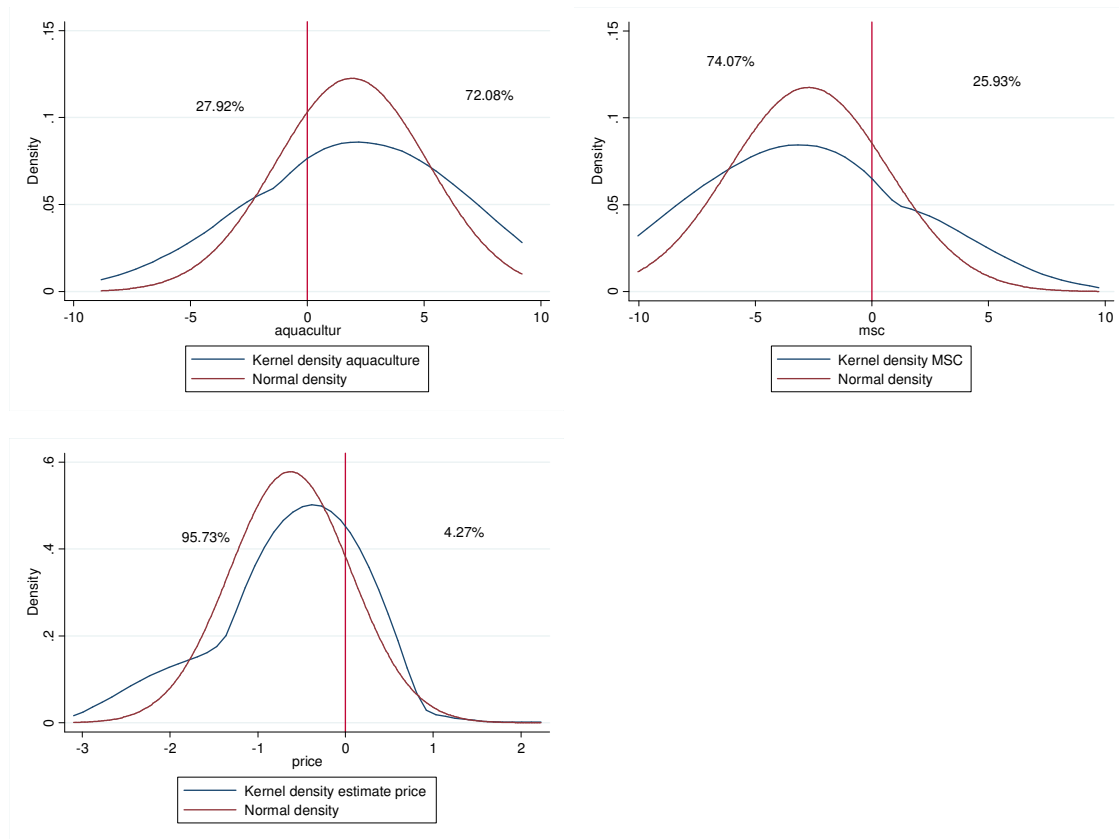
Table 5.3: Estimation Results of the Mixed Logit Model

Variable	M1 Main Effects Only			M2 Brand and Socioeconomic Effects		
	Parameter	Std.Err	Marginal Effects	Parameter	Std. Err	Marginal Effects
Price	-0.746***	0.131	-0.075	-0.561***	0.048	-0.042
MSC	-2.006***	0.146	-0.017	-0.621***	0.016	-0.003
MSC x income				-0.002***	0.001	-0.001
MSC x hhsz				-0.094***	0.033	-0.002
MSC x age				-0.014***	0.002	-0.001
MSC x employed				0.076	0.064	0.001
MSC x kids				-0.003	0.065	-0.001
MSC x singles				-0.084	0.065	-0.001
MSC x urban				-0.066	0.063	-0.001
MSC x Aldi				1.277***	0.057	0.032
MSC x Lidl				-0.746***	0.106	-0.011
MSC x Edeka				-1.035***	0.103	-0.014
MSC x Rewe				-0.573***	0.109	-0.009
MSC x Costa				-0.357***	0.105	-0.006
MSC x Paulus				0.479***	0.077	0.010
MSC x Iglo				-0.117	0.101	-0.002
MSC x Deutsche See				-0.366***	0.114	-0.006
MSC x PL_other				-0.459***	0.108	-0.007
MSC x brands_other				-0.211***	0.096	-0.004
Aquaculture	1.571***	0.131	0.015	1.327***	0.204	0.007
Aqua x income				0.001***	0.001	0.001
Aqua x hhsz				0.048	0.031	0.001
Aqua x age				0.002*	0.001	0.000
Aqua x employed				-0.091	0.075	-0.002
Aqua x kids				-0.108	0.075	-0.002
Aqua x singles				-0.106	0.102	0.000
Aqua x urban				0.041	0.067	0.001
Aqua x Aldi				1.999***	0.048	0.060
Aqua x Lidl				1.315***	0.052	0.034
Aqua x Edeka				-1.482***	0.105	-0.019
Aqua x Rewe				0.049	0.067	0.001
Aqua x Costa				-0.253***	0.076	-0.004
Aqua x Paulus				0.179***	0.064	0.003
Aqua x Iglo				-1.063***	0.099	-0.015
Aqua x Deutsche See				-1.085***	0.109	-0.015
Aqua x PL_other				-1.176***	0.100	-0.016
Aqua x brands_other				-1.347***	0.106	-0.017
Distribution estimates:						

Price	0.777***	0.045	0.798***	0.042
MSC	4.032***	0.226	2.691***	0.147
Aquaculture	3.734***	0.189	3.359***	0.192
Log Likelihood	-12,625.68		-10,048.17	
Pseudo R ²	0.176		0.189	

Source: Own estimations.

In figure 5.1 the kernel density plot for the random variables are plotted. For MSC the results show that for 74 % of the consumers the MSC label reduces the probability of the product being chosen, while for 26 % of the consumers, the MSC label increases the likelihood of purchase. This is an important result indicating substantial differences in consumer preferences with respect to MSC. The relatively small share of consumers that respond positively to MSC is particularly notable given the results reported in the stated preference studies (e.g. Uchida et al., 2014). However, the somewhat surprising effects from seafood wallet cards reported by Hallstein and Villas-Boas (2013) indicate that consumer responses are highly heterogeneous. For Aquaculture, the standard deviation is also relative high at 3.734. As one can see in the kernel density plot, 72 % of the consumers do buy aquacultured salmon products, as 28 % do not. Hence, there is a high probability for farmed product being purchased. This is also in contrast to a large part of the literature using stated preference data, where there is a clear preference for wild products (Roheim et al., 2012).

Figure 5.1: Kernel Density Estimates of the Random Variables for Model 1

Source: Own representation.

The brand specific variables in Model 2 capture the effect of a particular brand on the probability of a household purchasing a specific salmon product paired with the information if the product is farmed or certified with the MSC label. With one exception (Iglo) all interaction terms involving the MSC label are significant, indicating that brand also influences the probability of purchasing MSC-labeled products. The results indicate that the negative effect of MSC dominates the brand effect in most cases. However, the interaction effect associated with Aldi, the by far most important retailer of frozen seafood, is so strong that the MSC label increases the probability to purchase the product. This is also the case for the brand Paulus. For the remaining brands, the interaction terms are negative and further reduce the probability of purchasing MSC-labeled salmon.

Apart from the private label Rewe, all interaction terms are significant also for aquaculture products. For three brands, including Aldi, the interaction terms increase the probability of purchasing a farmed product. In six cases the interaction terms reduce the probability of purchasing a farmed product but the probability is still positive relative to wild salmon. In

one case, Edeka, the interaction term reverses the relationship giving a negative probability of purchasing farmed salmon relatively to wild.

Furthermore, the results in table 5.3 indicate that socioeconomic variables on average do not have a large impact on purchase decisions on salmon products, and therefore these results to a large extent support the notion of Grebitus et al. (2013) that demographics do not capture consumer heterogeneity well. The age parameter is significantly negative for the MSC attribute in model 2, meaning that being older reduces the probability of choosing MSC certified salmon, this is in line with Brécard et al. (2012). However, the age parameter is statistically significant and positive for aquacultured salmon. Income is significant and positive for aquaculture and negative for MSC labeled salmon. Finally, the results indicate that larger households are less likely to purchase MSC certified salmon.

5.5 Concluding Remarks

We estimated a Mixed Logit Model using household scanner panel data, to investigate the consumer choices with respect to farmed and ecolabeled frozen salmon as well as brand specific influences on the purchase decision. Consumer heterogeneity is expressed in the form of demographic variables as well as random parameters. This study represents an extension of the existing literature regarding seafood consumption, as most of the studies examine consumer behavior based on stated preference data disregarding brands, or using hedonic price analyses disregarding consumer heterogeneity to examine the influence of product attributes. This is possible as we have access to a large household panel data from Germany including detailed purchase observations of frozen salmon as well as socioeconomic characteristics of the households.

The empirical results of our study reveal that consumer heterogeneity plays an important role in the choices of farmed and MSC certified frozen salmon. In addition, the results give some support to the notion of Grebitus et al. (2013) that demographic variables may not explain consumers' heterogeneity well. However, some demographic variables, income and age, are important. On average, the households are quite price sensitive, there is a higher probability choosing farmed salmon than wild salmon and there is a lower probability to choose MSC-labeled products. However, the heterogeneity is substantial. While almost three quarters of the households have a lower probability of choosing MSC labeled salmon, a

quarter of the households have a higher probability of choosing MSC-labeled salmon. The market data also indicate a surprisingly strong preference for farmed salmon as 72 % of the households have a higher probability of choosing farmed salmon than wild salmon.

Furthermore, the results clearly indicate that the brands are important. In particular, in some cases the brand effect (the private label Aldi the brand Paulus) dominates the negative effect of the MSC label giving an increased probability to choose MSC-labeled product with these brands. For the other brands, the negative effect of MSC is stronger. In the case of farmed salmon, with the exception (Edeka), the product attribute increases the probability of purchase. However, there is still substantial variation between the different brands.

References

- Allender, W., & Richards, T. (2012). Brand Loyalty and price Promotion Strategies: An Empirical Analysis. *Journal of Retailing*, Vol. 88, 323-342.
- Ankamah-Yeboah, I., Nielsen, M., & Nielsen, R. (2016). Price premium of organic salmon in Danish retail sale. *Ecological Economics*, Vol. 122, 54-60.
- Asche, F., Bremnes, H., & Wessells, C. (1999). Product aggregation, market integration, and relationships between prices: an application to world salmon markets. *American Journal of Agricultural Economics*, Vol. 81, 365-581.
- Asche, F., Larsen, A., Smith, M., Sogn-Grundvåg, & Young, J. (2015). Pricing of eco-labels with retailer heterogeneity. *Food Policy*, Vol. 67, 82-93.
- Baker, G., & Burnham, T. (2001). Consumer response to genetically modified foods: Market segment analysis and implications for producers and policy makers. *Journal of Agricultural and Resource Economics*, Vol. 26, 387-403.
- Berry, S., Levisohn, J., & Pakes, A. (1995). Automobile Prices in Market Equilibrium. *Econometrica*, Vol. 63, 841-890.
- Blomquist, J., Bartolino, V., & Waldo, S. (2015). Price premiums for providing eco-labelled seafood: Evidence from MSC-certified cod in Sweden. *Journal of Agricultural Economics*, Vol. 66, 690-704.
- Bonnet, C., & Simioni, M. (2001). Assessing consumer response to Protected Designation of Origin labelling: a mixed multinomial logit approach. *European Review of Agricultural Economics*, Vol. 28, 433-449.
- Brécard, D., Lucas, S., Pichot, N., & Salladarré, F. (2012). Consumer Preferences for Eco, Health and Fair Trade Labels. An Application to Seafood Product in France . *Journal of Agricultural and Food Industrial Organization*, Vol. 10, 1-32.
- Bronnmann, J., & Asche, F. (2016). The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany. *Journal of Agricultural Economics*, Vol. 67, 231-244.

- Chidmi, B., & Lopez, R. (2007). Brand-Supermarket demand for Breakfast Cereals and Retail Competition. *American Journal of Agricultural Economics*, Vol. 89, 324-337.
- Diamond, P., & Hausman, J. (1994). Contingent Valuation: Is Some Number Better than no Number? *Journal of Economic Perspectives*, Vol. 8, 45-64.
- Fonner, R., & Sylvia, G. (2015). Willingness to Pay for Multiple Seafood Labels in a Niche Market. *Marine Resource Economics*, Vol. 30, 51-70.
- Grebitus, C., Jensen, H., & Roosen, J. (2013). US and German consumer preferences for ground beef packaged under a modified atmosphere- Different regulations, different behaviour? *Food Policy*, Vol. 40, 109-118.
- Greene, W. (2012). *Econometric Analysis. 7th Edition*. Edinburgh: Pearson.
- Hallstein, E., & Villas-Boas, S. (2013). Can Households Consumers Save the Wild Fish? Lessons from a Sustainable Seafood Advisory. *Journal of Environmental Economics and Management*, Vol. 66, 52-71.
- Johnston, R., Wessells, C., Donath, H., & Asche, F. (2001). Measuring consumer preferences for ecolabeled seafood: An international comparison. *Journal of Agricultural and Resource Economics*, Vol. 26, 20-39.
- Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economics*, Vol. 74, 132-157.
- Louviere, K., Hensher, D., & Swait, J. (2000). *Stated Choice Methods: Analysis and Application*. Cambridge,UK: Cambridge University Press.
- McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka, *Frontiers of Econometrics*. New York: Academic Press.
- McFadden, D., & Train, K. (2000). Mixed MNL models for discrete response. *Journal of Applied Econometrics*, Vol. 15, 447-470.
- Menpace, L., Colson, G., Grebitus, C., & Facendola, M. (2008). *Consumer preferences for extra virgin olive oil with COOL and GI labels in Canada*. Retrieved from AgEcon Search: <http://ageconsearch.umn.edu/bitstream/6430/2/467173.pdf>

- Naylor, R., Goldburg, R., Primavera, J., Kautsky, N., Beveridge, M., Clay, J., Troell, M. (2000). Effect of aquaculture on world fish supplies. *Nature*, Vol. 405, 1017-1024.
- Onozaka, Y., & McFadden, T. (2011). Does local labeling complement or compete with other sustainable labels? A conjoint analysis of direct and joint values for fresh produce claims. *American Journal of Agricultural Economics*, Vol. 93, 693-706.
- Revelt, D., & Train, K. (1999). Customer-specific taste parameters and mixed logit. *Working Paper, Department of Economics, University of California, Berkeley, USA*.
- Roheim, C. (2008). The economics of ecolabeling. In T. Ward, & B. Phillips, *Seafood Ecolabelling Principals and Practice* (S. 38-57). Oxford, UK: Wiley-Blackwell.
- Roheim, C., Asche, F., & Insignares Santos, J. (2011). The Elusive Price Premium for Ecolabelled Products: Evidence from Seafood in the UK Market. *Journal of Agricultural Economics*, Vol. 62, 655–668.
- Roheim, C., Sudhakaran, P., & Durham, C. (2012). Certification of shrimp and salmon for best aquaculture practice: Assessing consumers preferences in Rhode Island. *Aquaculture Economics and Management*, Vol. 16, 266-286.
- Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M.-C. (2010). The Demand for Seafood Eco-Labels in France. *Journal of Agricultural and Food Industrial Organization*, Vol. 8, 1-24.
- Smith, M., Roheim, C., Crowder, L., Halpern, B., Turnipseed, M., Asche, F., Bourillón, L., Guttormsen, A., Khan, A., Liguori, L., McNevin, A., O'Connor, M., Squires, D., Tyedmers, P., Brownstein, C., Carden, K., Klinger, D., Sagarin, R., & Selkoe, K. (2010). Sustainability and Global Seafood. *Science*, Vol. 327, 784-786.
- Sogn-Grundvåg, G., Larsen, T., & Young, J. (2014). Product differentiation with credence attributes and private labels: The case of whitefish in UK supermarkets. *Journal of Agricultural Economics*, Vol. 65, 368–382.
- Stemle, A., Uchida, H., & Roheim, C. (2016). Have Dockside Prices Improved after MSC Certification? Analysis of Multiple Fisheries. *Fisheries Research*, forthcoming.
- Thurstone, L. (1927). A law of comparative judgement. *Psychological Review*, Vol. 34, 273-286.

- Torissen, O., Jones, S., Asche, F., Guttormsen, A., Skilbrei, F., Nilsen, T., Jackson, D. (2013). Salmon lice-Impact on wild salmonids and salmon aquaculture. *Journal of Fish Diseases*, Vol. 36, 171-194.
- Train, K. (2009). *Discrete Choice Methods with Simulation*. Cambridge, UK.: Cambridge University Press.
- Uchida, H., Onozaka, Y., Morita, T., & Managi, S. (2014). Demand for Ecolabeled Seafood in the Japanese Market: A Conjoint Analysis of the Impact of Information and Interaction with Other Labels. *Food Policy*, Vol. 44, 68-76.
- Wessells, C., Johnston, R., & Donath, H. (1999). Assessing Consumer Preferences for Ecolabeled Seafood: The Influence of Species, Certifier and Household Attributes. *American Journal of Agricultural Economics*, Vol. 81, 1084-1089.
- Zhu, C., Lopez, R., & Liu, X. (2015). Information Cost and Consumer Choices of Healthy Foods. *American Journal of Agricultural Economics*, Vol. 98, 41-53.

6. Kapitel

Market Integration between Farmed and Wild Fish: Evidence from the Whitefish Market in Germany

Autoren:

Julia Bronnmann, Isaac Ankamah Yeboah, Max Nielsen

Dieser Artikel ist zur Veröffentlichung angenommen in:

Marine Resource Economics

Die hier abgedruckte Version des Artikels ist nicht die durch den Verlag lektorierte Version,
da diese zum Zeitpunkt der Abgabe noch nicht vorlag.

Eine auf dem Beitrag basierende Präsentation wurde im Rahmen eines Workshops der
Universität Kopenhagen am 08.07.2015 vorgestellt.

Market Integration between Farmed and Wild Fish: Evidence from the Whitefish Market in Germany

JULIA BRONNMANN, ISAAC ANKAMAH YEBOAH, MAX NIELSEN

Abstract

Following a decade long growth in worldwide farming of pangasius and tilapia, imports to Germany, a main European market, have been reduced since 2010. One reason for this might be supply growth of wild species at the total German whitefish market, if market integration exists between farmed and wild-caught whitefish. This paper examines market integration between farmed (pangasius and tilapia) and wild-caught (Alaska pollock, cod and saithe) frozen whitefish in Germany, and finds close integration. Hence, prices of frozen pangasius and tilapia fillets in Germany are determined not only by supply of these species, but more importantly by the much larger supplies of wild-caught cod and Alaska pollock. The implication of the presence of market integration is that the small-scale Asian farmers are secured against severe price reductions in Germany arising from farm productivity growth. However, market integration also makes them dependent on quotas and supply of competing wild-caught whitefish.

Keywords: co-integration, fish prices, law of one price, market integration, weak exogeneity, whitefish

JEL classification codes: C32, F15, Q21, Q22

6.1 Introduction

The German whitefish market is supplied both by wild-caught and farmed fish. In the decade up to 2008 imports of pangasius and tilapia, two of the most successful farmed species as measured by production growth, grew continuously (Eurostat, 2015). In 2010-2014, however, imports of these farmed whitefish species have been reduced by more than half (Destatis, 2015), despite continued production growth worldwide (FAO, 2014). If global supplies of wild-caught whitefish are increasing, the lack of growth in German imports of pangasius and tilapia can potentially be explained by ample supplies of wild-caught whitefish, provided that prices of farmed and wild-caught fish are formed in an integrated market with a common price determination process. This paper examines market integration between farmed and wild-caught whitefish in Germany using co-integration tests and also testing for the Law of One Price (LOP).

Knowledge of market integration between farmed and wild-caught whitefish is important since it reveals whether demand growth for farmed whitefish in Germany is negative, or whether declining imports of farmed whitefish are merely explained differently, such as by increased competition from wild-caught whitefish.²¹ If markets for farmed and wild-caught whitefish are integrated and prices move together over time, demand for pangasius and tilapia are influenced also by the supplies of the wild-caught cod and Alaska pollock that dominate the German whitefish market. The stagnation of German import over the last five years might then be a result of increased supplies of wild-caught whitefish. Farm growth policies might remain effective to fill increasing whitefish demand, although competition from fisheries must be taken into consideration. Global catches of cod have increased since 2007 (FAO, 2014), among other due to increased catches from the Barents Sea cod stock (ICES, 2014), supplying half of cod worldwide (Esmark and Jensen, 2004). Furthermore, the total catch of Alaska pollock from the main stocks in the North Pacific Ocean has been at the same level the last three years (NPFMC, 2014).

A growing literature exists on the interaction between markets supplied by both wild-caught and farmed fish. Theoretically, it departs from Anderson (1985), who shows that the entrance of a competitive fish farmer increases the wild fish stock, reduces prices and increases total

²¹ Asche et al. (2011) and Brækkan and Tyholdt (2014) show that demand growth is highly important for the success of salmon aquaculture. As prices and quantities for tilapia and pangasius have similar patterns (Asche et al., 2009), demand growth is likely to be important in explaining the global success of tilapia and pangasius.

supplies, provided that the wild fish stock is above the Maximum Sustainable Yield to start with and the markets are interrelated. Where Anderson (1985) studies the effect of changed aquaculture production on a wild fishery, Jensen, Nielsen, and Nielsen (2014) show theoretically that improved fisheries management might limit aquaculture growth. Empirical studies of market integration between farmed and wild species are also available, but not conclusive. Markets for farmed salmon and salmon trout are found integrated with wild salmon in Finland (Virtanen et al., 2005). In Spain, farmed salmon "is at best only a weak substitute for tuna, hake and whiting, but no significant interaction could be found" (Jaffry et al., 2000). Nielsen et al. (2007) find that farmed portion-sized trout in Germany is linked to the large wild-caught supplied whitefish market, but integration with the salmon market could not be found. Nielsen et al. (2011) identify integration between markets for trout and wild-caught redfish (also known as ocean perch) in Germany, both at markets for fresh and frozen fish. Asche et al. (2012) find that wild and farmed shrimp compete in the same market. Despite the literature not being conclusive, results of Nielsen et al. (2012) indicate that price formation studies must include the whole integrated markets when considering the effect on prices of changing supplies. Based on the literature, the decline in German imports of pangasius and tilapia in 2010-2014, together with the growth of cod imports in the same period, the hypothesis is that markets for the wild-caught whitefish in Germany are closely connected to the farmed whitefish (pangasius and tilapia) markets.

Asche et al. (2002) study market integration at the European wild-caught supplied whitefish import market. The cod market is found closely integrated with other whitefish, whereas markets for other whitefish species are more loosely integrated. Nielsen (2005) identifies market integration at the European wild-caught supplied whitefish landing market, geographically and between species. In Nielsen et al. (2009) market integration between fresh and frozen markets remains unidentified and fresh whitefish markets are found to be more integrated than frozen. Market integration is also studied for farmed whitefish, where Norman-López (2009) finds market integration between imported tilapia and wild-caught red snapper, dab and blackback flounder at the US fresh fillet market, but is unable to find integration between imported tilapia and domestically farmed catfish. Moreover, Norman-López and Asche (2008) and Norman-López and Bjørndal (2008) show that the tilapia market is

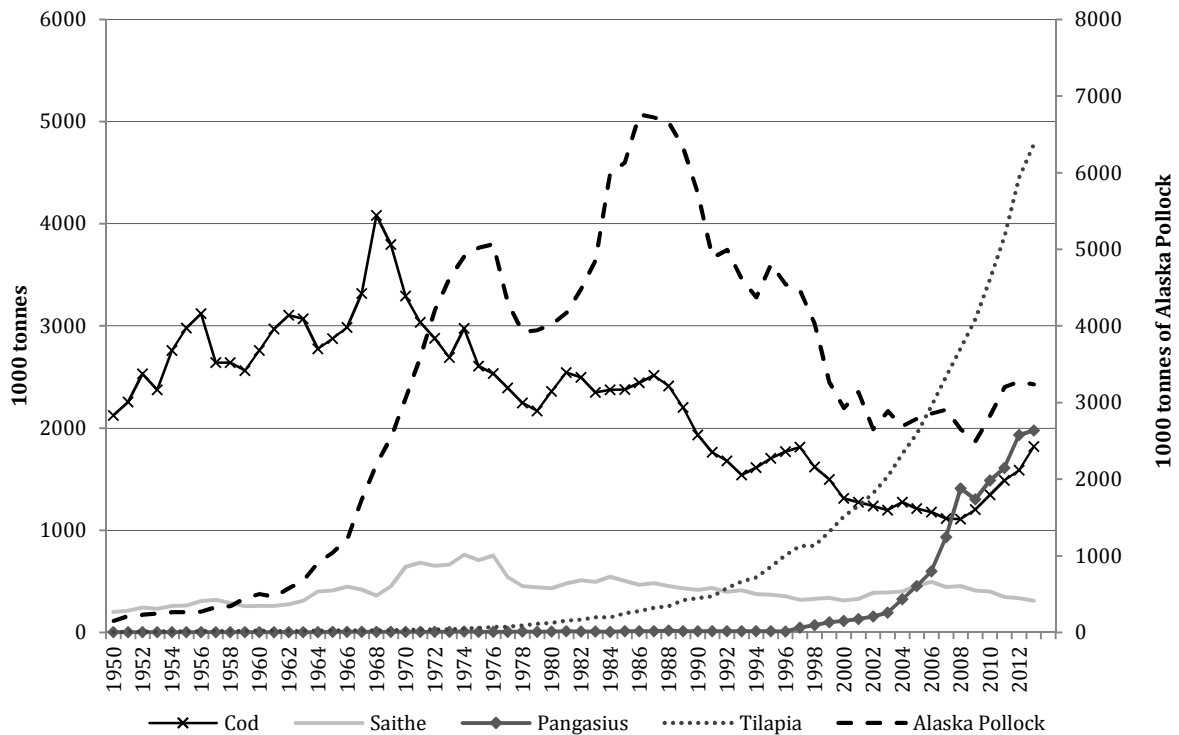
segmented. The role of pangasius at the wild-caught whitefish market has to our best knowledge not been studied earlier.²²

We proceed as follows: After this introduction, data are presented and an overview of the German whitefish market is provided. In the third section, the co-integration methodology of non-stationary data is described and adjusted to test for market integration. Thereafter, results are presented and implications discussed in the fourth section. The fifth section concludes the paper.

6.2 Data and Market Overview

The world's cod (*Gadus morhua*, *Gadus ogac* and *Gadus macrocephalus*) stocks have been in dramatic decline and global catch of cod has decreased by more than 70 % in 30 years. However, as shown in figure 6.1, cod has seen recovery from decades of declining catches following its nadir in 2007. Catches of Alaska pollock (*Theragra chalcogramma*), mostly from the North Pacific, have been around the same levels in the past decade (volume on the right axis of figure 6.1) following a sharp decrease in volume from 1986. Saithe (*Pollachius virens*) landings appear to be stable, at a volume below 500,000 tonnes. Looking at the farmed species, one can see that the production of pangasius (*Pangasius spp.*) increased since the 1990s and makes up approximately 2 million tonnes in 2013. According to the FAO production statistics, Vietnam is the largest producer with production volume of approximately 1.4 million tonnes in 2013. Tilapia (*Oreochromis spp.*) is originally from Africa but because of its ability to adjust to various conditions it is farmed in a lot of countries. China is the main supplier of tilapia, covering approximately half of the total global production, followed by Indonesia and Thailand (FAO, 2014). Tilapia production has seen significant rise in the last decade, with current global production exceeding 4 million tonnes. The European Union is a large consumption market for whitefish (Nielsen et al., 2012), mainly depending on imports.

²² It is worthwhile to note that there are different price levels for different species even if they compete in the same market, there are also heterogeneity in the pricing of the same species (Lee, 2014; Asche et al., 2015b; Bronnmann and Asche, 2016)

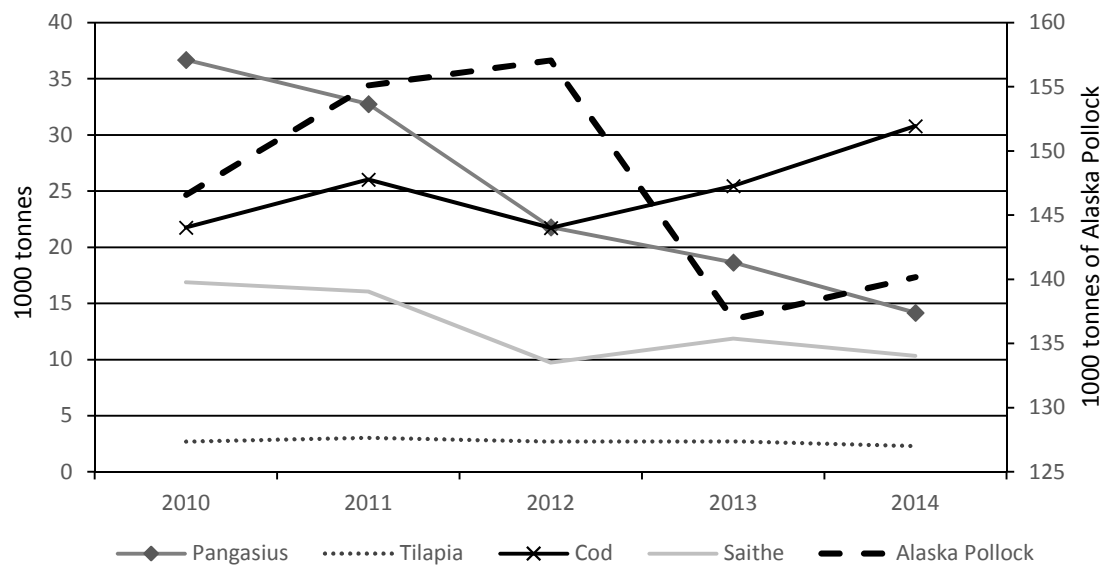
Figure 6.1: Annual Production of Farmed and Wild Caught Species

Source: Own representation based on FAO (2015) Online Query Panels.

Germany is a substantial net importer of seafood (Destatis, 2015; FAO, 2014) and by value it is the fourth largest importing country in the EU in 2012 (FAO, 2014).²³ Alaska pollock on the German market is primarily imported from China and the USA, saithe from Iceland and China and cod is mainly imported from Norway, China, Poland and Denmark. Chinas role in the value chain for all three species is mainly processing (filleting) based on imported raw material. Pangasius and tilapia are subtropical farmed species. Pangasius is mainly imported from Vietnam, followed by Indonesia, Thailand and Bangladesh. As shown in figure 6.2, the German import of pangasius has been declining since 2010. Following a peak in 2012, the imports of Alaska Pollock sharply declined the following year and appear to be picking up again but at a lower level. For the latest trend, cod has the largest market share while saithe is relatively stable at the bottom. The changing market share could be due to a number of demand factors or regional trade diversion²⁴.

²³ As such, Germany is a typical representative of wealthy countries that make up most of the worlds seafood imports (Asche et al., 2015a).

²⁴ Enquiry into the changing market shares and their determinants is beyond the scope of this paper and is reserved for future investigation.

Figure 6.2: Annual German Imports of Whitefish Species 2010-2014

Source: Own representation based on Destatis (2015).

Data used for this study are taken from the German external trade database (Destatis, 2015) and disaggregated at 8 digits code. In this study we focus on frozen fillets of the following whitefish species: Alaska Pollock, cod, saithe, pangasius and tilapia. Total German imports from all supplier countries are included in the analysis on a monthly basis and covering a time period under study from January 2010 to December 2014. The prices are CIF (cost, insurance, freight) and are obtained by dividing the imported value by the imported quantity. With no observations missing the particular price series include 60 observations²⁵.

Table 6.1 shows the descriptive statistics on German imports of the whitefish species averaged for the years 2010 to 2014. Imports of frozen Alaska pollock fillets are the category leader in imported quantity (147,178 t) and imported value (340,501 T€), followed by cod and pangasius. The imports of frozen tilapia fillets report the smallest both in terms of imported quantity (2,701 t) and imported value (9,266 T€).

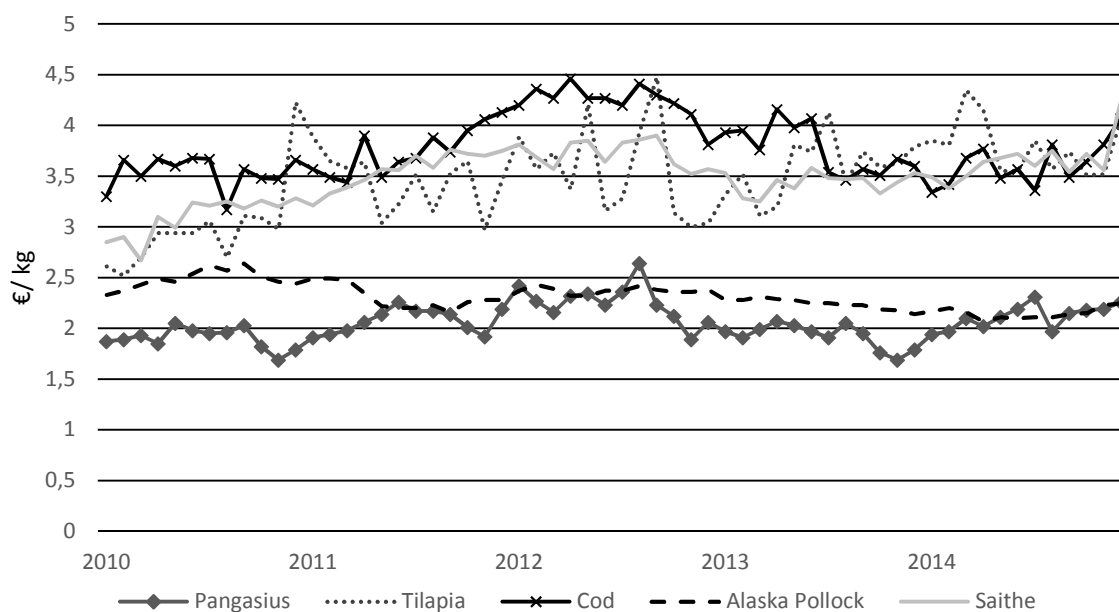
²⁵ Due to the fact that the import prices for frozen fillets of pangasius and tilapia are only available since 2010 we cannot study a longer time period.

Table 6.1: Data Summary Statistics on German Imports, Annual Average 2010-2014

	Quantity (tonnes)	Value (T€)	Price (€/kg)
Alaska Pollock	147,178	340,501	2.31
Cod	24,882	105,296	4.25
Saithe	12,676	43,629	3.44
Pangasius	24,808	50,371	2.05
Tilapia	2,701	9,266	3.44

Source: Destatis (2015).

Looking at the prices, frozen cod fillets command the highest import price on the German market. The average price is 4.25 €/kg. Import prices for frozen fillets of saithe and tilapia are positioned in the middle price segment, whereas the import prices of frozen Alaska pollock and pangasius are located in the lower price segment.

Figure 6.3: Monthly Import Prices of Wild-Caught and Aquaculture Whitefish in €/kg

Source: Own representation based on Destatis (2015).

The monthly import prices of the wild-caught and farmed whitefish species are plotted in figure 6.3. The prices of frozen fillets of cod and saithe seem to follow a similar pattern over time. Moreover, the monthly price variations of these two species are stronger than the price variations of Alaska pollock. The price for tilapia is more volatile than the prices of the other

whitefish species.²⁶ In general, it is not obvious from the graphs if the underlying data generating processes are unit root or not and need to be determined with econometric tests.

6.3 Econometric Specification

In order to examine whether farmed and wild whitefish species compete in the same market in Germany, we test for market integration. Over the last two decades, market integration studies have become a common tool when investigating the relationships between prices. Most studies are based on the market definition of Stigler (1969:85) who defines a market as “the area within which the price of a good tends to uniformity, allowance being made for transportation costs”, or similar definitions by for instance, Cournot (1971) and Marshall (1890). Thus, information on the relationship between goods can be gathered from price movements over time (Asche et al., 2004). The relationship between two prices in a static form can be expressed in logarithm²⁷ as:

$$\ln p_t^1 = a + \beta \ln p_t^2 + \varepsilon_t \quad (6.1)$$

where p^1 and p^2 are the price of product 1 and 2, the parameter a is a constant term that reflects transportation costs and quality difference between product 1 and 2, the parameter β determines the long-run relationship between the prices. If $\beta = 0$ the product prices are unrelated to each other, indicating that markets for the products are not integrated, while $\beta = 1$ indicates that the Law of One Price holds and there is complete market integration. In case of $\beta \neq 1$ in an integrated market, the commodities are formed in markets that are imperfectly integrated. Lags can be introduced into equation 1 to account for the dynamic adjustment process of Ravallion (1986). The equation is however, only valid for stationary price series. Price series have been noted to be often non-stationary. Hence, for non-stationary price series, co-integration “is a natural extension” (Asche, Gordon, and Hannesson, 2004: 195). Co-integration analysis is based on the principle, that a linear combination of time series integrated of order one is stationary.

²⁶ This is somewhat surprising given that farmed fish prices in general are less volatile than wild fish prices (Dahl and Oglend, 2014).

²⁷ The LOP is fulfilled when prices of different species move closely together over time. Specifying the market integration relationship in logarithmic form has been proven (Asche et al., 2004), to boost model specification and ease of interpretation of parameter estimates.

As a first step to the use of co-integration, the Augmented Dickey-Fuller (ADF) test is employed to test whether the time series have a unit root (Dickey and Fuller 1979; 1981). If prices have a unit root, co-integration tests are an appropriate tool. The Johansen (1988) Vector Autoregressive Representation in an error correction framework is the most common tool in this setting. If co-integration is detected then there exists a long term relationship (equilibrium) and a causal direction might also exist. This approach is an extension of the Engle and Granger (1987) procedure in a multivariate context.

Johansen's co-integration test is based following an error correction model (ECM) representation of the VAR model, with the $I(0)$ vector Δp_t which contains n prices, to test for co-integration in the system given by:

$$\Delta p_t = \sum_{i=1}^{k-1} \Gamma_i \Delta p_{t-i} + \Pi p_{t-1} + \mu + e_t \quad (6.3)$$

$$\text{where } \Pi = \sum_{i=1}^k A_k - I_k \quad \text{and} \quad \Gamma_i = -\sum_{j=i+1}^k A_j \quad (6.4)$$

The matrix Π contains the parameters in the long-run relationship (the co-integration vectors) and A is the coefficient matrix of the VAR representation. If the coefficient matrix has reduced rank $r < n$, then there exist $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta'p_t$ is stationary. The β -matrix contains the co-integrating vectors, which define the long-run relationships of the variable p_t . α represents the speed of adjustment to equilibrium²⁸, a test of $\alpha=0$ is the test for weak exogeneity (i.e., if p^1 is weakly exogenous to p^2 then p^1 does not adjust to deviations in p^2 and then p^1 can be thought of as the market leader). Johansen proposes two different likelihood ratio tests to determine the rank of the Π matrix: the trace test and the maximum eigenvalue test. The two tests have the null hypothesis that there are at most r co-integration vectors. The alternative hypothesis of the trace test is that there exist n co-integration vectors, the maximum eigenvalue test tests the null hypothesis against the alternative hypothesis of $r + 1$ co-integration vectors. The LOP is tested by imposing restrictions on the β matrix following Juselius (2006). The existence of co-integration in this bivariate system with $rank(\Pi=1)$ implies that the co-integrated vector error correction model can be written equation by equation as follows

²⁸ For a detailed description of the procedure, see e.g. Johansen (1995).

$$\begin{pmatrix} \Delta p_t^1 \\ \Delta p_t^2 \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} + \begin{pmatrix} \alpha_1 \\ \alpha_2 \end{pmatrix} (p_{t-1}^1 - a - \beta p_{t-1}^2) + \begin{pmatrix} \theta_{1j} & \vartheta_{1j} \\ \theta_{2j} & \vartheta_{2j} \end{pmatrix} \begin{pmatrix} \Delta p_{t-j}^1 \\ \Delta p_{t-j}^2 \end{pmatrix} + \begin{pmatrix} e_{t1} \\ e_{t2} \end{pmatrix} \quad (6.5)$$

where μ_i represents deterministic components and where the number of lags, $j = 1, 2, \dots, k$ is chosen. The error term e_t is assumed to be independent and identically distributed (i.i.d) with mean zero and finite variance.

6.4 Empirical Results and Discussion

Before conducting the formal tests of market integration, the time series properties of the prices are investigated. The presence of unit roots is tested using the ADF test. The test is implemented with trend, with constant and without constant for the level and the first difference of each price series. Table 6.2 presents the results of the ADF tests, where an asterisk marks the rejection of the null hypothesis of unit root in the data²⁹. The test statistics indicate that all price series have a unit root in their levels, while their first differences are stationary. Consequently, all prices are integrated of order one, I(1). Due to the fact that all price series are I(1), market integration can be investigated using co-integration tests.

Table 6.2: ADF Unit Root Test for Logarithm of Imported Prices

Specification	Trend		Constant		No constant	
	Level	First Difference	Level	First Difference	Level	First Difference
Alaska	-2.55 (0)	-6.75*** (0)	-1.44 (0)	-6.82***(0)	-0.30 (0)	-6.86*** (0)
Cod	-1.80 (1)	-12.07*** (0)	-1.81 (1)	-12.20*** (0)	0.32 (1)	-12.28***(0)
Saithe	-2.11 (1)	-11.30*** (0)	-2.05 (1)	-11.41*** (0)	1.41 (1)	-11.18*** (0)
Pangasius	-3.01 (0)	-8.12*** (0)	-2.87*(1)	-8.19***(0)	0.04 (0)	-8.25***(0)
Tilapia	-3.26* (3)	-6.65*** (2)	-2.80* (0)	-6.66***(2)	0.55 (2)	-6.64*** (0)

*** Statistically significant at the 1 % level. Optimal number of lags selected based on the Schwarz Information Criterion (SIC) are shown in parentheses.

Source: Own estimations.

Results from the Johansen co-integration test and test of the LOP are shown in table 6.3. We perform 10 separate pairwise³⁰ co-integration tests to identify common stochastic trends and thereby find out whether the price series move together over time. The lag lengths used in the

²⁹ The levels of significance considered are the 5 % and 1 % levels.

³⁰ It would be good to have the co-integration analysis for the system including all the price categories to avoid bias associated with the pairwise analysis. However, the size of the dataset limits this analysis owing to the multiplicity of parameters to be estimated and constrain on degrees of freedom.

estimation are selected by considering the following information criteria: LR, FPE, AIC, SC and HQ³¹. The most frequent selected lag is used (see values in parenthesis in table 6.3 column 1) and in the presence of autocorrelation, additional lags added to whiten the residuals. Model search is conducted over all cases of trend assumptions and the suitable specifications chosen. Misspecification tests include autocorrelation, normality and autoregressive conditional heteroscedasticity (ARCH) and are shown in table 6.4. In all cases the null hypothesis of no misspecification cannot be rejected at a 5 percent level.

Table 6.3: Bivariate Johansen Test for Integration between Imported Whitefish Prices

Market Pairs	Trend Assum	$r = 0$		$r = 1$		LOP LR, (p-value)
		L_{trace}	L_{max}	L_{trace}	L_{max}	
Alaska Pollock – Cod (2)	3	6.80	3.95	2.85	2.85	-
Alaska Pollock – Pangasius (2)	3	7.69	6.03	1.66	1.66	-
Alaska Pollock – Saithe (2)	2	21.54**	17.71**	3.83	3.83	0.74 (0.39)
Alaska Pollock – Tilapia (1)	3	25.31***	22.85***	2.46	3.84	0.06 (0.81)
Cod – Tilapia (1)	3	16.09**	13.81*	2.28	2.28	2.14 (0.14)
Pangasius – Cod (2)	2	23.06**	19.87**	3.20	3.20	0.02 (0.88)
Pangasius - Tilapia (2)	2	25.32***	19.46**	5.84	5.84	1.63 (0.20)
Saithe – Cod (2)	2	24.55**	18.24**	6.31	6.31	0.27 (0.60)
Saithe – Pangasius (4)	3	22.71***	19.24***	3.48	3.48	8.83 (0.00)***
Saithe – Tilapia (2)	2	26.77***	18.98**	7.80	7.80	2.02 (0.16)

*, **, *** Statistically significant at the 10 %, 5 % and 1 % levels. Under the LOP column is the Likelihood Ratio statistic (LR) and their p-values. Values in parentheses in column 1 are the selected lags. Trend assumptions 2 and 3 indicate restricted and unrestricted deterministic trends respectively.

Source: Own estimations.

Table 6.4: Model Diagnostics

Market Pairs	P(LM Stat) (l=8)	P(HC Stat)	P(JB Stat)
Alaska Pollock - Cod	0.40	0.30	0.14 0.92
Alaska Pollock - Pangasius	0.14	0.50	0.76 0.23
Alaska Pollock - Saithe	0.22	0.61	0.56 0.29
Alaska Pollock - Tilapia	0.61	0.34	0.25 0.24
Cod - Tilapia	0.20	0.13	0.03 0.40
Pangasius - Cod	0.09	0.13	0.18 0.04
Pangasius - Tilapia	0.11	0.19	0.42 0.18
Saithe – Cod	0.97	0.29	0.28 0.05
Saithe - Pangasius	0.43	0.29	0.35 0.77
Saithe - Tilapia	0.63	0.22	0.35 0.14

LM stat at lag 8 reported, LM and HC and JB are P-values.

Source: Own estimations.

³¹ LR: sequential modified LR test statistic (each test at 5 % level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion and HQ: Hannan-Quinn information criterion

The results of the Trace and the Maximum Eigenvalue Test for testing the null hypothesis that there is no co-integration (rank=0) are presented in columns two and three of table 6.3, while column four and five contain the results for testing the null hypothesis that there is less than or 1 co-integration vector (rank=1). The null hypothesis of no co-integration is rejected for all pairs, except for Alaska pollock and pangasius and Alaska pollock and cod. The null hypothesis of less than or equal to one co-integration vector cannot be rejected in any case. The bivariate comparison reveals two types of market linkages: a direct and an indirect³² relationship between the farmed and wild caught species. The direct linkage is shown between the co-integration of tilapia and all the wild caught species and also for pangasius and the wild species; cod and saithe. Since pangasius is integrated with saithe and saithe is integrated with Alaska pollock, pangasius might be indirectly linked to Alaska pollock through saithe. One could in principle resolve this inconsistency by conducting the test in a multivariate framework. However, the curses of dimensionality prevent that with our limited data set and we cannot go further than the bivariate tests (Asche, Gordon, and Hannesson, 2004). Given that most of the relationships indicate that the price series contain the same stochastic trend, it is natural to conclude that this is the case. Hence, the results provide empirical evidence that the frozen whitefish market in Germany is characterized by integration between the farmed and wild-caught whitefish species. These results are in accordance with a priori expectations in the sense that the whitefish market in Germany is formed on the basis of similar characteristics.

To identify whether prices are formed within the same closely integrated markets, the LOP is tested, the results are presented in the sixth column of table 6.3. In a closely integrated market, the relative prices are constant. As one can see, at the 5 % level, the LOP cannot be rejected in 7 of the 10 pairs, and the markets of the whitefish species under study are closely integrated. For the saithe and pangasius pair, the prices are co-integrated, but the LOP does not hold. In this case the price series follow similar movements, but their relative prices are not constant over time. Thus, the markets are partially integrated. However, again there is indirect evidence of the LOP holding also here as it holds both between pangasius and cod and cod and saithe.

Hence, frozen fillets of cod, saithe, Alaska pollock, pangasius and tilapia in Germany are all found formed within the same market in this study, with the LOP being in force in seven out of

³² Indirect linkage as used in this study is the application of the transitivity property that if $A \leq B$ and $B \leq C$, then $A \leq C$. this property is used because the different trend assumptions of the VECM could potentially hinder the effect in finite samples.

the ten performed bivariate tests. Market integration might increase acceptance of pangasius and tilapia among German consumers.

In addition, weak exogeneity tests (i.e., significance of the speed of adjustment parameter) are performed to identify market leadership in the long run. Table 6.5 reports the results of the tests. Considering the relationship between pangasius and the wild species; it can be observed that the adjustment parameter is statistically significant for pangasius and not for cod (Pair 6), indicating that cod may be exogenous. This implies that pangasius is the follower market while cod is the leading price. Between pangasius and saithe (Pair 9), pangasius is the leading price while saithe is the follower. For tilapia and the other wild species, tilapia is a follower market to both saithe and cod (Pairs 5 and 10 respectively). For tilapia and Alaska pollock, there is a bidirectional feedback, though Alaska pollock adjustment to tilapia is faster than vice versa. Hence, while not clear cut, the results indicate a tendency that the wild species lead the farmed species in the German market.

Table 6.5: Test for Weak Exogeneity

	Market Pairs	Weak Exogeneity
Pair 1	Alaska Pollock - Cod	-
Pair 2	Alaska Pollock - Pangasius	-
Pair 3	Alaska Pollock - Saithe	-0.01 -0.13***
Pair 4	Alaska Pollock - Tilapia	-0.52*** -0.07**
Pair 5	Cod - Tilapia	-0.01 -0.07***
Pair 6	Pangasius - Cod	-0.18 -0.39***
Pair 7	Pangasius - Tilapia	-0.38*** -0.01***
Pair 8	Saithe - Cod	-0.14*** -0.04
Pair 9	Saithe - Pangasius	0.13*** -0.14
Pair 10	Saithe - Tilapia	-0.06 -0.43***

Source: Own estimations.

As indicated by the market shares in figure 2, the wild species are most important in the German whitefish market, the farmed quantities are not large enough for the production cost of the farmed fish to determine prices for wild fish as found for salmon by Asche et al. (1999). The wild species being integrated with the farmed species could imply the tendency of the farmed species being secured against severe price reductions that could emanate from their own increase in productivity. This points towards the need of an increased focus on export potentials in pangasius and tilapia producing countries such as China, Vietnam, Indonesia and

Bangladesh. The implication for consumers is that any cost increases from the farmed species acting as market followers cannot be passed on to the leading wild species, hence securing them against high price increases. However, cod catches might continue to enjoy the premium market prices without interference from the farmed fish species.

6.5 Concluding Remarks

The whitefish market has changed substantially in recent years with the introduction of large volumes of farmed fish, and particularly pangasius and tilapia (Asche, Roll and, Trollvik, 2009). However, there have been few studies empirically investigating the relationship between these species and the traditional whitefish species cod, saithe and Alaska Pollock. Therefore, the purpose of this article is to test for market integration in the German whitefish market, focusing particularly on the relationship between farmed and wild-caught species. It is of particular interest that supply of wild-caught whitefish has increased in the period 2010-2014, reversing the development in market shares that are normally observed between wild and farmed fish. The analyses are performed by pairwise tests of co-integration and the Law of One Price within the Johansen co-integration framework. Monthly import price series, which span a period from 2010-2014, are used for the analysis.

The results indicate that all prices contain the same stochastic trend, and accordingly that there exists a well-integrated whitefish market in Germany, where also the Law of One Price holds. However, some of the inconsistencies that are often observed when using bivariate test are present in that a co-integration relationship is transitively found between Alaska pollock and respectively cod and pangasius, and the LOP is rejected between pangasius and saithe. For the three wild species the results are in line with what has been reported in the literature (Asche et al., 2004; Nielsen et al., 2007; Nielsen et al., 2009). The farmed species pangasius and tilapia are clearly a part of this market. Hence, the competition between farmed and wild-caught species implies that the recent stagnating growth for tilapia and pangasius is not necessarily attributed to declining demand growth, but rather to increased supplies of wild-caught whitefish supplied at the German market. The high degree of market integration indicates that the farmed whitefish species are an integrated part of the whitefish market and policies that affect prices in one market would transmit to the other market prices. Given that the recent recoveries of supplies of wild-caught whitefish are expected to stabilize and production of tilapia and pangasius is expected to continue to increase (Kobayashi, 2015), the high degree of market

6. Market Intergration

integration indicates that this will put downward pressure also on prices of wild-caught whitefish.

References

- Anderson, J. (1985). Market Interactions between Aquaculture and the Common-Property Commercial Fishery. *Marine Resource Economics*, Vol. 2, 1-24.
- Asche, F., Bellemare, M., Roheim, C., Smith, M., & Tveterås, S. (2015a). Fair Enough? Food Security and the International Trade of Seafood. *World Development*, Vol. 67, 151-160.
- Asche, F., Benneer, L., Oglend, A., & Smith, M. (2012). U.S. Shrimp Market Integration. *Marine Resource Economics*, Vol. 27, 181-192.
- Asche, F., Bremnes, H., & Wessells, C. (1999). Product Aggregation, Market Integration, and Relationships between Prices: An Application to World Salmon Markets. *American Journal of Agricultural Economics*, Vol. 81, 568-581.
- Asche, F., Chen, Y., & Smith, M. (2015b). Economic incentives to target species and fish size: Prices and fine scale product attributes in Norwegian fisheries. *ICES Journal of Marine Science*, Vol. 72, 741-752.
- Asche, F., Dahl, R., Gordon, D., Trollvik, T., & Aandal, P. (2011). Demand growth for salmon in the European market. *Marine Resource Economics*, Vol. 26, 255-265.
- Asche, F., Gordon, D., & Hannesson, R. (2002). Searching for price parity in the European whitefish market. *Applied Econometrics*, Vol. 34, 1017-1024.
- Asche, F., Gordon, D., & Hannesson, R. (2004). Tests for market integration and the law of one price: the market for whitefish in France. *Marine Resource Economics*, Vol. 19, 195-210.
- Asche, F., Roll, K., & Trollvik, T. (2009). New Aquaculture Species-The Whitefish Market. *Aquaculture Economics & Management*, Vol. 13, 76-93.
- Brækkan, E., & Tyholdt, S. (2014). The Bumpy Road of Demand Growth - An Application to Atlantic Salmon. *Marine Resource Economics*, Vol. 29, 339-350.
- Bronnmann, J., & Asche, F. (2016). The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany. *Journal of Agricultural Econommics*, Vol. 67, 231-244.

- Cournot, A. (1971). *Researchs into the mathematical principles of theory of wealth*. New York: A.M. Kelly.
- Dahl, R., & Oglend, A. (2014). Fish price volatility. *Marine Resource Economics*, Vol. 29, 305-322.
- Destatis. (2015). *Statistisches Bundesamt Wiesbaden*. Retrieved from <https://www-genesis.destatis.de/genesis/online/> last accessed 14.12.2015
- Dickey, D., & Fuller, W. (1979). Distribution of the estimators for autoregressive time series with unit root. *Journal of the American Statistical Association*, Vol. 74, 427-431.
- Dickey, D., & Fuller, W. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, Vol. 49, 1057-1072.
- Engle, R., & Granger, C. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica*, Vol. 55, 251-276.
- Esmark, M., & Jensen, M. (2004). The Barents Sea Cod - The last of large cod stocks. *WWF Norway Report 4*.
- Eurostat. (2015). *EU Foreign Trade Statistics, new Cronos Database*. Retrieved from <http://ec.europa.eu/eurostat/web/international-trade/data/database>, accessed 21.12.2015
- FAO. (2014). *The State of World Fisheries and Aquaculture 2014*. Rome: Food and Agriculture Organization of the United Nations.
- FAO. (2015). *FAO Fisheries and Aquaculture Department*. Retrieved from Online Query Panels: <http://www.fao.org/fishery/topic/16140/en> , accessed 21.12.2015
- Granger, C. (1969). Investigating causal relationships by econometrics models and cross spectral methods. *Econometrica*, Vol. 37, 425-435.
- ICES. (2014). International Council for Exploration of the Sea. *Report of the Advisory Committee for Fisheries Management 2014, Copenhagen*.
- Jaffry, S., Pascoe, S., Taylor, G., & Zabala, U. (2000). Price Interactions between Salmon and Wild Caught Fish Species on the Spanish Market. *Aquaculture Economics and Management*, Vol. 4, 157-167.

- Jensen, F., Nielsen, M., & Nielsen, R. (2014). Increased competition for aquaculture from fisheries: Does improved fisheries management limit aquaculture growth? *Fisheries Research, Vol. 159*, 25-33.
- Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, Vol. 12*, 231-254.
- Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models*. New York: Oxford University Press.
- Juselius, K. (2006). *The cointegrated VAR model, methodology and applications*. Oxford: University Press.
- Kobayashi, M., Msangi, S., Batka, M., Vannuccini, S., Dey, M., & Anderson, J. (2015). Fish to 2030: The Role and Opportunity for Aquaculture. *Aquaculture Economics and Management, Vol. 19*, 282-300.
- Lee, M.-Y. (2014). Hedonic Pricing of Atlantic Cod: Effects of Size, Freshness and Gear. *Marine Resource Economics, Vol.29*, 259-277.
- Marshall, A. (1890). *Principles of Economics*. London: Macmillan.
- Nielsen, M. (2005). Price formation and market integration on the European first-hand market for whitefish. *Marine Resource Economics, Vol. 20*, 185-202.
- Nielsen, M., Jensen, F., Setälä, J., Virtanen, & J. (2011). Causality in fish demand: A cointegrated demand system for trout in Germany. *Applied Economics, Vol. 43*, 797-809.
- Nielsen, M., Setala, J., Laitinen, J., Saarni, K., Virtanen, J., & Honkanen, A. (2007). Market integration of farmed trout in Germany. *Marine Resource Economics, Vol. 22*, 199-214.
- Nielsen, M., Smit, J., & Guillen, J. (2009). Market integration of fish in Europe. *Journal of Agricultural Economics, Vol. 60*, 367-385.
- Nielsen, M., Smit, J., & Guillen, J. (2012). Price effects of changing quantities supplied at the integrated European fish market. *Marine Resource Economics, Vol. 27*, 165-180.
- Norman-López, A. (2009). Competition between different farmed and wild species: the US tilapia market. *Marine Resource Economics, Vol. 24*, 237-251.

- Norman-López, A., & Asche, F. (2008). Competition between imported tilapia and US catfish in the US market. *Marine Resource Economics*, Vol. 23, 199-214.
- Norman-López, A., & Bjørndal, T. (2008). Is tilapia the same product worldwide or are markets segmented? *Aquaculture Economics & Management*, Vol. 13, 138-154.
- NPFMC. (2014). *North Pacific Fishery Management Council*. Retrieved from North Pacific Groundfish Stock Assessment and Fishery Evaluation Reports for 2015: <http://www.afsc.noaa.gov/REFM/stocks/assessments.htm>
- Ravallion, M. (1986). Testing market integration. *American Journal of Agricultural Economics*, Vol. 68, 102-109.
- Stigler, G. (1969). *The theory of price*. London: Macmillan.
- Virtanen, J., Setälä, K., Saarni, K., & Honkanen, A. (2005). Finnish Salmon Trout-Discriminated in the European Market. *Marine Resource Economics*, Vol. 20, 113-119.

7. Kapitel

The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany

Autoren:

Julia Bronnmann und Frank Asche

Dieser Artikel ist erschienen in:

Journal of Agricultural Economics (2016), Vol. 67(1) 231-244

Eine auf dem Beitrag basierende Präsentation wurde auf dem 6th ad-hoc FAO Fish Price
Index Workshop am 19.09.2014 auf Ponza, Italien vorgestellt.

The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany

JULIA BRONNMANN AND FRANK ASCHE³³

[Original submitted February 2015, Revision received July 2015, Accepted September 2015]

Abstract

It is well known that the price of a food in general and fish in particular is a function of a number of attributes such as species, product form, processing form and size. However, limited attention has been given to the influence of private labels, production method, eco-labels and promotions. We use a unique dataset which identifies these attributes in the German seafood market. We estimate a hedonic price function, and our results highlight the importance of brand and labels for seafood prices in Germany. Our results also suggest that private label products are discounted by 20 %, while branded products achieve substantial price premiums, as do fish products from aquaculture.

Keywords: Ecolabel, hedonic pricing, MSC, price premia, private labels, scanner data, seafood

JEL classification codes: C23, D21, Q11, Q22

³³ Julia Bronnmann is in the Department of Agricultural Economics at the University of Kiel, Germany. Frank Asche is the contact author (frank.asche@uis.no) and is with both the Institute for Sustainable Food Systems and School of Forest Resources and Conservation, University of Florida and with the Department of Industrial Economics, University of Stavanger, Norway. The authors acknowledge the financial support from the Research Project Systematische Verfahrensoptimierung der Edelfischaufzucht in rezirkulierenden Systemen “Aqua-Edel” by Bundesanstalt für Landwirtschaft und Ernährung and the Norwegian Research Council. The authors also would like to thank two anonymous reviewers and the editor David Harvey for their helpful comments.

7.1 Introduction

It is well known that there is substantial heterogeneity between and within products groups in the food market. This is also the case in the seafood market where a fish is not necessarily a fish, as claimed by Gordon et al. (1993), despite a substantial literature showing highly integrated markets for most species groups. Rather, price is a function of a number of attributes such as species, product form, processing form and size, and key attributes vary with the level in the supply chain being investigated. McConnell and Strand (2000), Carroll et al. (2001), Kristofersson and Rickertsen (2004), Lee (2014), Asche et al. (2015a,b,c) and Blomquist et al. (2015) show that attributes such as species, size and freshness and even which vessel catches the fish influence the ex. vessel price.³⁴ Recently, there has been increased interest in the value of attributes at the retail level, although only with data for the UK. Roheim et al. (2007), Roheim et al. (2011), Sogn-Grundvåg et al. (2013; 2014) and Asche et al. (2015a) show that species, brands, retailers, product form, labels and packing are important attributes.³⁵ However, our knowledge is constrained by the information available in the data, in particular the information on specific attributes.

We have access to a unique data set for frozen fish from Germany, where we can identify three sets of attributes that have not received much attention in the literature; private labels, production method, and promotions. During the last two decades, the retail sector in Europe has changed substantially from specialised seafood outlets such as fishmongers and market stalls to big retail chains (Murray and Fofana, 2002; Guillotreau et al., 2005). As a consequence, private labels of the retail chains have increased their importance relative to industry brands (Dobson et al., 2003), and home delivery is a new market channel. Aquaculture is becoming an increasingly important part of seafood production and the seafood market (Tveterås et al., 2012), while some consumers prefer wild fish (Roheim et al., 2012). Furthermore, there is increasing evidence that consumers are willing to pay a price premium for sustainably harvested seafood (Roheim et al., 2011), indicating that production method can be an important attribute. Finally, promotion is often an important part of retail chains sales strategy, where a discount is associated with promoted products.

³⁴ The attributes are increasingly important also in relation to fisheries management as improved management systems allow fishers to optimise over more margins (Smith, 2012). Aquaculture producers, with their control of the production process have even more flexibility to optimise over attributes (Anderson, 2002; Asche, 2008).

³⁵ There are also several market integration studies that allow for premiums and show that size and certification can influence margins (Asche and Guttormsen, 2001; Asche et al, 2012; Wakamatsu, 2014).

Until the early 1980s, seafood production was dominated by wild fisheries. Since then, aquaculture production has increased rapidly and now provides about 50 % of the seafood for human consumption (FAO, 2014), while providing greater control over the production process (Anderson, 2002; Asche, 2008). This control can be used to improve specific attributes and create more efficient logistics and sales (Guttormsen 1999; Anderson, 2002; Forsberg and Guttormsen 2006; Asche et al., 2007; Kvaløy and Tveterås 2008; Olson and Criddel, 2008; Asche et al., 2013), and thereby add value.³⁶ Meanwhile, there are competing arguments about consumers' preferences for either aquaculture or wild products, which requires empirical testing.

In addition, some consumers are willing to pay for production practices that help improve the environment (Onozaka and McFadden, 2011). This has led several producers to adopt standards to support environmental and sustainable policies, and to use ecolabels showing that they follow the standard (Satimanon and Weatherspoon, 2010). In the seafood sector, the Marine Stewardship Council (MSC) is the leading ecolabel (Roheim et al., 2011). Several studies have shown that the MSC-label generates price premiums in the UK (Roheim et al., 2011; Sogn-Grundvåg et al., 2014).³⁷ However, stated preference studies indicate that preference for ecolabels can vary substantially between countries (Johnston et al., 2001). Obtaining evidence from other markets than the UK is therefore important.

The large retail chains are dominating the seafood market in a number of countries (Murray and Fofana, 2002; Guillotreau et al., 2005). A feature that has received limited attention is the use of private labels.³⁸ Some studies have analysed the relative value of national brands and private labels using scanner data that do not allow identification of individual private labels for seafood (Roheim et al., 2007; Roheim et al., 2011).³⁹ These studies indicate that branded products generate a premium over private label products. Sogn-Grundvåg et al. (2014) and Asche et al. (2015a) use observational data and are to our knowledge the only

³⁶ It is also of interest to note that price volatility tends to lower for farmed products (Oglend, 2013; Dahl and Oglend, 2014) despite the highly volatile input factor markets for aquaculture Tveterås and Tveterås (2010) and Asche et al. (2013).

³⁷ One should also note that MSC does not certify aquaculture products. Asche et al. (2015a) argue that organic labeling is used as an alternative. From 2013, a similar certification scheme, the Aquaculture Stewardship Council (ASC) has been available. Fisheries Improvement Programs (FIPs) are also increasing in importance, but these provide no labels (Sampson et al., 2015).

³⁸ Private label products encompass all goods sold under a retailer's brand. That brand can be the retailer's own name or a name created exclusively by that retailer.

³⁹ Similar studies are also undertaken for other food products, such as Smith et al. (2009).

available studies with data that shed some light on pricing differences between retail chains. However, these studies still have private labels as a joint category for all retailers. In Germany, private labels have become important in the market for frozen seafood with a combined market share of 52 % according to our data set. In contrast to earlier studies using scanner or observational data, we identify the private labels for the different retail chains, so that we can investigate the extent of consumer preference for these labels versus traditional brands.⁴⁰ In addition, home delivery is also an increasingly important segment.

Our approach treats the price of different fish products as a sum of their characteristics (Lancaster, 1966), with consumers maximising their utility based on product attributes rather than on the product themselves. Product attributes induce systematic variation in the price of fish. The approach of hedonic prices has a long tradition in food market analysis. Waugh (1928) published the pioneering paper analysing the influence of quality factors on the price of asparagus, tomato and cucumber. Studies focusing on seafood includes; McConnell and Strand (2000), Carroll et al. (2001), Roheim et al. (2007), Roheim et al. (2011), Sogn-Grundvåg et al. (2013, 2014), Lee (2014), Asche et al. (2015a,b,c) and Blomquist et al. (2015).

The paper is organised as follows: Data are described in section 2. The empirical methodology is introduced in section 3. In section 4, the empirical results are reported before we conclude in section 5.

7.2 Data

The fish and seafood market in Germany heavily relies on imports. In 2012 fish imports reached 1.84 million tonnes at a value of €3.50 billion (Destatis, 2015). One major characteristic of the German fish market is a high market share for frozen fish. This also leads frozen fish to be more widely available than fresh fish, as most supermarkets do not have fresh fish departments (Destatis, 2015). Frozen fish products are diverse and the retailers provide a range of species, product forms, packaging and labels that makes the German market highly interesting.

⁴⁰ However, in common with other studies using scanner data, like Roheim, Gardiner and Asche (2007), we cannot identify from which retailer the branded products are purchased. It is also worthwhile to note that some discount chains like Aldi and Lidl do not carry any branded products, only private label products.

Our data originate from the German scanner household panel dataset (ConsumerScan), provided by the 'Gesellschaft für Konsumforschung' (GfK) for the time period from January 2000 to December 2010. We use monthly data (132 months) on frozen fish products. For each product, information on the following attributes is provided: EAN-code⁴¹ (568), fish species (11), brand (17), product form (4), process form (4), package size (4) and if the product was on sale or not.⁴² Brands include national labels such as Costa, Deutsche See and Iglo and private labels from the different retailers, including the so-called "hard discounters", such as Aldi and Lidl, which carry only a limited assortment and only their own private labels.⁴³ Based on the EAN-codes, we can distinguish between farmed (aquaculture) and wild (catch) fish. In addition, the data also contain information on purchases from two home delivery outlets, Bofrost and Eismann. Moreover, using the logo licensing manager of the MSC, we could identify 36 products displaying the MSC label in 2009 and 2010. Of these products, 9 were private label products. The price observations are deflated by the consumer price index (base year=2010). The dataset contains a total of 24,457 observations. During the sample period, not all of the fish products appear in the market for the entire period. Some products are introduced, and other products are withdrawn from the market. The descriptive statistics are calculated with 100 g weighted average prices, to ensure comparability over different product prices. Table 7.1 presents the descriptive statistic for the respective fish species and attributes. An overview of how the different attributes are represented at the EAN-code level is provided in Table A7.1 in the on-line appendix.

⁴¹ The EAN-code is the International Article Number, which is a 13 digit barcode and identifies each item.

⁴² For some species, such as hake, tuna the recorded species name covers several sub-species, while for salmon one can only separate wild and farmed, but not the different wild species. Hence, the species attribute provides the average price for a group of species rather than the individual species.

⁴³ However, the data do not contain information on which retailer were selling the national brands. Hence, while being richer in information with respect to the retailers than the earlier studies using scanner data (Roheim et al., 2007; Roheim et al., 2011), they contain different information from the studies using observational data (Sogn-Gruntvåg et al., 2013; 2014; Asche et al. 2015a).

Table 7.1: Descriptive Statistics of the Product Attributes

Product Attribute	Frequency in %	Mean price €/100g			Std. Dev.	Market share in %
		Min	Max			
Fish Species						
Salmon	24.92	1.24	0.25	5.16	0.66	22.97
Alaska-Pollock	17.04	0.59	0.15	2.79	0.31	14.23
Pollock	15.47	0.65	0.14	2.91	0.37	13.15
Plaice	10.21	1.22	0.26	2.41	0.41	12.57
Redfish	8.78	0.84	0.27	2.29	0.37	11.52
Trout	7.68	0.74	0.23	3.16	0.28	7.08
Cod	5.45	1.09	0.24	2.76	0.60	6.62
Pangasius	3.42	1.23	0.25	4.30	0.71	5.33
Tuna	2.76	1.23	0.44	2.97	0.55	2.19
Hake	2.72	0.68	0.29	1.67	0.25	2.53
Pikeperch	1.55	1.26	0.36	4.01	0.70	1.80
Product Form						
Fillet	64.89	0.99	0.14	5.16	0.57	68.69
Other Form	30.13	0.85	0.15	4.98	0.47	26.83
Steak	2.95	0.94	0.26	2.16	0.45	2.82
Whole Fish	2.04	0.68	0.25	1.29	0.25	1.65
Process Form						
Other Form	47.33	0.92	0.14	5.16	0.54	45.97
Natural	24.91	0.96	0.21	4.01	0.52	26.49
Breaded	15.69	0.91	0.18	4.30	0.53	17.57
Battered	12.06	0.98	0.20	3.02	0.55	9.97
Brand						
PL_Aldi	11.37	0.69	0.15	2.24	0.30	8.98
PL_Lidl	6.84	0.78	0.22	1.67	0.34	4.29
PL_Metro	6.39	0.77	0.24	1.94	0.32	5.62
PL_Rewe	5.15	0.90	0.21	1.59	0.35	3.21
PL_Tengelmann	2.46	0.67	0.21	1.24	0.29	1.26
PL_Edeka	1.69	0.86	0.14	1.50	0.36	1.05
PL_Netto	1.42	0.55	0.18	0.96	0.21	0.59
Other Brand	17.56	0.83	0.20	2.91	0.40	17.03
Pickenpack	9.76	0.63	0.15	1.97	0.26	7.13
Paulus	8.05	0.81	0.22	2.07	0.31	6.91
Bofrost	7.34	1.60	0.24	4.30	0.52	18.23
Eismann	5.50	1.69	0.65	3.16	0.63	11.49
Costa	5.17	1.30	0.28	4.98	0.54	4.93
Royal Greenland	4.91	0.61	0.15	1.78	0.26	3.64
Deutsche See	2.40	2.19	0.33	5.16	0.78	3.26

7. Frozen Seafood in Germany

Femeg	2.31	0.82	0.26	1.99	0.33	1.31
Iglo	1.68	1.25	0.25	2.23	0.50	1.07
Package Size						
100- 399 g	31.99	1.21	0.25	5.16	0.56	20.04
400- 699 g	21.45	0.89	0.20	4.30	0.64	17.53
700- 849 g	19.17	0.73	0.15	2.24	0.44	20.46
> 849 g	27.39	0.80	0.14	3.16	0.42	41.98
Additonal						
Aquaculture	23.92	1.21	0.23	5.16	0.69	25.76
Promotion Price	11.60	0.77	0.14	3.02	0.41	12.56
MSC	3.91	0.80	0.15	2.59	0.50	3.10
Overall mean		0.96	0.23	3.07	0.43	

Source: Own calculations.

There is substantial variation in price, which ranges from €0.50 per 100g to €2.19 per 100g for the listed categories. The price on average, across all observations, is €0.96 per 100 g. Salmon is the most important species both in terms of the number of product forms and market share. Twenty three (23) percent of the considered fish products include salmon, which makes up 25 % of total sales values. The second highest market share is held by Alaska pollock (14.2 %). Alaska pollock has the lowest price with an average of €0.59 per 100 g. Surprisingly, pangasius has one of the highest average prices (€1.23 per 100 g).⁴⁴ Moreover, redfish and plaice have a relatively high market share on the German fish market. The data show that in particular tuna, hake and pikeperch are niche products of the German market. The market share of aquaculture is almost 30 %, consisting of the three species salmon, trout and pangasius. For salmon and trout, there are both wild and farmed products, while pangasius products are only farmed. For salmon, almost half of the products are based on wild fish.

Fish products are purchased in a number of forms. The average price ranges from €0.68 per 100 g for whole fishes to €0.99 per 100 g for fish fillet. On average, fish fillet is the category leader in terms of market share. Steak and whole fish are small categories, and have market shares of respectively 3 % and 2 %. The market share of discounters has significantly increased over the last years (FIZ, 2014). Looking at the different brands, we can distinguish between private labels from hard discounters (Aldi, Lidl), co-operate discounters (Netto),

⁴⁴ This indicates that the price of pangasius may be influenced by high value product attributes like brand or process form, which is confirmed by our econometric results.

small and big supermarkets (Edeka, Rewe, Tengelmann), and small, regional and national hypermarkets (Metro) on the one hand and branded products on the other hand. Bofrost and Eismann are home delivered brands. While supermarkets generally choose to offer comparably higher prices connected with lower sales prices (“HILO”), discounters advertise everyday low prices (“EDLP”). In general, private brands are cheaper than branded products. The lower prices are possible due to the purchase of large volumes of exclusive products without any manufactures proprietary brand name (Colla, 2003). The average price of private labeled products is €0.75 per 100 g. Of the private labels, Aldi has the highest market share (8.9 %) followed by Metro (5.6 %). In the case of branded products Paulus has the highest market share (6.9 %). Fish products of the brand Deutsche See are the most expensive. The average price for these products is €2.19 per 100 g, making these products almost three times as expensive as the overall average fish product. Correspondingly the market share is relatively small. Fish products manufactured by Royal Greenland are the cheapest, with an average price of €0.61 per 100 g fish.

With regards to the package size small packages (100 to 399 g) are mostly purchased. Nearly 40 % of the fish products are sold in this package size generating approximately 20 % of total revenue in this packet size.

7.3 Model Specification

A first stage hedonic price model is used to estimate how brand and other characteristics directly affect the price of frozen fish products. The hedonic price model assumes that a product (X) consist of a bundle of characteristics x_j (e.g. brand, package size, product form, process form) that combine to form bundles of utility-affecting attributes that the consumer values. The hedonic price function can be written in its general form (Rosen, 1974) as

$$p_{it}(X) = f(x_1, \dots, x_j) \quad (7.1)$$

where p_i is the price of good i , and $X = (x_1, \dots, x_j)$ represents a vector of associated attributes that determines the price of the good.

The partial derivative of this function with respect to any attribute is the implicit marginal attribute price, *ceteris paribus*, which can be easily acquired from the regression coefficient.

Hence, the observed price of a fish product can be considered as the sum of the prices related with each of its quality attributes and is determined by demand and supply. Thus, under the assumption that the market is competitive, the regression coefficients reflect the valuation of each market participant i.e. the preferences of the consumers as well as the costs of the producers (Oczkowski, 1994; Nerlove, 1995).

Linear and log-linear functional forms are frequently found in the literature for hedonic price models. For our model the results of a Box-Cox test were inconclusive. We chose a linear model as the estimate theta of the Box-Cox test was 0.36, and a linear model is easier to interpret than a log-linear form. However, we will also report the average percentage premiums based on this model as well as the percentage premiums from a log-linear model to show that the results are relatively stable over these two model specifications.

Based on the standard assumption that any unobservables are uncorrelated with the observed product characteristics, the empirical model can be expressed as:

$$\begin{aligned}
 Price_{it} = & \sum_{j=1}^J \beta_j species_{jit} + \sum_{k=1}^K \gamma_k product\ form_{kit} + \sum_{l=1}^L \delta_l process\ form_{lit} + \\
 & \sum_{m=1}^M \theta_m brand_{mit} + \sum_{n=1}^N \vartheta_n package\ size_{nit} + \sum_{p=1}^P \rho_p year_{pit} + \sum_{r=1}^R \tau_r month_{rit} + \\
 & b\ aquaculture_{it} + c\ promo_{it} + dMSC_{it} + \epsilon_{it}
 \end{aligned} \tag{7.2}$$

Where $Price_{it}$ is the deflated price € per 100 g in time period t ; $\beta, \gamma, \delta, \theta, \vartheta, \rho, \tau, b, c, d$ are parameters to be estimated, and ϵ_{it} is a stochastic error term. In this analysis, the attributes are dummy variables as shown in table 1. Expressing the product attributes as dummy variables follows established practice in the literature (McConnel and Strand, 2000; Carroll et al., 2001; Roheim et al., 2007; Roheim et al., 2011, Asche and Guillen, 2012). In addition, we include yearly and monthly dummy-variables to account for possible time patterns.

Asche et al. (2015a) introduce interaction effects in their model between different ecolabels and retail chains, while Blomquist et al. (2015) introduce interaction effects for fish size. While interesting, these issues are not explored here due to the characteristics of our data. However, a potential important issue is the interaction between processing form and package size, since there may be some economies of production associated with larger sizes for more processed products.

We therefore also estimate a model allowing for these interactions:

$$\begin{aligned}
 Price_{it} = & \sum_{j=1}^J \beta_j species_{jit} + \sum_{k=1}^K \gamma_k product\ form_{kit} + \sum_{l=1}^L \delta_l process\ form_{lit} + \\
 & \sum_{m=1}^M \theta_m brand_{mit} + \sum_{n=1}^N \vartheta_n package\ size_{nit} + \sum_{p=1}^P \rho_p year_{pit} + \sum_{r=1}^R \tau_r month_{rit} + \\
 & b\ aquaculture_{it} + c\ promo_{it} + dMSC_{it} + \sum_{k=1}^K \sum_{l=1}^L \delta_{kl} product\ form_{kit} * \\
 & process\ form_{lit} + \epsilon_{it}
 \end{aligned} \tag{7.3}$$

Asche et al. (2015a,b,c) note that the standard errors are not likely to be independent across units, but rather independent across some clusters of units and correlated within those clusters. Pricing of supermarkets in general limit price variation due to menu costs, and increasingly such features are present also for seafood (Kvaløy and Tveteras, 2008; Larsen and Asche, 2011). The potential for correlation among species, product types, process forms, package size or brand could bias the estimated standard errors as in the clustered standard errors literature (Moutlon, 1990). As there is no obvious criterion to select the unit of clustering, we estimate the models with clustering for all the main categories (species, brand, product form and process form) of attributes.

7.4 Empirical Results

Table 2 reports the results for the linear hedonic price regression over the sample period January 2000 to December 2010. The R^2 indicates that 63 % of variation in fish prices is explained by the product attributes. The maximum variance inflation factor of 1.82 suggests that multicollinearity is not an issue. The F -test shows that the model is highly significant with a p -value < 0.001 . Using the RESET and the White-test we check for misspecification and heteroscedasticity, and in both cases the null hypothesis is rejected. Hence, we compute robust standard errors. The estimated parameters are reported in the second column, ordered by the size of the premium within each attribute category. In the third column robust standard errors are reported, and in the fourth column clustered standard errors are reported. In the fifth column the average percentage premiums associated with each attribute are reported. Finally, in the last column the percent premiums estimated from a log-linear model are reported as a stability consistency check.

Table 7.2: Parameter Estimations and Price Premiums

	Coefficients level model	Robust SE	Clustered SE	Price premium level model (in %)	Price premium log-linear model (in %) ^a
Species	Base: Salmon				
Pikeperch	0.35	0.02***	0.09***	51.31	55.58
Plaice	0.30	0.01***	0.04***	43.60	43.76
Tuna	0.26	0.02***	0.06***	37.21	27.51
Cod	0.12	0.01***	0.08	16.72	16.07
Hake	-0.14	0.01***	0.06*	-20.35	-12.45
Redfish	-0.08	0.01***	0.05	-11.19	-0.60
Pangasius	-0.20	0.02***	0.11	-28.92	-16.72
Pollock	-0.22	0.01***	0.05***	-31.25	-23.74
Alaska Pollock	-0.24	0.01***	0.05***	-35.47	-27.75
Trout	-0.45	0.01***	0.08***	-65.12	-31.41
Product Form	Base: Other product form				
Fillet	0.04	0.01***	0.03	5.96	6.08
Steak	-0.10	0.02***	0.06	-14.97	-4.30
Whole Fish	-0.36	0.03***	0.05***	-52.47	-42.13
Process Form	Base: Other process form				
Natural	-0.01	0.01	0.03	-1.02	0.50
Breaded	-0.10	0.01***	0.03***	-14.10	-10.33
Battered	-0.18	0.01***	0.05***	-26.45	-18.37
Brand	Base: Other brand				
PL_Edeka	-0.10	0.02***	0.07	-13.95	-11.75
PL_Lidl	-0.12	0.01***	0.04**	-17.88	-15.13
PL_Rewe	-0.13	0.01***	0.04**	-19.19	-9.52
PL_Aldi	-0.18	0.01***	0.04***	-26.60	-19.99
PL_Metro	-0.19	0.01***	0.04***	-27.33	-18.05
PL_Tengelmann	-0.19	0.01***	0.04***	-28.20	-21.73
PL_Netto	-0.22	0.01***	0.06***	-31.83	-26.29
Deutsche See	1.02	0.03***	0.10***	147.97	107.92
Bofrost	0.78	0.01***	0.07***	113.52	120.56
Eismann	0.72	0.02***	0.10***	104.80	111.91
Costa	0.28	0.01***	0.08***	39.97	33.38
Iglo	0.17	0.02***	0.05**	24.42	11.74
Pickenpack	-0.09	0.01***	0.04**	-13.08	-8.97
Femeg	-0.10	0.01***	0.05*	-14.10	-13.50
Royal Greenland	-0.11	0.01***	0.04*	-15.84	-12.54
Paulus	-0.13	0.01***	0.04***	-19.33	-12.72
Package Size	Base: >850 g				
100-399 g	0.09	0.01***	0.04*	13.23	16.07
400- 699 g	0.15	0.01***	0.05***	21.95	10.41
700-849 g	0.07	0.01***	0.03*	9.45	5.44

Aquaculture	0.28	0.01 ^{***}	0.06 ^{***}	40.41	24.36
MSC	0.03	0.01 [*]	0.03	3.63	2.74
Promotion Price	-0.14	0.01 ^{***}	0.01 ^{***}	-20.20	-19.18
No yearly effects	45.56 ^{***}	F(10,24397)	<i>p</i> -value <0.000		
No monthly effects	1.83 ^{***}	F(11,24397)	<i>p</i> -value <0.000		
Intercept	0.69	0.02 ^{***}	0.06 ^{***}		
<i>N</i>	24,457				
<i>R</i> ²	0.63				

^a *p*^{***}<0.01, *p*^{**}<0.05, *p*^{*}<0.10

^a Computed as described by Halvorsen and Palmquist (1980).

Source: Own estimations.

The results indicate that there are statistically significant attributes in all categories, indicating that all the attribute groups influence the price of fish. Accounting for the potential clustering of errors appears to be important, as 11 parameters become statistically insignificant when the dependencies within the clusters are accounted for. Still, most of the estimated coefficients are statistically significant at the 1 % level. In Table 3, tests of the null hypothesis that each of the attribute characteristics are irrelevant are reported for those attributes with more than two categories. As one can see, all these hypotheses are rejected, indicating that all attribute categories are important and there are temporal patterns in the prices. When comparing the premiums in percent with the premiums from a log linear model, it is clear that there is substantial correspondence between the results from the two models despite the results being obtained with two different functional forms. There is a high degree of correlation between the magnitudes of the premiums. Moreover, with three exceptions the signs are the same, and these exceptions are associated with three statistically insignificant parameters for the category natural and two yearly dummies.

Table 7.3: Tests of the Relevance of each Attribute Category

Null Hypothesis	Test Statistic	Distribution	Prob > F
No effect of species	583.00 ^{***}	F (10, 24397)	0.000
No effect of product form	122.36 ^{***}	F (3, 24397)	0.000
No effect of process form	186.69 ^{***}	F (3, 24397)	0.000
No effect of brand	898.86 ^{***}	F (16, 24397)	0.000
No effect of package size	142.95 ^{***}	F (3, 24397)	0.000

^{***} *p* < 0.01, ^{**} *p* < 0.05.

Source: Own estimations.

Species has a strong influence on market price, as also found in earlier studies. The individual parameters indicate that on average pikeperch obtains the highest price on the German market. Moreover, the consumers are willing to pay a premium for cod, tuna and plaice relative to salmon. Trout, pangasius, Alaska pollock and pollock are discounted relative to salmon, although for pangasius the difference is not statistically significant with the clustered standard errors. The low value of Alaska pollock and pollock is not unexpected. These species are among the most important whitefish species with low price and a stable high market share. In many years these species are the most popular fish species as measured by market shares (FIZ, 2014). Nielsen et al. (2009) indicate that also trout, which largely is farmed domestically, is a part of this low-valued whitefish segment (albeit not a whitefish), and the low price is to be expected. The parameter for pangasius indicates that the high average price reported in the descriptive statistics is due to other attributes. The most important categories are that a relatively high share of pangasius is sold as fillets (91 %), by the discounters as other brands and the home delivery brand Bofrost makes up 52 % of the sales of pangasius, and the fact that pangasius is farmed.

Fillets have a higher value with a premium of €0.04 per 100 g whereas steaks has a discount of €0.10 per 100 g and whole fish a discount of €0.37 per 100 g relative to other product forms, but both these premiums are statistically insignificant with the clustered errors. Battered and breaded products have a discount relative to natural fish and fish of other process forms. This seems to imply, as also found by Roheim et al. (2007), that these value adding processes actually destroy value. As in earlier studies, package size is important, with the largest being the least expensive.

Table 2 also shows that there are significant premiums on brands, with the Deutsche See brand obtaining the largest premium at €1.02 per 100 g and the home delivery brands Bofrost €0.79 per 100g and Eismann at €0.73 per 100 g relative to the base category other brands. Deutsche See is a German premium manufacturer, best known for quality and a high level of social and ecological responsibility. The company has several times won the consumers' association test of 'Stiftung Warentest'. Moreover, the regression results indicate a relatively high premium for fish products from Iglo and Costa.

The results clearly show that private label products are discounted relative to branded fish products, and that the discounts vary for different private labels. The largest discount (€0.22

per 100 g) is associated with the discounter Netto. The discount for the largest discounter Aldi is nearly €0.20 per 100 g. Given that the average fish price is €0.96 per 100g (table 1), this represents an approximately 21 % discount relative to other brands. For the private labels Tengelmann and Metro, the discount is nearly as high. The discounts from the second hard discounter Lidl are lower than for the other discounters at €0.12 per 100 g. An important marketing technique is promotional pricing. The average discount associated with promotion is estimated to be €0.14 per 100 g, which is over 15 %.

Seasonality was controlled by including monthly dummies, and annual dummies were included to capture longer term movements in prices. The annual dummies (not reported) indicate that prices in the base year 2010 were the lowest observed, and imply a declining trend for real seafood prices, although the development is not smooth. There is also some evidence of seasonality, but the magnitudes are all small and most parameters are statistically insignificant.

With respect to the production technology, fish products from aquaculture have a higher value than wild fish. On average, the premium is €0.28 per 100 g for fish originating from aquaculture. Hence, it seems as if the control of production and supply chain for aquaculture products facilitate a higher price, at least in the German market.⁴⁵

The results show a small price premium for MSC-labelled products. The premium is estimated to be €0.03 per 100 g fish. This unit premium is not directly comparable to the percentage premiums at 10-14 % reported by Roheim et al. (2011) and Sogn-Grundvåg et al. (2013; 2014) for the UK market. With an average price of €0.80 per 100 g, the average MSC premium in Germany is about 4 %. Moreover, while the premium is statistically significant with robust standard errors, it becomes statistically insignificant with the clustered standard errors. Hence, the use of the MSC-label does not seem to provide incentives for better fisheries management from the German market. While somewhat speculative, it is of interest to note the high premium associated with the high end Deutsche See brand. This may capture some of the MSC-premium. The results of Asche et al (2015a,b,c) for the UK suggest that this is the case for high-end retailers, but it is hard to

⁴⁵ In addition, aquaculture products have lower price volatility (Oglend, 2013; Dahl and Oglend, 2014), reducing price risk.

separate it out with our data given that Deutsche See has a so much higher premium than the next retail chain.

The results from the model with the interaction terms are reported in Table A7.2 in the appendix. As one can see, for the parameters that are not related to the interaction effects there are only very small changes. The interaction terms show that for natural fillets and steaks, there are no effects, while there is a significant effect for the breaded fillets and steaks and battered fillets and steaks. Hence, there is an interaction between product and process form for the more processed products.

7.5 Concluding Remarks

The advent of retail chains has substantially changed food sales in general and also seafood. In this paper we provide evidence of the value of different attributes in seafood retail in Germany. A unique data set allows us to assess the value of different private labels as well as home delivery, the average price premium associated with promotions and if there is a premium associated with production method. As there is no reason for pricing practices for other (frozen) food to be different from seafood, these results shed light on retailers' use of private labels and promotion more generally. Private labels are important for frozen seafood in Germany, and make up about 52 % of total sales. The results indicate that private labels for seafood in Germany are associated with lower prices. With two exceptions, private labels command a lower price than brands, and it is only the two lowest valued brands that command a lower premium than respectively one and two of the private labels. Home delivery, on the other hand, does not seem to compete on price, as only the highest valued brand command a higher premium. Promotions are quite aggressive in the price dimension, as the price is reduced with an average of 15 when a product is used for promotion.

During the last decade, there has been a trend for at least some consumer groups to be more concerned about environmental issues (Onozaka and McFadden, 2011). For seafood this is related to two main issues, wild versus aquaculture as production technique and whether the fishery documents that it is well managed by carrying an ecolabel. Wild fish is often perceived to be more environmentally friendly than fish from aquaculture, and a number of stated preference studies indicate a consumer preference for wild fish (Roheim et al., 2012). However, the higher control with the production process in aquaculture allows a more market oriented production process (Asche et al., 2011). In Germany, the benefits associated

with aquaculture seem to be most important, as farmed fish commands a premium over wild fish. MSC has been the most successful ecolabel for seafood, and Roheim et al. (2011) and Sogn-Grundvåg et al. (2013; 2014) document a premium of 10-14 % in the UK, although Asche et al. (2015a) show that it vary by retail chain. In Germany there the premium associated with the MSC-label is estimated to be 4 %, which it is much lower than in the UK, with the premium, being statistically insignificant using clustered standard errors to account for dependencies in the data. As there is a discussion about the effectiveness of ecolabels for seafood in providing incentives for fishers to improve management (Roheim et al. 2011), the limited size and the possible insignificance of the German premium is an indication that the incentives for better fisheries management provided from this marked is not very strong, or is otherwise catered for in the branded product (such as Deutsche See in our data). That the German premium is so different from what has been reported from the UK confirms an important result from the stated preference literature; there are substantial differences between countries (Johnston et al., 2001).

References

- Anderson, J. (2002). Aquaculture and the future: why fisheries economists should care. *Marine Resource Economics, Vol. 17*, 133-151.
- Asche, F. (2008). Farming the sea. *Marine Resource Economics, Vol. 23*, 527-547.
- Asche, F., & Guillen, J. (2012). The importance of fishing method, gear and origin: The Spanish hake market. *Marine Policy, Vol. 36*, 365–369.
- Asche, F., & Guttormsen, A. (2001). Patterns in the relative price for different sizes of farmed fish. *Marine Resource Economics, Vol. 16*, 235-247.
- Asche, F., Roll, K., & Tveterås, R. (2007). Productivity growth in the supply chain- another source of competitiveness for aquaculture. *Marine Resource Economics, Vol. 59*, 329-334.
- Asche, F., Benneer, L., Oglend, A., & Smith, M. (2012). U.S. shrimp market integration. *Marine Resource Economics, Vol. 27*, 181-192.
- Asche, F., Oglend, A., & Tveterås, S. (2013). Regime shifts in the fish meal/soyabean meal price ratio. *Journal of Agricultural Economics, Vol. 64*, 97-111.
- Asche, F., Bellemare, M., Roheim, C., Smith, M., & Tveterås, S. (2015a). Fair enough? Food security and the international trade of seafood. *World Development, 67*, 151-160.
- Asche, F., Chen, Y., & Smith, M. (2015b). Economic incentives to target species and fish size: Prices and fine scale product attribute in Norwegian fisheries. *ICES Journal of Marine Science, Vol. 72*, 741-752.
- Asche, F., Larsen, T., Smith, M., Sogn-Grundvåg, & Young, J. (2015c). Pricing of eco-labels with retailer heterogeneity. *Food Policy, Vol. 67*, 82-93.
- Asche, F.; Dahl, R.E., & Steen, M. (2015d). Price volatility in seafood markets: Farmed vs' wild fish. *Aquaculture Economics and Management, Vol. 19*, 316-335.
- Asche, F., Dahl, R., Gordon, D., Trollvik, T., & Aandal, P. (2011). Demand growth for salmon in the European market. *Marine Resource Economics, Vol. 26*, 255-265.

- Blomquist, J., Bartolino, V., & Waldo, S. (2015). Price premiums for providing eco-labelled seafood: Evidence from MSC-certified cod in Sweden. *Journal of Agricultural Economics*, Vol. 66, 690-704.
- Carroll, M., Anderson, J., & Martínez-Garmendia, J. (2001). Pricing U.S. north atlantic bluefin tuna and implications for management. *Agribusiness*, Vol. 17 , 243-254.
- Colla, E. (2003). International expansion and strategies of discount grocery retailers: The winning models. *International Journal of Retail and Distribution Management*, Vol. 31 , 55-66.
- Dahl, R., & Oglend, A. (2014). Fish price volatility. *Marine Resource Economics*, Vol. 29, 305-322.
- Destatis. (2015). *Statistisches Bundesamt Wiesbaden*. Retrieved from <https://www-genesis.destatis.de/genesis/online/>(last accessed Accessed 14.06.2015).
- Dobson, P., Waterson, M., & Davies, S. (2003). The patterns and implications of increasing concentration in european retailing. *Journal of Agricultural Economics*, Vol. 54 , 111-125.
- FAO. (2014). *The state of world fisheries and aquaculture 2014*. Rom: Food and Agriculture Organization of the United Nations.
- FIZ. (2014). *Fischwirtschaft -Daten und Fakten 2013*. Retrieved from Fischinformationszentrum: <http://www.fischinfo.de>(last accessed Accessed 12.01.2015).
- Forsberg, O. I., & Guttormsen, A. (2006). A pigmentation model for farmed atlantic salmon: Nonlinear regression analysis of published experimental data. *Aquaculture*, Vol. 253, 415-420.
- Gordon, D., Salvanes, K., & Atkins, F. (1993). A fish is a fish is a fish? Testing for market linkages on the Paris fish market. *Marine Resource Economics*, Vol. 8, 331-343.
- Guillotreau, P., Le Grel, L., & Simioni, M. (2005). Price-cost margins and structural change: sub contracting within the salmon marketing chain. *Review of Development Economics*, Vol. 9, 581-597.

- Guttormsen, A. (1999). Forecasting weekly salmon prices: Risk management in fish farming. *Aquaculture Economics & Management*, Vol. 3 , 159-166.
- Halvorsen, R., & Palmquist, R. (1980). The Interpretation of Dummy Variables in Semilogarithmic Equations. *The American Economic Review*, 70(3), 471-475.
- Johnston, R., Wessells, C., Donath, H., & Asche, F. (2001). Measuring consumer preferences for ecolabeled seafood: An international comparison. *Journal of Agricultural and Resource Economics*, Vol. 26, 20-39.
- Kristofersson, D., & Rickertsen, K. (2004). Efficient estimation of hedonic inverse input demand systems. *American Journal of Agricultural Economics*, Vol 86, 1127-1137.
- Kvaløy, O., & Tveterås, R. (2008). Risk preferences, production risk and firm heterogeneity. *Scandinavian Journal of Economics*, Vol. 105, 275-293.
- Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economics*, Vol. 74, 132-157.
- Larsen, T., & Asche, F. (2011). Contracts in the salmon aquaculture industry: An analysis of Norwegian salmon exports. *Marine Resource Economics*, Vol. 26, 141-149.
- Lee, M.-Y. (2014). Hedonic pricing of atlantic cod: Effects of size, freshness and gear. *Marine Resource Economics*, Vol. 29 , 259-277.
- McConnell, K., & Strand, I. (2000). Hedonic prices for fish: Tuna prices in Hawaii. *American Journal of Agricultural Economics*, Vol. 82, 133-144.
- Moulton, B. (1990). An illustration of pitfall in estimating the effects of aggregate variables on micro units. *The Review of Economics and Statistics*, Vol. 72, 334-338.
- Murray, A., & Fofana, A. (2002). The changing nature of UK fish retailing. *Marine Resource Economics*, Vol. 17, 335-340.
- Nerlove, M. (1995). Hedonic price functions and the measurement of preferences: The case of Swedish wine consumers. *European Economic Review*, Vol. 39, 1697-1716.
- Nielsen, M., Smit, J. and Guillen, J. (2009). Market Integration of Fish in Europe. *Journal of Agricultural Economics*, Vol. 60, 367-385.

- Oczkowski, E. (1994). A hedonic price function for Austrian premium table wine. *Australian Journal of Agricultural Economics*, Vol. 38, 133-144.
- Oglend, A. (2013). Recent trends in salmon price volatility. *Aquaculture Economics and Management*, Vol. 17, 281-299.
- Olson, T., & Criddle, K. (2008). Industrial evolution: A case study of Chilean salmon aquaculture. *Aquaculture Economics and Management*, Vol. 12, 89-106.
- Onozaka, Y., & McFadden, T. (2011). Does local labeling complement or compete with other sustainable labels? A conjoint analysis of direct and joint values for fresh produce claims. *American Journal of Agricultural Economics*, 93, 693-706.
- Roheim, C., Asche, F., & Insignares Santos, J. (2011). The elusive price premium for ecolabelled products: Evidence from seafood in the UK market. *Journal of Agricultural Economics*, Vol. 62, 655–668.
- Roheim, C., Gardiner, L., & Asche, F. (2007). Value of brands and other attributes: Hedonic analysis of retail frozen fish in the UK. *Marine Resource Economics*, Vol. 22, 239-245.
- Roheim, C., Sudhakaran, P. O., & Durham, C. (2012). Certification of shrimp and salmon for best aquaculture practices: Assessing consumer preferences in Rhode Island. *Aquaculture Economics and Management*, Vol. 16, 266-286.
- Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economics*, 82 , 34-55.
- Sampson, G., Sanchirico, J., Roheim, C., Bush, S., Taylor, E., Anderson, J., et al. (2015). Secure sustainable seafood from developing country fisheries: Require improvements as conditions for market access. *Science*, Vol. 348, 504-506.
- Satimanon, T., & Weatherspoon, D. (2010). Hedonic analysis of sustainable food products. *International Food and Agribusiness Management Review*, Vol. 13, 57-74.
- Smith, M. (2012). The new fisheries economics: Incentives across many margins. *Annual Review of REsource Economics*, Vol. 4, 379-402.

- Smith, T, Huang, C., & Lin, B.-H. (2009). Estimating organic premiums in the U.S. fluid milk market. *Renewable Agriculture and Food Systems*, Vol. 24, 197-204.
- Sogn-Grundvåg, G., Larsen, T., & Young, J. (2013). The value of line-caught and other attributes: An exploration of price premiums for chilled fish in UK supermarkets. *Marine Policy*, Vol. 38, 41-44.
- Sogn-Grundvåg, G., Larsen, T., & Young, J. (2014). Product Differentiation with Credence Attributes and Private Labels: The Case of Whitefish in UK Supermarkets. *Journal of Agricultural Economics*, 65 (2), 368–382.
- Tveterås, S., & Tveterås, R. (2010). The global competition for wild fish resources between livestock and aquaculture. *Journal of Agricultural Economics*, Vol. 61 , 381-397.
- Tveterås, S., Asche, F., Bellemare, M., Smith, M., Guttormsen, A., Lem, A., Lien, K.; Vannuccini, S. (2012). *Fish is food-the FAO's fish price index*. From PLoS ONE, 7(5):
<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0036731>
- Wakamatsu, H. (2014). The impact of MSC certification on a Japanese certified fishery. *Marine Resource Economics*, Vol. 29, 55-67.
- Waugh, F. (1928). Quality factors influencing vegetable price. *Journal of Farm Economics*, Vol. 19, 185-196.

On-Line appendix

Table A7.1: Descriptive Statistics based on EAN Codes

Product Attribute	Frequency in %	Price of the Product Attribute in € per 100g				Marketshare ^a in %
		Mean	Min	Max	Std. Dev.	
Fish Species						
Salmon	25.35	1.23	0.26	4.10	0.69	24.47
Pollock	14.61	0.78	0.29	2.91	0.48	12.12
Alaska-Pollock	13.03	0.69	0.23	2.01	0.40	11.40
Plaice	11.44	1.16	0.30	1.97	0.36	13.62
Trout	8.10	0.84	0.48	2.26	0.33	8.17
Redfish	7.57	0.81	0.38	1.52	0.31	8.75
Cod	7.04	1.01	0.40	2.66	0.49	8.06
Hake	5.11	0.77	0.30	1.49	0.27	4.60
Pangasius	3.17	1.29	0.34	4.30	1.01	4.37
Tuna	2.29	1.18	0.70	2.14	0.47	1.50
Pikeperch	2.29	1.28	0.47	3.15	0.69	2.93
Product Form						
Fillet	59.33	1.00	0.23	4.30	0.55	60.33
Other Form	35.04	0.99	0.26	4.10	0.61	35.13
Steak	3.17	0.87	0.54	2.14	0.35	2.35
Whole Fish	2.46	0.44	0.26	0.86	0.22	2.22
Process Form						
Other Form	47.36	0.98	0.23	4.10	0.59	47.95
Natural	23.94	0.97	0.34	3.15	0.44	24.76
Battered	14.79	1.05	0.37	3.02	0.63	12.59
Breaded	13.91	0.96	0.29	4.30	0.60	14.70
Brand						
PL_Aldi	12.15	0.66	0.23	1.55	0.28	8.78
PL_Metro	6.16	0.72	0.35	1.35	0.28	4.92
PL_Lidl	5.63	0.77	0.33	1.55	0.34	3.73
PL_Rewe	5.28	0.85	0.32	1.38	0.29	3.34
PL_Tengelmann	2.29	0.64	0.31	1.11	0.29	1.08
PL_Edeka	1.58	0.80	0.37	1.21	0.31	0.91
PL_Netto	0.70	0.56	0.33	0.90	0.24	0.28
Other Brand	25.70	1.00	0.29	2.91	0.51	29.77
Pickenpack	8.27	0.71	0.30	1.53	0.27	5.71
Eismann	7.22	1.65	0.80	2.79	0.54	14.48
Royal Greenland	5.46	0.81	0.40	1.78	0.32	3.87
Costa	4.93	1.39	0.55	4.10	0.70	5.22

7. Frozen Seafood in Germany

Bofrost	4.93	1.73	0.83	4.30	0.77	9.93
Paulus	4.40	0.88	0.34	2.00	0.36	3.53
Iglo	2.29	0.96	0.27	1.47	0.38	1.12
Deutsche See	1.94	2.14	1.23	3.15	0.61	2.68
Femeg	1.06	0.96	0.64	1.38	0.32	0.64
Package Size						
100- 399 g	28.87	1.22	0.50	4.10	0.56	16.81
400- 699 g	22.01	1.00	0.37	4.30	0.70	17.58
700- 849 g	18.13	0.81	0.23	2.18	0.43	20.32
> 849 g	30.99	0.86	0.26	2.52	0.45	45.29
Additonal						
Aquaculture	23.06	1.26	0.34	4.30	0.72	25.64
Promotion Price	13.73	0.89	0.33	2.91	0.56	11.11
MSC	6.34	0.89	0.42	1.33	0.35	11.44
Overall average 568 EANs		0.99	0.40	2.57	0.47	

^a Revenue based

Source: Own calculations.

Table A7.2: Parameter Estimations and Price Premiums Interaction Model

	Coefficients level model	Robust SE	Clustered SE	Price premium level model (in %)	Price premium log-linear model (in %) ^a
Species	Base: Salmon				
Pikeperch	0.36	0.02***	0.09***	50.91	57.15
Plaice	0.31	0.01***	0.04***	42.92	26.87
Tuna	0.25	0.02***	0.06***	35.34	45.21
Cod	0.14	0.01***	0.08	19.21	18.77
Redfish	-0.06	0.01***	0.05	-7.99	0.70
Hake	-0.12	0.01***	0.06*	-17.25	-11.13
Pollack	-0.21	0.01***	0.05***	-28.89	-23.59
Pangasius	-0.21	0.02***	0.11	-29.31	-26.95
Alaska Pollack	-0.23	0.01***	0.05***	-32.54	-15.72
Trout	-0.49	0.02***	0.08***	-69.14	-32.23
Product Form	Base: Other product form				
Fillet	-0.01	0.01	0.04	-1.40	-42.65
Steak	-0.16	0.02***	0.07*	-22.72	-6.01
Whole Fish	-0.40	0.03***	0.06***	-55.68	4.92
Process Form	Base: Other process form				
Breaded	-0.16	0.01***	0.06**	-22.44	8.00
Natural	-0.02	0.01	0.06	-2.95	-23.05
Battered	-0.27	0.01***	0.06***	-37.59	-13.50
Brand	Base: Other brand				
PL_Edeka	-0.10	0.02***	0.07	-12.76	-20.07
PL_Lidl	-0.12	0.01***	0.04**	-17.11	-14.96
PL_Rewe	-0.15	0.01***	0.05**	-20.62	-10.33
PL_Aldi	-0.19	0.01***	0.04***	-25.95	-25.84
PL_Metro	-0.19	0.01***	0.04***	-26.09	-11.40
PL_Tengelmann	-0.19	0.01***	0.04***	-27.21	-18.21
PL_Netto	-0.23	0.01***	0.06***	-31.84	-21.42
Deutsche See	1.00	0.03***	0.11***	139.97	-12.37
Bofrost	0.77	0.01***	0.07***	108.56	-13.06
Eismann	0.72	0.02***	0.10***	101.26	-8.79
Iglo	0.17	0.02***	0.05***	23.98	-13.76
Costa	0.26	0.01***	0.06***	36.47	13.88
Pickenpack	-0.09	0.01***	0.03**	-12.90	102.18
Femeg	-0.10	0.01***	0.05*	-14.31	113.61
Royal Greenland	-0.12	0.01***	0.05**	-17.11	32.45
Paulus	-0.14	0.01***	0.04***	-18.93	121.00
Package Size	Base: >850 g				
100-399g	0.10	0.01***	0.04*	13.46	10.74
400-699 g	0.15	0.01***	0.05***	21.32	5.34
700-849 g	0.07	0.01***	0.03*	9.96	16.53

7. Frozen Seafood in Germany

Aquaculture	0.30	0.01***	0.06***	42.22	1.71
MSC	0.01	0.01	0.03	1.68	-19.02
Promotion Price	-0.14	0.01***	0.01***	-19.21	25.61
Interaction Effects					
Steak_Battered	0.30	0.05***	0.11**		
Fillet_Battered	0.21	0.02***	0.08**		
Fillet_Breaded	0.09	0.01***	0.06		
Steak_Natural	0.03	0.02	0.09		
Fillet_Natural	0.02	0.01	0.07		
No yearly effects	42.72***	F(10,24392)	<i>p</i> -value <0.000		
No monthly effects	1,89***	F(11,24392)	<i>p</i> -value <0.000		
Intercept	0.71	0.02***	0.06***		
<i>N</i>	24,457				
<i>R</i> ²	0.63				

p***<0.01, p**<0.05, p*<0.10.

^a Computed as described by Halvorsen and Palmquist (1980).

Source: Own estimations.

8. Kapitel

Price Premiums for Eco-labeled Seafood: MSC –Certification in Germany

Autoren:

Frank Asche und Julia Bronnmann

Dieser Artikel befindet sich im Begutachtungsprozess bei:
Environmental and Resource Economics

Eine auf dem Beitrag basierende Präsentation wurde auf der XXII Conference 2015 of the
EAFE, University of Salerno, Italy, April 28-30 vorgestellt.

Price Premiums for eco-labeled seafood: MSC –Certification in Germany

FRANK ASCHE UND JULIA BRONNMANN

Abstract

Whether eco-labelled seafood actually provides incentives for providing better fisheries management is a controversial issue. A number of stated-preference studies indicate a substantial willingness-to-pay for eco-labelled seafood, but evidence from actual market data is limited. This paper contributes to this literature by estimating a hedonic price model for whitefish species on the German market that includes information on MSC, the leading seafood ecolabel, and allowing the potential premium to vary by species. The results indicate that the MSC-premiums in Germany vary substantially between species, from a hefty 30.6 % for the high-end species cod, to small and not statistically significant premiums for the cheaper species saithe and Alaska pollock.

Keywords: consumer preferences, Eco-labeling, hedonic, pricing, Marine Stewardship Council, price premium, scanner data

JEL classification codes: C23, D12, Q11, Q22

8.1 Introduction

During the last decade the eco-label of the Marine Stewardship Council (MSC) has established itself as the leading eco-label for seafood. At the end of 2014, 252 fisheries are certified (MSC, 2015). However, despite the obvious success in terms of the number of fisheries certified, the label remains controversial for a number of reasons. One of the most important is whether it actually provides fishers with incentives to demand better management. While there are a substantial number of studies showing a stated preference for eco-labeled seafood, there is limited evidence of these preferences being translated into an actual premium providing incentives for improved management (Roheim et al., 2011), and there is also outright scepticism that such a premium exist. For instance, Washington (2008) states that the price premium is a myth. The few studies investigating the presence of a premium associated with the MSC label using actual market data at the consumer level are all focusing on the UK market (Roheim et al., 2011; Sogn-Gruntvåg et al. 2013; 2014). Stated preferences studies indicate highly different preferences for an eco-label, even with comparable data sets (Johnston et al., 2001) and for different species (Johnston and Roheim, 2006). In this study we will investigate whether there is a premium associated with the MSC label for whitefish in Germany using scanner data. Introducing an interaction term in the hedonic price model allows us to differentiate a possible premium by species.

The basic intention with any ecolabel is to provide market-based incentives for producers to embrace better environmental production practices (Roheim, 2009). A credible eco-label, generally acknowledged to be provided by an independent third-party, allows consumers to choose products from such producers and avoid products from producers with less environmentally friendly practices. A successful eco-label will then segment the market by increasing demand for labeled product and reduce demand for unlabeled product. The increased demand for the eco-labeled product will provide “green” producers with a price premium (Gudmundsson and Wessells, 2000). This is also necessary as there is a cost associated with obtaining and using the eco-label.

A substantial number of stated preference studies indicate that a large number of consumers have a preference for seafood from well managed fisheries, and that they have increasing willingness to pay for seafood confirming this with an eco-label. These studies include Wessells et al. (1999), Johnston et al. (2001), Jaffry et al. (2004), Johnston and Roheim (2006), Brécard

et al. (2009), Salladarré et al. (2010) and Uchida et al. (2014). However, there is substantial scepticism with respect to whether this translates into an actual premium, and therefore actual incentives (OECD, 2006; Washington, 2008). In recent years, marked based evidence of a premium as associated with the MSC-label is starting to appear, but so far only for the UK. Roheim et al. (2011) use scanner data for the London Metropolitan Area to estimate a premium of 14.2 % for MSC-labeled Alaska pollock. Using store observation data, Sogn-Gruntvåg et al. (2013) report a premium of 10.1 % for haddock in Glasgow and Sogn-Gruntvåg et al. (2014) report a premium of 12.7 % for frozen whitefish, but without distinguishing by species.

In this study, scanner data for Germany are used to investigate the presence of a price premium associated with the MSC-label for three whitefish species in Germany, namely cod, Alaska pollock and saithe. These species are the only whitefish species with products carrying the MSC label during the period covered by our data set. We will follow the same basic approach as Roheim et al. (2011) and Sogn-Gruntvåg et al. (2013; 2014). However, Roheim et al. (2011) and Sogn-Gruntvåg et al. (2013) used data for only one species and Sogn-Gruntvåg et al. (2014) estimated a model that did not allow the MSC-premium to vary by the three observed species. In this paper the MSC-premium will be allowed to vary with species, by including an interaction term. It is then testable whether the premium varies by species in addition to whether a premium actually exists.

The paper is organized as follows: In the next section, we briefly describe the German fish market as well as the data used in this study. The empirical methodology is introduced in section 3. The estimation results are reported in the next section, followed by the last section, which draws some conclusions.

8.2 The German fish market and data

The German seafood market is dominated by imported fish. In 2013, the imports of fish and fishery products were 1.8 million tonnes, giving a market share of 88 %. The two main product categories are frozen and canned fish. In 2013 the market share of frozen fish was 30 % and the market share of canned fish was 27 %. Frozen fish is easily available, primarily being sold in the large retail chains. Moreover, discount chains are becoming increasingly important. In 2013, discount chains like Aldi and Lidl had a market share over 50 % of the seafood retail market, and do not sell fresh fish (Destatis, 2014).

This article analyzes the price premiums and discounts for frozen filets of cod, Alaska pollock and saithe purchased by German households. Frozen whitefish filets are among the most consumed fish products in Germany, led by Alaska pollock, which is the most popular seafood species. The data used in this study are provided by the ConsumerScan Homescan panel dataset on food purchases of German Households, which is conducted by the ‘Gesellschaft für Konsumforschung` (GfK), Nuremberg, Germany, the largest consumer research company in Germany. The data set contains monthly observations aggregated from the households’ daily fish purchases as well as detailed product specific information including the European Article Number (EAN) code. Based on the EAN code we can detect all whitefish products in our dataset carrying a MSC label.

The data set contains 1,348 observations covering a sample period of 36 months (January 2008-December 2010). The dataset allows for analysis at a disaggregated level given 57 different whitefish filet products with 11 products carrying the MSC label, 3 process forms and 10 brand categories. Among the brands we can distinguish between private label products and branded products. In our analysis we include private label brands from the hard discounters Aldi and Lidl, the co-operate discounter Netto and branded products from the manufacturers Pickenpack, Paulus and Royal Greenland. Moreover, we take products from the national home deliverers Bofrost and Eismann into account. Furthermore, we have information if the product was on promotion.

During the sample period not all of the fish products appear in the market for the entire period. Some products are withdrawn, other products have entered the market. Due to this, the price observations are deflated by the consumer price index (2010=100). This procedure is commonly used in case of hedonic price analyses based on scanner data (Chang et al., 2010).

Table 8.1 reports the descriptive statistics of the various attributes considered in this analysis. The empirical statistics are calculated with on 100 g weighted average price due to ensure comparability. The average price for a whitefish filet over the entire period is 0.70 € per 100 g. The German market is dominated by Alaska pollock, both in terms of market shares and frequency. In the data set, about 43 % are Alaska pollock filets, 37 % are saithe filets and 20 % are filets of cod. Cod has the highest price with an average of 0.88 € per 100 g. Most of the

purchased whitefish filets are sold as natural filets. Breaded and battered filets are the other important product forms, and are cheaper than natural filets.

Table 8.1: Descriptive Statistic

Product Attribute	Frequency in %	Price of the Product Attribute in € per 100 g				Marketshare ^a in %
		Mean	Min	Max	Std. Dev.	
Fish Species						
Cod	19.81	0.88	0.36	1.60	0.24	20.68
Saithe	36.94	0.64	0.22	1.46	0.35	34.73
Alaska-Pollock	43.25	0.65	0.26	1.42	0.34	44.59
Process Form						
Battered	2.45	0.47	0.44	0.53	0.02	1.14
Breaded	44.29	0.71	0.22	1.46	0.36	44.85
Natural	53.84	0.68	0.26	1.60	0.32	54.02
Brand						
Royal Greenland	2.60	0.60	0.50	0.72	0.07	1.35
Paulus	3.34	0.67	0.51	0.80	0.07	4.25
other brands	8.38	1.05	0.46	1.60	0.30	13.15
Pickenpack	22.70	0.54	0.26	1.28	0.21	15.33
Eismann	8.53	1.20	0.90	1.42	0.16	17.30
Bofrost	8.09	1.14	0.63	1.23	0.07	19.23
PL_Netto	12.09	0.59	0.26	0.89	0.18	5.69
other PL	10.83	0.45	0.32	1.02	0.13	6.95
PL_Lidl	11.94	0.61	0.22	1.28	0.38	7.34
PL_Aldi	11.50	0.47	0.32	0.70	0.12	9.41
Package Size						
< 300 g	10.53	0.98	0.36	1.28	0.23	6.68
300-500 g	27.30	0.57	0.26	1.28	0.18	14.36
> 500 g	62.17	0.70	0.22	1.60	0.37	78.96
Additional						
Promotion price	20.77	0.56	0.22	1.60	0.29	16.70
MSC	28.12	0.70	0.26	1.33	0.35	26.00
Overall average		0.70	0.36	1.24	0.22	21.08

^a Revenue based

Source: Own calculations.

Germany is among the five European countries with the largest share of private labels in retailing. Since years the supply of private labels has increased (Nielsen, 2013). In our dataset

about 46 % of the products were sold as private label products with an average price of 0.53 € per 100g. The private label of the discounter Aldi is the largest, with a market share of nearly 9 %, followed by Lidl (7 %). The branded whitefish filets are on average around 60 % more expensive (0.87 € per 100 g on average) than private label products. Whitefish filets from the home deliver brands Bofrost and Eismann are the most expensive. The average price for Bofrost products is 1.14 € per 100g and for Eismann products 1.20 € per 100g. Despite soaring prices these brands also have the highest market shares. With regard to the MSC labeling, the average price of the labeled whitefish filets is 0.70€ per 100g, and has a market share of nearly 26 %.

8.3 Method

Investigating the value of specific product attributes and their contribution to the price of a product has a long tradition, starting with Lancaster (1966). From the turn of the century, this approach has been used to show that various product attributes have a substantial impact on seafood prices at the landing point (McConnell and Strand, 2000; Lee, 2014; Asche et al., 2015a; Blomquist et al., 2015), the wholesale level (Asche and Guillen, 2012) and the retail level (Roheim et al., 2011; Ahmad and Anders, 2012; Sogn-Grundvåg et al., 2013; 2014; Asche et al, 2015b). These studies typically estimate a single parameter for each product attribute with Asche et al (2015b) and Blomquist et al. (2015) as exceptions as they allow interaction respectively between ecolabel and retail chain and size and quality grading.

The starting point is a price equation specified with a log-linear functional form, following the most common approach in the literature. The basic specification (Model 1) is given as:

$$\ln P_{it} = a + \sum_{j=2}^3 b_j s_j + \sum_{k=2}^K c_k r_k + dMSC + e_{it}, \quad (8.1)$$

where P_{it} is the price of product i at time t , s_2, s_3 is a vector of species that influence the price and r_2, \dots, r_k is a vector of the other product attributes that determine the price of the product and MSC is a dummy variable for products carrying the MSC label. The parameters b_j, c_k, d to be estimated are associated respectively with the species, the other product attributes and the MSC eco-label. Finally, e_{it} is an iid error term.

The model specification in equations (8.1) is similar to Sogn-Gruntvåg et al. (2014), where the MSC premium is restricted to be equal for all species. To allow the premium to vary, interaction dummies between the species and the MSC-label are introduced (Model 2). The model then becomes:

$$\ln P_{it} = a + \sum_{j=2}^3 b_j s_j + \sum_{k=2}^K c_k r_k + dMSC + \sum_{j=1}^3 d_j s_j MSC + e_{it}, \quad (8.2)$$

where d_j provides the interaction effect, showing how the eco-label is enhanced (positive value) or discounted (negative value) relative to the base case for any species. If all the null hypothesis that all d_j parameters cannot be rejected, the premium will be equal for all species.

In both models a White test for the null hypothesis of no heteroscedasticity is rejected, and only robust standard errors are accordingly reported. For testing against multicollinearity we compute the conditional index according to Belsley et al. (1980) which indicates the absence of multicollinearity.

Asche et al. (2015b) note that the standard errors are not likely to be independent across units, but rather independent across some clusters of units and correlated within those clusters. The potential for correlation among species, product types, process forms, package size or brand could bias the estimated standard errors as in the clustered standard errors literature (Moulton, 1990). As there is no obvious criterion to select the unit of clustering, we estimate the models with clustering for all the main categories of attributes.

8.4 Empirical Results

The base category in the estimation is natural cod fillets from Pickenpack in packets larger than 500g from 2010 without an MSC-label. The parameter estimates from the two models are reported in table 8.2 together with the implied premiums associated with each attribute. These are computed using the approach of Halvorsen and Palmquist (1980) and are calculated as $(e^{\beta} - 1) * 100$ where β is the estimated parameter. With an R^2 respectively of 0.8420 and 0.8463, Model 2 explains slightly more of the price variation than Model 1. Moreover, with the exception of the parameters associated with the MSC-label, all parameters are fairly similar between the two models.

Table 8.2: Parameter Estimates and Computed Premiums

Variable	Model 1				Model 2			
	Coefficient estimate	Robust SE	Clustered SE	Price effect (in %) ^a	Coefficient estimate	Robust SE	Clustered SE	Price effect (in %) ^a
Intercept	-0.240	0.056***	0.128*		-0.235	0.057***	0.140*	
Fish Species	base: cod							
Alaska Pollack	-0.517	0.027***	0.096***	-40.37	-0.493	0.027***	0.093***	-38.92
Saithe	-0.331	0.029***	0.117***	-28.18	-0.280	0.036***	0.140*	-24.65
Process Form	base: natural							
Battered	-0.615	0.075***	0.067**	-45.94	-0.601	0.082***	0.325*	-45.17
Breaded	-0.152	0.016**	0.305**	-14.10	-0.137	0.014***	0.576**	-12.80
Brand	base: Pickenpack							
PL_Netto	-0.269	0.024***	0.091***	-23.59	-0.284	0.03***	0.118**	-24.72
PL_Lidl	-0.224	0.02***	0.068***	-20.07	-0.314	0.025***	0.087***	-26.95
PL_Aldi	-0.205	0.023***	0.080**	-18.54	-0.222	0.024***	0.081**	-19.91
other PL	-0.181	0.025***	0.075**	-16.56	-0.193	0.028***	0.087**	-17.55
Paulus	-0.171	0.043***	0.141	-15.72	-0.365	0.061***	0.197*	-30.58
Royal Greenland	0.12	0.025***	0.055**	12.75	0.142	0.028***	0.078*	15.26
other brands	0.398	0.061***	0.267	48.88	0.373	0.058***	0.249	45.21
Bofrost	0.794	0.021***	0.084***	121.22	0.752	0.023***	0.093***	112.12
Eismann	1.006	0.02***	0.069***	173.46	0.989	0.022***	0.079***	168.85
Package Size	base: >500 g							
300-500 g	0.235	0.022***	0.069***	26.49	0.207	0.026***	0.089**	23.00
< 300 g	0.508	0.044***	0.164***	66.20	0.472	0.058***	0.213**	60.32
Additional								
Promotional Price	-0.104	0.013***	0.015***	-9.88	-0.103	0.012***	0.016***	-9.79
MSC	0.072	0.014***	0.052*	7.47	0.267	0.038***	0.121**	30.60
Dynamics	base: 2010							
2008	-0.054	0.036	0.027*	-5.26	-0.056	0.036	0.027**	-5.45
2009	0.037	0.02*	0.018**	3.77	-0.037	0.02*	0.017**	-3.63
trend	-0.004	0.003	0.001	-0.40	-0.001	0.001	0.010	-0.10
Interaction effects								
Saithe MSC					-0.277	0.051***	0.195	-24.19
Alaska Pollack MSC					-0.230	0.047***	0.151	-20.55
R²	0.8420				0.8463			
Observations	1.348				1.348			
Pr > F	0.000				0.000			

p*** < 0.01, p** < 0.05, p* < 0.10.

^a relative to base category at average price (0.70 €), adjustments made according to Halvorsen and Palmquist (1980).

Source: Own estimations.

With the exception of the time dummies and trend, all estimated parameters are significant at a 1 % level, and table 8.3 show that all groups of attributes containing more than one attribute are

statistically significant. This is also true for the clustered standard errors, although these standard errors as expected are somewhat wider. Hence, all groups of product attributes influence the product price.

Table 8.3: Hypothesis for Attribute Category Inclusion

Null Hypothesis	Test Statistic	Distribution	Prob > F
No effect of species	232.05	F (2, 1325)	0.000
No effect of product form	108.51	F (2,1325)	0.000
No effect of package size	38.66	F (2,1325)	0.000
No effect of brand	1378.21	F (9,1325)	0.000
No yearly effects	19.76	F (2,1325)	0.000

Source: Own estimations.

In Model 1, there is a discount of 28.2 % for saithe and 40.4 % for Alaska pollock relatively to cod, fitting with cod as the leading species in the whitefish market (Gordon and Hannesson, 1996; Asche et al., 2002). In a price conscious market like Germany, it is also as expected that Alaska pollock has the lowest prices given its commanding market share. There is a discount of 14.1 % for breaded and 45.9 % for battered relatively to natural fillets. This lines with Roheim et al. (2007), who argue that more processing destroys value. Natural fillets show the whole piece of fish, and have to be of good quality.

Branded products command significantly higher prices on the German market than private label products. The discount for a private label product from Netto (Lidl, Aldi) relative to a whitefish product from the brand Pickenpack is 23.6 % (20.1 %, 18.5 %) and the premium for the brand Royal Greenland is 12.8 %. Products from the home deliverer brands Bofrost and Eismann receive premiums well above 100 %.

Scale matters, and prices increase as packet size becomes smaller. On the other hand, the price level has remained stable, as neither annual dummies nor trend are statistically significant.

The attribute that is of most interest, the MSC premium is found to be 7.47 % in Model 1, and it is statistically significant at a 1 % level. However, Model 2 shows that there are significant differences between the species. Both interaction parameters are negative and significant at 1 % level, and an *F*-test that they are jointly zero can also be rejected with a *p*-value less than 0.01. The MSC premium without the interaction term is now associated with cod. This is found to be

30.6 % and statistically significant at a 1 % level. Accounting for the interaction effect, the premium of saithe is $30.6\% - 24.2\% = 6.4\%$ and for Alaska pollock it is $30.6\% - 20.6\% = 10\%$. Moreover, these premiums are not statistically significant. Hence, the MSC-premiums in Germany vary substantially between species, from a hefty 30.6 % for the high-end cod, to small and not statistically significant for the cheaper species saithe and Alaska pollock. While we do not have any demographic information with respect to who buys cod, the results seem to support the notion that it is high income and high knowledge consumers who care about both quality (Onozaka et al., 2014) and sustainable seafood (Johnston et al., 2001).

8.5 Concluding Remarks

Whether eco-labels in general and the MSC-label in particular provide incentives for better fisheries management has been a contentious issue. While there are a large number of studies indicating a strong consumer preference for sustainable seafood, and for eco-labels as a mean to achieve this, the preferences vary between markets and consumer groups. Moreover, there has been substantial scepticism with respect to what extent the stated preferences could be turned into actual incentives for fishers to demand better management. As market data has become available, studies using data at the retail level support the existence of an MSC-premium have started to appear. Roheim et al. (2011) and Sogn-Gruntvåg et al. (2013; 2014) showed that an MSC-premium exists for whitefish in the UK, and Asche et al. (2015b) show a premium for salmon in the UK. However, Blomquist et al. (2015) indicate that MSC-certification is not sufficient for fishers to obtain a premium at the landing location in the Swedish cod fisheries, but that the share of the cod landings that are sold through certified supply chains do obtain a premium. Hence, their results indicate that the management incentives depend on the share of fish that is being sold with an MSC label.

Our results indicate that whether a premium exists depends on species in the German retail market. There is a much stronger premium for cod than in the UK, but a lower and statistically insignificant premium for saithe and Alaska pollock. This is an important result, as it indicates that the general heterogeneity of the seafood market (Tveterås et al., 2012) also translates into the issue of eco-labels. As a consequence, the question of whether an eco-label provides incentives for better fisheries management, is a question that in general does not make sense. One has to qualify the question with respect to species, market and supply chain. This implies that eco-labels will most likely be an effective tool in some cases, but not in all.

To provide advice with respect to whether an eco-label is a useful tool for a specific fishery will accordingly require specific information with respect to that fisheries and the markets and supply chains it serves. This is also the case with respect to the often-forwarded argument that an eco-label will help market access to better paying markets. That this complexity is real is also evidenced by Alaska processors' decision to opt out of MSC certification for salmon in 2013 (Intrafish, 2013). They apparently did not experience market benefits sufficient to compensate the cost. This is also an indication that it is in the interest of the providers of an eco-label to investigate market factors in each specific case, if the eco-label is to remain credible. Eco-labels can only provide incentives for better management in markets with a sufficiently strong preference for the eco-label and the message it conveys for this to translate into real value. Since eco-labels are costly, producers will otherwise abstain.

References

- Ahmad, W. S. Anders (2012). The Value of Brand and Convenience Attributes in Highly Processed Food Products, *Canadian Journal of Agricultural Economics*, Vol. 60, 113-133.
- Asche, F., Larsen, T., Smith, M., Sogn-Grundvåg, & Young, J. (2015b). Pricing of eco-labels with retailer heterogeneity. *Food Policy*, Vol. 67, 82-93.
- Asche, F., & Guillen, J. (2012). The importance of fishing method, gear and origin: The Spanish Hake market. *Marine Policy*, Vol. 36, 365-369.
- Asche, F., Chen, Y., & Smith, M. D. (2015a). Economic incentives to target species and fish size: Prices and fine-scale product attributes in Norwegian fisheries. *ICES Journal of Marine Science*, Vol. 72, 733-740.
- Asche, F., Gordon, D., & Hannesson, R. (2002). Searching for price parity in the European whitefish market. *Applied Economics*, Vol 34, 1017-1024.
- Belsley, D., Kuh, E., & Welsch, R. (1980). *Regression diagnostics: Identifying influential data and source of collinearity*. New York: John Wiley.
- Blomquist, J., Bartolino, V., & Waldo, S. (2015). Price premiums for providing eco-labelled seafood: Evidence from MSC-certified cod in Sweden. *Journal of Agricultural Economics*, Vol. 66, 690-704
- Brécard, D., Hlaimi, B., Lucas, S., Perraudou, Y., & Salladarre, F. (2009). Determinants of demand for green products: An application to ecolabel demand for fish in Europe. *Ecological Economics*, Vol. 69, 115-125.
- Chang, J. B., Lusk, J. L., & Norwood, F. (2010). The price of happy hens: A hedonic analysis of retail egg prices. *Journal of Agricultural and Resource Economics*, Vol. 35, 406-423.
- Destatis. (2014). *Statistisches Bundesamt Wiesbaden*. Retrieved from <https://www-genesis.destatis.de/genesis/online/>
- Gordon, D., & Hannesson, R. (1996). On price of fresh and frozen cod. *Marine Resource Economics*, Vol. 11, 223-238.

- Gudmundsson, E., & Wessells, C. (2000). Ecolabeling seafood for sustainable production: Implications for fisheries management. *Marine Resource Economics*, Vol. 15, 97-113.
- Halvorsen, R., & Palmquist, R. (1980). The interpretation of dummy variables in semilogarithmic equations. *The American Economic Review*, Vol. 70, 471-475.
- Intrafish. (2013). *Five companies agree to continue using MSC eco-label for Alaska Salmon*.
- Jaffry, S., Pickering, H., Ghulam, Y., Whitmarsh, D., & Wattage, P. (2004). Consumer choices for quality and sustainability labelled seafood products in the UK. *Food Policy*, Vol. 29, 215-228.
- Johnston, R., Wessells, H., Donath, H., & Asche, F. (2001). A contingent choice analysis of ecolabeled seafood: Comparing consumers preferences in the United States and Norway. *Journal of Agricultural and Resource Economics*, Vol. 26, 20-39.
- Jonston, R., & Roheim, C. (2006). A battle of taste and environmental convictions for ecolabeled seafood: A contingent ranking experiment. *Journal of Agricultural and Resource Economics*, Vol. 31, 283-300.
- Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economics*, Vol. 74, 132-157.
- Lee, M. (2014). Hedonic pricing of Atlantic Cod: Effects of size, freshness and gear. *Marine Resource Economics*, Vol.29, 259-277.
- McConnell, K., & Strand, I. (2000). Hedonic prices for fish: Tuna prices in Hawaii. *American Journal of Agricultural Economics*, Vol. 82, 133-144.
- Moulton, B. (1990). An illustration of pitfall in estimating the effects of aggregate variables on micro units. *The Review of Economics and Statistics*, Vol. 72, 334-338.
- MSC. (2015). *Marine Stewardship Council*. Retrieved from Certified sustainable seafood: <http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified>
- Nielsen. (2013). *Deutschland 2013. Handel, Verbraucher, Werbung*. Retrieved from http://www.nielsen.com/content/corporate/de/de/insights/reports-downloads/_jcr_content/par/download_0/file.res/Nielsen_Universen_D_Internet.pdf

-
- OECD. (2006). *High Seas Task Force Closing the Net: Stopping illegal fishing on the High Seas*. Retrieved 3 25, 2010, from www.high-seas.org
- Onozaka, Y., Hansen, H., & Sørvig, A. (2014). Consumer product perceptions and Salmon consumption frequency: The role of heterogeneity on food lifestyle segments. *Marine Resource Economics, Vol. 29*, 351-374.
- Roheim, C. (2009). An evaluation of sustainable seafood guides: Implications for environmental groups. *Marine Resource Economics, Vol. 24*, 301-310.
- Roheim, C., Asche, F., & Insignares Santos, J. (2011). The elusive price premium for ecolabelled products: Evidence from seafood in the UK market. *Journal of Agricultural Economics, Vol. 62*, 655–668.
- Roheim, C., Gardiner, L., & Asche, F. (2007). Value of brands and other attributes: Hedonic analysis of retail frozen fish in the UK. *Marine Resource Economics, Vol. 22*, 239-245.
- Salladarré, F., Guillotreau, P., Perraudeau, Y., & Monfort, M. (2010). The demand for seafood eco-labels in France. *Journal of Agricultural and Food Industrial Organization, Vol. 8: Iss 1, Article 10*.
- Sogn-Grundvåg, G. L., & Young, J. (2013). The value of line-caught and other attributes: An exploration of price premiums for chilled fish in UK supermarkets. *Marine Policy, Vol. 38*, 41-44.
- Sogn-Grundvåg, G., Larsen, T., & Young, J. (2014). Product differentiation with credence attributes and private labels: The case of whitefish in UK supermarkets. *Journal of Agricultural Economics, Vol.65*, 368–382.
- Tveterås, S., Asche, F., Bellemare, M., Smith, M., Guttormsen, A., Lem, A., . . . Vannuccini, S. (2012). *Fish is food-the FAO's fish price index*. From PLoS ONE, 7(5): [http://www.plosone.org/article/info %3Adoi %2F10.1371 %2Fjournal.pone.0036731](http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0036731)
- Uchida, H., Onozaka, Y., Morita, T., & Managi, S. (2014). Demand for ecolabeled seafood in the Japanese market: A conjoint analysis of the impact of information and interactions with other labels. *Food Policy, Vol. 44*, 68-76.
- Washington, S. (2008). *Ecolabels and marine capture fisheries: Current practise and emerging issues*. Rome, FAO: GLOBEFISH Research Programme.

Wessells, C., Johnston, R., & Donath, H. (1999). Assessing consumer preferences for ecolabeled seafood: the Influence of species, certifier and household attributes. *American Journal of Agricultural Economics*, Vol. 81, 1084-1089.

9. Kapitel

Schlussbetrachtung

Inhalt der vorliegenden Dissertation sind sieben unabhängige empirische Untersuchungen, die das Konsumentenverhalten sowie das Preissetzungsverhalten bezüglich Fischprodukte im deutschen LEH analysieren. Die Berichte lassen sich in Nachfrageanalysen (Kapitel 2, 3, 4, 5) und Preisanalysen (Kapitel 6, 7, 8) einteilen. Die Fragestellungen zwischen den einzelnen Beiträgen unterscheiden sich ebenso wie die in den empirischen Analysen verwendeten Modellspezifikationen, insofern, als dass der deutsche Fischmarkt mit einem breiten methodischen Spektrum beleuchtet wird.

Im Methodenfeld der Nachfrageanalysen wird das Verbraucherverhalten in Bezug auf wildgefangenen Fisch und gezüchteten Fisch aus Aquakulturanlagen untersucht und es werden Preis- und Ausgabenelastizitäten berechnet. Ferner wird anhand eines Random Coefficient Ansatzes die Zahlungsbereitschaft der Konsumenten für gezüchteten Fisch und Fischprodukte, die mit Nachhaltigkeitslabeln gekennzeichnet sind, analysiert. Die Analysen erfolgen durch stated preference Daten, die im Rahmen einer selbst durchgeführten DCE ermittelt wurden und anhand tatsächlicher Marktdaten (revealed preferences). Im Bereich der Preisanalysen wird in einer Marktintegrationsstudie beleuchtet, ob wildgefangene und gezüchtete Weißfische einen gemeinsamen Markt bilden und inwieweit die verschiedenen Sorten als Substitute zu betrachten sind. Außerdem wird mittels hedonischer Preisanalysen untersucht, wie verschiedene Produktattribute die Preise für Fischprodukte beeinflussen.

Die Antworten auf die verschiedenen aufgezeigten Fragen zeigen jedoch auch die Grenzen der verwendeten Ansätze zur Analyse des deutschen Fischmarktes auf. In der folgenden Schlussbetrachtung werden daher die Ergebnisse der durchgeführten Studien kritisch beleuchtet, und es wird möglicher weiterer Forschungsbedarf diskutiert. Ferner wird auf Vor- und Nachteile von Scannerdaten und DCE eingegangen.

Kritische Würdigung von Scannerdaten (tatsächlichen Marktdaten)

Bis auf einen Beitrag dieser Dissertation beruhen die Studien auf Scannerdaten. Dabei handelt es sich einmal um Scannerdaten des Haushaltspanels (ConsumerScan) der GfK sowie um das Haushaltspanel der SymphoniIRI Group. Im Rahmen des Haushaltspanels berichten Haushalte über ihre getätigten Einkäufe. Das Handelspanel beinhaltet Daten, die beim Einlesen der Barcodes an den Kassen verschiedener Lebensmitteleinzelhändler erhoben wurden.

Das Haushaltspanel (ConsumerScan) der GfK dokumentiert die Einkäufe EAN-kodierter Lebensmittel von rund 30.000 für Deutschland repräsentativen Haushalten. Somit ist die Datengrundlage in ihrer Größe und ihrem Informationsgehalt einzigartig. Für jeden Fischeinkauf sind Kaufdatum, gekaufte Menge, Anzahl der gekauften Artikel, Einkaufsstätte sowie die Art des Fischproduktes erfasst. Zudem stellen die Haushalte soziodemographische Merkmale zur Verfügung. Erfasst werden u.a. das Alter des Haushaltsführers, die Postleitzahl des Wohnortes, die Haushaltsgröße, das Haushaltseinkommen, die Anzahl der Kinder im Haushalt sowie Angaben über Beruf und Beziehungsstand.

Die Einzelhandelsscannerdaten der SymphoniIRI Group (IRI Daten) werden auf wöchentlicher Basis erfasst. Neben den erhobenen Preisen und verkauften Mengen enthält der Datensatz auch produkt- und geschäftsspezifische Zusatzinformationen. Die Stichprobe des IRI Handelspanels umfasst verschiedene Geschäftstypen (wie z.B. Discounter, Supermärkte, Verbrauchermärkte), die sich in ihrer Verkaufsfläche, ihrer Lage und der Handelsorganisation unterscheiden. Damit liefert der Datensatz homogene Gruppen von Geschäften. Das Handelspanel maskiert jedoch die Kettenzugehörigkeit und eine explizite Identifizierung von Handelsmarken ist somit nicht möglich. Die Produktbeschreibung im Handelspanel ist detailliert und auch Sonderangebote werden erfasst (IRI, 2012).

Während die Scannerdaten für die Nachfrageanalysen (Kapitel 2 und 3) zu Monatsdaten aggregiert wurden, arbeiten die hedonischen Preisanalysen (Kapitel 7 und 8) mit den ursprünglichen Einkaufsdaten, so dass jeder einzelne Kauf eines Fischproduktes eines Haushaltes eine Beobachtung darstellt.

Die wesentlichen Vorteile von Scannerdaten liegen darin, dass die Daten aufgrund ihrer Informationsfülle und Aktualität die Qualität der erhaltenen Ergebnisse erhöhen und diese auf einer großen und repräsentativen Stichprobe basieren. Die miterfassten Verkaufsmengen erlauben die Bestimmung der Artikelumsätze und damit eine präzise Auswahl der wichtigsten Produkte für die Analyse. Zudem können die einzelnen Produkte detailliert durch die EAN Codes identifiziert werden und es können somit stark disaggregierte Untersuchungen durchgeführt werden. Darüber hinaus sind die Einkäufe der Haushalte in verschiedenen Einkaufsstätten und Geschäftstypen, inklusive Discountern, dokumentiert. Somit lässt sich über die Identifikationsnummer der Haushalte auch Gewohnheitsverhalten der Haushalte abbilden.

Neben der allgemeinen Vorteilhaftigkeit von Scannerdaten gibt es auch Schwachstellen. Genannt sei die Tatsache, dass anhand von Scannerdaten nicht ermittelt werden kann, welchen Einfluss die Hersteller einer- und die Lebensmitteleinzelhändler andererseits auf die Preissetzungsstrategie von einzelnen Produkten haben. Es fehlen die Angaben zu den Einkaufs- bzw. Großhandelspreisen, um die genauen Margen der Einzelhändler und somit deren Einfluss auf die Preisgestaltung bestimmen zu können. Ein Nachteil der IRI Daten ist ferner, dass diese nur maskierte EAN Codes enthalten und somit eine Unterscheidung von Handelsmarken nicht möglich ist. Zudem stellen Analysen auf Basis umfangreicher Datensätze sehr hohe Anforderungen an die Datenaufbereitung und die Durchführung der gewählten Schätzmethodik.

Kritische Würdigung von DCE Daten (stated preference Daten)

Die Durchführung von Discrete Choice Experimenten stellt eine Methode dar, Konsumentenpräferenzen für bestimmte Produkte zu ermitteln. Das Verfahren erlaubt eine Abfrage von komplexen und realistischen Entscheidungen mittels zum Teil auch mehrerer Choice Sets, so dass eine großen Umfragestichprobe erreicht werden kann (Auspurg und Liebe, 2011). Dadurch, dass die Teilnehmer sich für eine der vorgestellten Alternativen im Choice Set entscheiden müssen, kommt die Methode dem tatsächlichen Kaufentscheidungsprozess der Konsumenten nah. Ein wesentlicher Vorteil der DCE besteht in der theoretischen Fundiertheit des Modells. Die DCE Methode beruht auf der

Zufallsnutzentheorie (Random Utility Theorie) nach Lancaster (1966), die von McFadden (1974) entscheidend weiterentwickelt und geprägt wurde. Weiter ist es auch möglich, hypothetische Entscheidungen über Produktalternativen abzufragen, die bislang noch nicht auf dem Markt existieren. Dies kann insbesondere dem LEH oder auch Produzenten bei geplanten Markteinführungen neuer Produkte zu Gute kommen. Verschiedene Untersuchungen (Carlsson und Martinsson, 2001; Scarpa et al., 2003; Telser und Zweifel, 2007) zeigen, dass hypothetische Entscheidungen oftmals mit tatsächlichem Kaufverhalten stark übereinstimmen.

Auf der anderen Seite besteht jedoch ein wesentlicher Kritikpunkt der Methode der DCE eben genau darin, dass nur hypothetische (stated preferences) und nicht reale Entscheidungen (revealed preferences) abgefragt und modelliert werden. Es kann dadurch passieren, dass sich das Entscheidungsverhalten der Teilnehmer an sozial erwünschten Antworten orientiert und die Antworten somit nicht die wahren Präferenzen abbilden. Entsprechend sollte diese Möglichkeit in der Interpretation der Zahlungsbereitschaft für einzelne Produktattribute berücksichtigt werden. Weiterhin ist zu beachten, dass sich die Abfrage der Produktattribute nur auf bestimmte Ausprägungen bezieht und sich auch die Zahlungsbereitschaften nur auf eben diese Ausprägungen beziehen können.

Das Vorliegen möglicher heterogener Präferenzen für die abgefragten Produktattribute zwischen den Befragungsteilnehmern lässt sich durch Aufnahme Interaktionseffekte in das zu schätzende Modell, oder die Anwendung erweiterter Modelle, wie das Mixed Logit Model, berücksichtigen. Hensher et al. (2009) stellt heraus, dass stated preference Methoden nicht in der Lage sind, alle Gegebenheiten des Marktes aufzufangen und daher mit tatsächlichen Marktdaten kombiniert werden sollten. Dennoch sind DCE gut geeignet, um das Entscheidungsverhalten von Konsumenten zu untersuchen und wichtige Erkenntnisse für weitere Marketingstrategien abzuleiten (Hensher et al., 1999; Auspurg und Liebe, 2011).

The German Whitefish Market: An Application of the LA/AIDS Model using Retail-Scanner-Data

Dieser Beitrag zielt darauf ab, den deutschen Weißfischmarkt dahingehend zu untersuchen, ob es Unterschiede im Nachfrageverhalten der Konsumenten bezüglich wildgefangener und gezüchteter Weißfischsorten gibt. Insbesondere der Weißfischmarkt hat sich innerhalb der letzten Jahre stark entwickelt. Es werden durch die Verbesserungen der Produktionsprozesse und die dadurch resultierende kostengünstigere Produktion von Fischen in Zuchtanlagen immer mehr Fischarten auf dem deutschen Markt angeboten. Neben den traditionellen wildgefangenen Weißfischsorten wie Kabeljau und Seelachs, konnten vor allem Sorten wie Pangasius und Tilapia Marktanteile gewinnen.

Anhand eines LA/AIDS wird die Nachfrage nach den traditionellen Weißfischsorten Kabeljau, Alaska-Seelachs und Seelachs und den Sorten Pangasius und Tilapia aus Aquakulturen untersucht. Die Stärke des Einflusses auf das Nachfrageverhalten wird mittels Elastizitäten quantifiziert; im Fokus der Betrachtung stehen die Substitutionsbeziehungen zwischen den einzelnen Fischarten. Als Datengrundlage für die Analysen dienen Scannerdaten aus dem Einzelhandel der SymphonyIRI Group.

Alaska-Seelachs dominiert mit einem Marktanteil von 45 % nach wie vor den deutschen Weißfischmarkt, während Pangasius mit einem Marktanteil von 26 % den zweiten Platz einnimmt und Tilapia mit einem Marktanteil von 3 % keine wesentliche Rolle spielt. Für die traditionellen wildgefangenen Fischarten wird eine etwas preiselastischere Nachfrage ermittelt als für die gezüchteten Weißfische. Im Allgemeinen kann die Aussage getroffen werden, dass die verschiedenen Weißfischsorten in einer substitutiven Beziehung zueinander stehen. Interessant ist die Tatsache, dass sich Pangasius auf dem deutschen Markt vollkommen etabliert hat und zunehmend Marktanteile gewinnt. Die Konsumenten weichen mehr und mehr auf den günstigeren Pangasius aus und Pangasius fungiert insbesondere als ein starkes Substitut für Kabeljau und Seelachs. Dieses Phänomen ist ebenfalls auf anderen internationalen Fischmärkten beobachtbar.

Das in diesem Beitrag verwendete LA/AIDS Modell ist nach wie vor eine weit verbreitete Methodik, um das Nachfrageverhalten nach Lebensmitteln zu untersuchen. Jedoch besteht

der Nachteil dieser Methodik darin, dass das AIDS lineare Engelkurven mit konstanten Ausgaben- bzw. Einkommenselastizitäten annimmt. Diese restriktive Annahme erlaubt nicht, dass ein Produkt an einem Punkt der Nachfrage ein normales Gut und an anderer Stelle ein Luxusgut ist (Dhar und Foltz, 2005). Insbesondere bei der Betrachtung verschiedener Fischarten scheint diese Annahme fragwürdig, denn es ist durchaus denkbar, dass beispielsweise ein höherpreisiger Fisch für einkommensschwache Haushalte ein Luxusgut darstellt, während einkommensstärkerer Haushalte die Fischart als Gut des täglichen Bedarfs ansehen. Resultierend daraus ist vielmehr anzunehmen, dass die Ausgaben für Fisch nicht proportional zum Einkommen wachsen. Eine Möglichkeit auch nicht lineare Einflüsse zu erfassen, stellt das QUAIDS Modell von (Banks et al., 1997) dar, das die Schätzgleichung um einen quadratischen Ausgabenterm erweitert.

Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood in Germany: An Application of QUAIDS Modeling with Correction for Sample Selection

Der Fokus dieses Beitrags liegt ebenfalls auf der Untersuchung, ob deutsche Konsumenten unterschiedlich auf Preisänderungen bei wildgefangenen Fischen und Meerestieren reagieren als bei Fischen und Meerestieren aus Zuchtanlagen. Zur Validierung wird die erweiterte Form des AIDS, das QUAIDS herangezogen. Scannerdaten des Haushaltspanels der GfK für das Tiefkühl Fischsegment dienen dabei als Datengrundlage. Ferner wird der Korrektur von Nullbeobachtungen Rechnung getragen.

Dadurch, dass der Preis in dem Haushaltspanel datensatz nicht direkt angegeben ist, muss dieser als sogenannter Durchschnittspreis, als Quotient aus Ausgaben und Mengen, errechnet werden. Die Problematik, die sich durch diesen Durchschnittspreis ergibt, liegt darin, dass der Preis neben tatsächlichen Preisunterschieden auch qualitative und regionale Unterschiede sowie Messfehler widerspiegelt und so zu verzerrten Schätzungen der Elastizitäten führen kann (Cox und Wohlgenannt, 1986). Eine Korrektur der Preisdaten um Qualitätsaspekte wurde in Studien, die Nachfragesysteme für Fischprodukte auf Basis von Haushaltspanel daten schätzen, bisher nicht durchgeführt. In diesem Beitrag wird eine

Korrektur nach Cox und Wohlgenannt (1986) angewandt, die somit einer Unterschätzung der Preissensibilität von Konsumenten vorbeugt.

Eine von anderen bisher untersuchten Fischmärkten abweichende Feststellung dieser Studie ist, dass die Preise für gezüchtete Fische in Deutschland höher sind als die Preise der wildgefangenen Fische. Eine vage Erklärung könnte darin liegen, dass die Aquakulturproduktion in den letzten Jahren erheblich zugenommen hat und gezüchtete Fische somit auch in größeren Mengen auf den deutschen Markt importiert werden. Die gestiegenen Transportkosten könnten zu diesen höheren Preisen beitragen.

Die Ergebnisse zeigen, dass deutsche Konsumenten besonders bei den höherpreiseigen Lachs und Shrimp Produkten preissensibel reagieren. Die Ergebnisse für Lachs und Shrimps aus beiden Produktionstechnologien sind jedoch nicht einheitlich. Für Lachs finden wir kaum Unterschiede in der Höhe der Elastizitäten, während die Nachfrage nach wildgefangenen Shrimps elastischer reagiert als die Nachfrage nach gezüchteten Shrimps. Es kann daher gefolgert werden, dass das Marktpotential für gezüchtete Shrimps in Deutschland noch nicht so ausgeschöpft ist wie für Lachsprodukte.

Wie bereits an vorheriger Stelle dieses Kapitels erwähnt, liegt ein wesentlicher Vorteil in der Verwendung von Scannerdaten darin, dass diese detaillierte Produktinformationen liefern. Auf wöchentlicher Basis werden die verkauften Mengen innerhalb einer Produktkategorie erfasst. Somit sind Untersuchungen auf sehr disaggregierter Ebene möglich. Aufgrund der Tatsache, dass das Kaufverhalten vieler Haushalte erfasst wird, können die Schlussfolgerungen außerdem auf Basis einer großen Stichprobe gezogen werden.

In dieser Studie werden die wöchentlichen Daten zu monatlichen Daten aggregiert, um Nullbeobachtungen zu minimieren. Durch diese Prozedur kann zwar eine verzerrte Schätzung verhindert werden, jedoch geht auch ein Teil der Varianz der Daten verloren. Ferner werden die betrachteten Produkte der verschiedenen Fischarten und der Shrimps so aggregiert, dass nur unbehandelte Filets in die Nachfrageanalyse einfließen. Weitere in den Daten vorhandene Informationen, wie unterschiedliche Packungsgröße, Verarbeitungs- und Produktformen der betrachteten Fischarten werden somit wegaggregiert. Zudem bleiben Sonderpreise in der Studie unberücksichtigt. Zukünftige Untersuchungen, in denen eine

disaggregiertere Produktebene gewählt und der Einfluss von Sonderangeboten modelliert wird, wären daher interessant und hilfreich.

Die Heterogenität der Konsumenten wird in dieser Studie lediglich durch Aufnahme sozioökonomischer Variablen in das Nachfragesystem analysiert. Es ist zudem möglich, dass unterschiedliche Konsumentengruppen unterschiedlich preissensibel reagieren; getrennte Nachfragesystemsätzungen für spezifische Konsumentengruppen könnten daher zu unterschiedlichen Ergebnissen führen. Um die Robustheit der erhaltenen Ergebnisse zu überprüfen und die Konsumentenheterogenität explizit zu berücksichtigen, ist die Anwendung eines Random Coefficient Modells denkbar.

Assessing Consumer Preferences and Willingness to Pay for Fish from Aquaculture and Eco-labeled Fish: Insights from a Discrete Choice Experiment in Northern Germany

Die Frage, welches Attribut von Fischprodukten zu höheren oder weniger hohen Zahlungsbereitschaften bei den Konsumenten führt, kann durch die Anwendung von DCE beantwortet werden. In diesem Beitrag wird die Methode genutzt, um den Einfluss des Preises, der Produktionsmethode, der Verarbeitungsform sowie der Zertifizierung auf die Kaufwahrscheinlichkeit von Lachs- und Steinbuttprodukten zu untersuchen.

Die Ergebnisse der Mixed Logit Schätzung zeigen, dass die norddeutschen Konsumenten bezüglich der Produktattribute heterogene Präferenzen aufweisen. Der durchschnittliche Befragungsteilnehmer ist gegenüber Fischprodukten aus Zuchtanlagen sowie Tiefkühlfischprodukten abgeneigt. Hingegen haben die Konsumenten eine erhöhte Zahlungsbereitschaft für mit Nachhaltigkeitslabel gekennzeichnete Produkte. Die Kaufwahrscheinlichkeit ist dabei für das MSC Siegel für beide betrachteten Fischarten erhöht. Weiter verstärken sich die Effekte, wenn die Konsumenten über die Produktionsmethoden sowie die Nachhaltigkeitslabel aufgeklärt werden.

Durch die Anwendung von DCE kann das optimale Preissetzungsverhalten für die Produkte im LEH prognostiziert werden. Die erhaltenen Informationen können vom Marketing der Hersteller von Fischprodukten sowie vom LEH genutzt werden, um zugeschnittene

Werbemaßnahmen durchzuführen und die Marktanteile der Produkte sowie die Margen zu erhöhen.

Wie bereits zu Beginn dieses Kapitels erwähnt, liegt ein wesentlicher Kritikpunkt der DCE Methode darin, dass Konsumenten geneigt sind, sozial erwünschte Antworten zu geben. Daher ist es sinnvoll, die Einflüsse der betrachteten Produktattribute auf die Kaufwahrscheinlichkeit der deutschen Konsumenten nochmals anhand tatsächlicher Marktdaten zu analysieren und somit die Ergebnisse zu verifizieren.

Preference Heterogeneity in the Demand for Salmon: A Random Coefficients Approach

Das Ziel dieser Untersuchung ist es, anhand eines Haushaltsscannerdatensatzes der GfK die Kaufentscheidung von Konsumenten bezüglich tiefgefrorener Lachsprodukte in Deutschland zu analysieren. Dabei liegt der Fokus, wie in der Studien im vorigen Kapitel 4, auf dem Einfluss der Produktionsmethode sowie der Zertifizierung der Lachsprodukte mit dem MSC Siegel. Zusätzlich wird untersucht, inwiefern Hersteller- und Handelsmarken eine Rolle beim Kaufprozess spielen. Diese Studie erweitert die bestehende Literatur dahingehend, dass Kaufentscheidungen von Konsumenten anhand tatsächlicher Marktdaten und nicht anhand von in Befragungen gewonnenen Daten ermittelt werden. Ferner werden in vorigen Studien die Effekte verschiedener Marken nicht mit in die Analysen einbezogen. Um den Aspekt der heterogenen Konsumentenpräferenzen zu berücksichtigen, werden zum einen sozioökonomische Charakteristika der Haushalte mit in die Berechnungen integriert sowie zum anderen auf die Schätzung eines Mixed Logit Models zurückgegriffen. Somit werden auch die in der Literatur häufig anzufindenden hedonischen Preisanalysen ergänzt, welche die Heterogenität der Konsumenten außer Acht lassen.

Die in dieser Studie erhaltenen Ergebnisse weichen teilweise von Ergebnissen bereits durchgeführter Studien ab und stehen ebenfalls im Widerspruch zu den erhaltenen Ergebnissen, die im Hinblick auf den Einfluss der Produktionsmethode sowie des MSC Labels auf die Kaufentscheidung von Lachsprodukten in der Studie in Kapitel 4 gewonnen wurden. Die verwendeten Marktdaten geben überraschenderweise einen Hinweis darauf, dass das MSC Siegel die Kaufwahrscheinlichkeit von Lachsprodukten nicht erhöht; im

Gegensatz dazu wird ein Lachsprodukt eher gekauft, wenn es aus gezüchtetem Fisch hergestellt worden ist.

Die erhaltenen Divergenzen in den beiden Studien (Kapitel 4 und 5) können einen Hinweis auf mögliche Verzerrungen in den Bewertungen hypothetischer Kaufentscheidungen sein, die im Rahmen von DCE von den Probanden getroffen werden. Die Konsumenten geben in den Befragungen unter Umständen sozial erwünschte Antworten an, die von dem realen Kaufverhalten abweichen.

Um dieses Problem zu beheben und die Reliabilität der erhaltenen Ergebnisse zu untersuchen, sollte in weiterführenden Untersuchungen den hypothetischen Verzerrungen in den Stated-Preference-Studien explizit Rechnung getragen werden. Zudem besteht außerdem die Möglichkeit, auf Methoden der experimentellen Ökonomie zurückzugreifen und Befragungsteilnehmer direkte Auswirkungen ihrer Entscheidung spüren zu lassen.

Market Integration between Farmed and Wild Fish: Evidence from the Whitefish Market in Germany

Für die Untersuchung der Preisbeziehungen zwischen gezüchteten und wildgefangenen Weißfischsorten auf dem deutschen Markt wird auf die Analyse der Marktintegration zurückgegriffen. Es wird anhand des LOP getestet, in welchem Umfang sich die Preise der betrachteten Weißfischsorten unterscheiden und inwieweit die Produkte als Substitute anzusehen sind.

Der Beitrag liefert Hinweise dafür, dass der Weißfischmarkt in Deutschland im Wesentlichen durch eine starke Marktintegration gekennzeichnet ist und dass das LOP gilt. Der Markt für gezüchtete und der Markt für wildgefangene Weißfischsorten bilden eindeutig einen gemeinsamen Markt, und jegliche Preisanpassungen werden von dem einen Markt zu dem anderen Markt weitergegeben. Einige Inkonsistenzen sind jedoch in dem Sinne präsent, dass keine Kointegrationsbeziehungen zwischen Alaska-Seelachs und Kabeljau sowie Alaska-Seelachs und Pangasius zu finden sind und das LOP für Pangasius und Seelachs zurückgewiesen werden muss. Es lassen sich aber indirekte Beziehungen nachweisen.

Zur weiteren Steigerung der Repräsentativität der Ergebnisse sollten zukünftige Untersuchungen darauf abzielen, die Preisbeziehungen auf verschiedenen Stufen der Wertschöpfungskette zu analysieren. Durch Hinzunahme der Scannerdaten können beispielsweise Preisbeziehungen zwischen den Importpreisen und den Preisen der Weißfischprodukte im Lebensmitteleinzelhandel untersucht werden. Somit kann gezeigt werden, in welchem Umfang und in welchem Zeitraum die Preise aufeinander reagieren. Es wäre zudem interessant zu sehen, ob auf dem deutschen Fischmarkt, wie auf anderen Agrarmärkten, asymmetrische Preistransmissionen vorhanden sind, die auf Marktunvollkommenheiten hindeuten. Die Betrachtung der Preistransmission für die verschiedenen Distributionskanäle des LEH, erlaubt, Unterschiede zwischen diesen Kanälen aufzudecken.

The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany

Das Ziel dieses Beitrages liegt darin, den Einfluss wesentlicher Produktattribute auf den Preis von Fischprodukten zu quantifizieren. Die Verwendung des GfK Scannerdatensatzes bietet die Möglichkeit, auf Produkteigenschaften zurückzugreifen, die bislang in der internationalen Literatur noch wenig bis keine Beachtung gefunden haben. Die Berücksichtigung des Einflusses von Hersteller- und Handelsmarken, Sonderangeboten sowie der Produktionsmethode (gezüchteter vs. wildgefangener Fisch) der Fischprodukte unterscheidet die hier vorgestellten Preisanalysen von existierenden Studien.

Der Beitrag zieht interessante Ergebnisse für den deutschen LEH mit sich, da nicht automatisch davon ausgegangen werden kann, dass sich die Preissetzungsstrategie für andere (gefrorene) Lebensmittel von der von Tiefkühlfisch stark unterscheidet. Handelsmarken machen mit 51 % einen Großteil des Abverkaufs an Tiefkühlfischprodukten aus. Weiter implizieren die Ergebnisse, dass Handelsmarken im Allgemeinen mit einem niedrigen Preis assoziiert werden und dass Sonderangebote als ein zentrales Wettbewerbsinstrument und ein charakteristisches Merkmal der Preissetzungsstrategie auf dem deutschen Tiefkühlfischmarkt fungieren. Weiter kann auf dem deutschen Markt für Aquakulturprodukte sowie für MSC zertifizierte Produkte Preisaufläge erzielt werden.

Es kann nicht davon ausgegangen werden, dass einzelne Produkteigenschaften in allen Einkaufsstätten den gleichen Preisaufschlag erzielen, da Einkaufsstätten unterschiedliche Preis- und Qualitätsstrategien verfolgen. In diesem Beitrag wurden die Handelsmarken nach ihren Einkaufsstätten unterschieden, um dieser Tatsache Rechnung zu tragen. Es scheint jedoch ebenfalls sinnvoll, in zukünftiger Forschung auch nach den Preisaufschlägen der Herstellermarken und neben der Markenzugehörigkeit auch nach der Einkaufsstätte zu differenzieren.

Price Premiums for Eco-labeled Seafood: MSC-Certification in Germany

Auch in dieser Studie wird auf die Methodik der hedonischen Preisanalyse zurückgegriffen, um die Existenz und die Höhe von Preisauflschlägen für verschiedene MSC zertifizierte Fischprodukte zu betrachten. In der Literatur wird kontrovers diskutiert, ob das MSC Siegel tatsächliche Anreize für ein besseres Fischereimanagement bietet.

Die Ergebnisse dieses Beitrages zeigen, dass MSC zertifizierte Fischprodukte einen Preisauflschlag gegenüber nicht zertifizierten Produkten erzielen. Die Höhe der Preisauflschläge variieren jedoch stark mit der betrachteten Fischart. Dieses Ergebnis unterstreicht die Heterogenität des Fischmarktes. Als Konsequenz macht die Frage, ob das MSC Siegel einen allgemeinen Anreiz für besseres Fischereimanagement bietet, keinen wirklichen Sinn. Es ist demnach von der Fischart und speziell von dem Fischmarkt abhängig, ob auf diesem Präferenzen für Nachhaltigkeitslabel bestehen und sich diese in tatsächlichen Preisauflschlägen niederschlagen. Andernfalls wird sich das Siegel für die Produzenten nicht rentieren.

Im Allgemeinen bilden hedonische Preisanalysen einen guten Startpunkt für die Analyse von Preissetzungsstrategien im LEH, die im Zusammenhang mit den jeweiligen Produktattributen stehen. Jedoch ist zu beachten, dass bei hedonischen Preisanalysen nicht geklärt werden kann, ob die Preisauflschläge angebots- oder nachfrageinduziert sind. Es bleiben demnach weitere Fragen offen. Es wird nicht ersichtlich, ob der Preisauflschlag für MSC zertifizierte Fischprodukte daraus resultiert, dass die Fischerei für die Zertifizierung zahlen muss und dies den höheren Preis verursacht, oder ob Unternehmen mehr in die

Werbung für diese Produkte investieren. Ein weiterer Grund kann auch sein, dass die Hersteller und der LEH ihre Margen erhöhen möchten oder, dass die Konsumenten tatsächlich eine höhere Zahlungsbereitschaft für MSC zertifizierten Fisch und somit Nachhaltigkeit haben. Die Ergebnisse sollten dahingehend weiter untersucht werden. Die Zahlungsbereitschaft der Konsumenten kann beispielsweise mit der DCE Methode abgefragt werden.

Literaturverzeichnis

- Auspurg, K., & Liebe, U. (2011). Choice-Experimente und die Messung von Handlungsentscheidungen in der Soziologie. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, Vol. 63, 301-314.
- Banks, J., Blundell, R., & Lewbel, A. (1997). Quadratic Engel Curves and Consumer Demand. *The Review of Economics and Statistics*, Vol. 79, 527-539.
- Carlsson, F., & Martinsson, P. (2001). Do Hypothetical and Actual Marginal Willingness to Pay Differ in Choice Experiments? Application to the Valuation of the Environment. *Journal of Environmental Economics and Management*, Vol. 41, 179-192.
- Cox, T. L., & Wohlgenant, M. K. (1986). Prices and Quality Effects in Cross-Sectional Demand Analysis. *American Journal of Agricultural Economics*, Vol. 68, 908-919.
- Dhar, T., & Foltz, J. (2005). Milk by Any Other Name... Consumer Benefits from Labeled Milk. *American Journal of Agricultural Economics*, Vol. 87, 214-218.
- Hensher, D., Louviere, J., & Swait, J. (1999). Combining sources of preference data. *Journal of Econometrics*, Vol. 89, 197-222.
- IRI. (2012). *Das Handelspanel von IRI*. Aus einer Präsentation von Marco Sinn: https://www.pim.wiwi.uni-due.de/fileadmin/fileupload/BWL-MARKETING/Lehre/Skripte/CMK_12/CM_Kompakt__F_JM__IRI_Handelspanel.pdf abgerufen
- Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economics*, Vol. 74, 132-157.
- McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka, *Frontiers of Econometrics*. New York: Academic Press.
- Scarpa, R., Ruto, E., Kristjanson, P., Radeny, M., Drucker, A., & Rege, J. (2003). Valuing indigenous Cattle Breeds in Kenya: An Empirical Comparison of Stated and Revealed Preference Value Estimates. *Ecological Economics*, Vol. 45, 409-426.
- Telser, H., & Zweifel, P. (2007). Validity of Discrete Choice Experiments Evidence for Health Risk Reduction. *Applied Economics*, Vol. 39, 69-7

10. Kapitel

Summary

The present cumulative dissertation consists of seven journal articles analyzing the German fish market. The studies account for various methodological approaches that typically arise in investigating fish markets. Knowledge about different fish markets is important for a number of reasons, and until very recently our knowledge has been very limited despite the fact that most research has suspected the fish market to be highly heterogeneous. This was primarily due to limited access to sufficiently disaggregated data. The present dissertation studies a different market, Germany, which received little attention before and with data that include more and different information than earlier studies. Moreover, Germany is particularly interesting, as several studies show that the German seafood market is more price conscious and less quality conscious than other European markets (e.g. Asche et al., 2004).

At the same time, improved fisheries management allows fishers to better target specific markets allowing them to optimize over new margins (Smith, 2012). Control with the production process in aquaculture also enables these producers to optimize over different margins (Asche, 2008). There is a large literature discussing the relative merits of wild versus farmed fish from different perspectives, where the environmental externalities associated with aquaculture are often shown to lead to a negative consumer perception. Moreover, aquaculture production is still rapidly increasing at the global level and has overtaken the fishery sector's role as the main source of seafood for human consumption in 2013 (FAO, 2015).

The main objective of the following studies is to investigate how the German consumers react to the trend of farmed seafood from aquaculture as well as how retailers are pricing these products. Results may affect the behavior of producers, importers and suppliers of seafood. The following section summarizes the conducted studies and their key findings.

The German Whitefish Market: An Application of the LA/AIDS Model using Retail-Scanner-Data

Aquaculture has been the world's fastest food production technology during the last decades. Production expanded at an average annual rate of 6.2 % in the period 2000 - 2012 and at a rate of 9.5 % in the decade before reaching its all-time high in 2012 at more than 90 million tonnes which translates to 42 % of total annual fisheries supply (FAO, 2014). This is a development that substantially transforms many seafood markets. One example is the whitefish market, which is one of the largest segments in the global seafood market.

The whitefish market includes traditional wild caught species; cod, pollock and Alaska pollock, and the more recent introduction of aquaculture species; pangasius and tilapia. The most important competitive advantage of farmed species is the ability to increase production in response to market demand, as aquaculture is farming, while fisheries are our last big harvesting industry depending on nature for primary production.

While it is obvious that aquaculture is winning market share in some markets, there has been limited interest in investigating how these processes progress. The quantity impact of aquaculture species like pangasius and tilapia is already significant but little evidence is found if the farmed and wild species are substitutes and if the farmed species also determine the prices in the whitefish market.

In chapter 2 of this dissertation, a demand study for Germany is conducted and the objective of this research is to determine whether there are differences in the consumption behavior of German households with respect to price changes of farmed and wild whitefish species. It is well known that the German consumers are extremely price sensitive, so it could be expected that the consumers substitute the high-price species like cod against the low-value species originating from aquaculture. For demand estimation, the general form of the Almost Ideal Demand System (AIDS) with linear approximation (LA) is applied.

For estimation, a unique retail scanner dataset is used. The data consists of weekly sales, volume and price information for frozen processed whitefish fillets from the Symphony IRIGroup and covers 261 weeks from January 2008 to December 2012. The information on the whitefish species was gathered in 507 stores on a weekly basis resulting in 743,145 price observations.

The whitefish category contains 48 different products, which can be identified by means of the European Article Number (EAN).

The demand for whitefish on the German market is relatively elastic with the exception of pangasius. The uncompensated cross-price elasticities indicate substantial substitution between pangasius and the three wild species, while tilapia does not seem to be a part of the larger whitefish market in Germany.

Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood in Germany: An Application of QUAIDS Modeling with Correction for Sample Selection

The global market for fish has undergone significant changes in recent years. The worldwide population growth and associated increase in food demand, as well as the overfishing of several key marine stocks have affected both the supply and demand for food and fish. Aquaculture or farmed fish production is one alternative to meet the increasing demand with respect to the production of fish. Over the last decades, the share of farmed fish has been rapidly increasing; today it provides an almost equal share of seafood for human consumption.

Consumers' reaction to price changes of fish originating from different sources is largely unexplored and market data like production mode are in general not available. The main objective of the paper in chapter 3 is to investigate potential differences in the consumption behavior with respect to price changes of fish from capture fisheries or aquaculture. In this study, we use the Quadratic Almost Ideal Demand System (QUAIDS) for the specification of a demand system and for calculating price and income elasticities. We model a demand system for six frozen seafood product groups and employ a QUAIDS demand model specification with correction for sample selection. The data under study are collected by GfK ConsumerScan for the period from 2006 to 2010, providing information also on production mode for the different species under study, namely salmon, shrimp, pangasius as well as redfish. Salmon and shrimp are available both as wild and farmed and are examples of relatively high-valued seafood.

In this study, consumers are found to be price sensitive, particularly with regard to the high-valued seafood species salmon and shrimp. Interestingly, there are no large differences between the elasticities of aquacultured and wild salmon even though farmed salmon is more expensive

than wild salmon. For shrimps, the demand for wild shrimp is more elastic than the demand for farmed shrimp.

Preference Heterogeneity in the Demand for Salmon: A Random Coefficients Approach

Seafood consumers are confronted with an increasing load of information in forms of brands and labels when making their purchasing decision. In recent years, ecolabeling has received substantial attention in relation to fisheries, and the negative image of aquaculture caused by environmental effects has led to the fact that consumers prefer wild-caught fish. The study in chapter 3 examines the importance of the seafood attributes farmed and the MSC-ecolabel as well as different brands for frozen salmon on the German seafood market. A household scanner panel dataset, which provides purchase information and socioeconomic variables is analysed using a Mixed Logit Model. Consumer heterogeneity is expressed in the form of demographic variables as well as random parameters.

This study represents an extension of the existing literature regarding seafood consumption habits, as most of the studies examine consumer behavior based on stated preference data, disregarding brands, or using hedonic price analyses disregarding consumer heterogeneity to examine the influence of product attributes. The results of the Mixed Logit Model indicate that preferences regarding production mode and ecolabeling vary among consumers. We find that 72 % of the households have a higher probability of purchasing farmed salmon over wild salmon while 74 % of the households have a higher probability to avoid ecolabeled salmon. These results are highly interesting, as they deviate substantially from several stated preference studies. Furthermore, in several cases the brand appears to be more relevant for the purchasing decision.

Assessing Consumer Preferences and Willingness to Pay for Fish from Aquaculture and Eco-labeled Fish: Insights from a Discrete Choice Experiment in Northern Germany

Discrete Choice Experiments are often used to determine the influence of product attributes on consumers preferences and the willingness to pay for these attributes. In this study the influence of price, production method (farmed vs. wild), processing (frozen vs. fresh) and labeling of

salmon and turbot products are examined. The questionnaire is divided into four parts: The first part contains a DCE for both species respectively in which the respondents have to choose among two product alternatives, consisting of different versions of the product attributes, and the opt- out alternative (neither of these products). In the second part, the consumers are asked about some sociodemographic aspects like income, household size, education and profession. The third part identifies perceptions and beliefs regarding aquacultured fish and sustainable fish production. In the last part of the questionnaire, the respondents get some background information regarding the aquaculture practice of salmon and trout as well as the eco-labeling of the Marine Stewardship Council (MSC)⁴⁶ and the Aquaculture Stewardship Council (ASC)⁴⁷. Subsequently the respondents are confronted with the DCE again. The study investigates the question if informed consumers value the product attributes under study prior to the receipt of information in another way.

The empirical investigation is based on a survey of 485 respondents, which was conducted in three hypermarkets in the North of Germany (Kiel and Kaltenkirchen) within two weeks of November. To account for preference heterogeneity among consumers the econometric approach of the Mixed Logit Model is used for analyzing the data. The average consumer has a negative perception of farmed fish products and prefers purchasing wild caught fish. The willingness to pay for the attribute farmed is negative for both salmon and turbot. Furthermore, the respondents do not like frozen fish even if this is the most consumed processed form in Germany (FIZ, 2015). However, for salmon the ASC label has a positive influence on the purchase decision of consumers. The MSC label increases the probability of being purchased for salmon and turbot. After receiving information about aquaculture and sustainable fish production the willingness to pay for fish products carrying the eco-labels significantly rises.

Market Integration between Farmed and Wild Fish: Evidence from the Whitefish Market in Germany

In the sixth chapter, market integration between farmed and wild-caught whitefish in Germany is examined using co-integration tests and also testing for the Law of One Price (LOP). Knowledge of market integration between farmed and wild-caught whitefish is important since

⁴⁶ The MSC label assesses and certifies fisheries for sustainable fishing and supply chain traceability.

⁴⁷ The ASC label certifies aquaculture farms for best aquaculture practice.

it reveals whether demand growth for farmed whitefish in Germany is negative, or whether declining imports of farmed whitefish are merely explained differently, such as by increased competition from wild-caught whitefish.

Data used for this study are taken from the German external trade database and disaggregated at 8 digits code. Total German imports from all supplier countries are included in the analysis on a monthly basis and covering a time period under study from January 2010 to December 2014. This paper examines market integration between farmed (pangasius and tilapia) and wild-caught (Alaska pollock, cod and saithe) frozen whitefish in Germany, and finds close integration. Hence, prices of frozen pangasius and tilapia fillets in Germany are determined not only by supply of these species, but more importantly by the much larger supplies of wild-caught cod and Alaska pollock.

The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany

It is well known that the price of a food in general and fish in particular is a function of a number of attributes such as species, product form, processing form and size. Recently, there has been increased interest in the value of attributes at the retail level, although only with data for the UK. In the study in chapter 7, the access to a unique data set for frozen fish from Germany, makes it possible to identify three sets of attributes that have not received much attention in the literature; private labels, production method, and promotions. In contrast to earlier studies using scanner or observational data, the private labels for the different retail chains can clearly be identified, so it is possible to investigate the extent of consumer preference for these labels versus traditional brands

In this study, a hedonic price function for the period 2000 – 2010 is estimated, and the results highlight the importance of brand and labels for seafood prices in Germany. The results also suggest that private label products are discounted by 20 %, while branded products achieve substantial price premiums, as do fish products from aquaculture. Furthermore, the study shows that in Germany the premium associated with eco-labels is estimated up to 4 %, which it is much lower than in the UK, with the premium being statistically insignificant using clustered standard errors to account for dependencies in the data. That the German premium is so different

from what has been reported from the UK confirms an important result from the stated preference literature; there are substantial differences between countries.

Price Premiums for Eco-labeled Seafood: MSC-Certification in Germany

During the last decade the eco-label of the Marine Stewardship Council (MSC) has established itself as the leading eco-label for seafood. At the end of 2014, 252 fisheries had been certified (MSC, 2015). However, whether eco-labelled seafood actually provides incentives for providing better fisheries management is a controversial issue. A number of stated-preference studies indicate a substantial willingness-to-pay for eco-labelled seafood, but evidence from actual market data is limited.

In the study in chapter 8 of this dissertation, scanner data for Germany are used to investigate the presence of a price premium associated with the MSC-label for three whitefish species in Germany, namely cod, Alaska pollock and saithe. For estimation, the basic approach of a hedonic price model for whitefish species on the German market is used. In this study the MSC-premium will be allowed to vary with species, by including an interaction term. It is then testable whether the premium varies by species in addition to whether a premium actually exists.

The results indicate that the MSC-premiums in Germany vary substantially between species, from a hefty 30.6 % for the high-end species cod, to small and not statistically significant premiums for the cheaper species saithe and Alaska pollock. This is an important result, as it indicates that the general heterogeneity of the seafood market also translates into the issue of eco-labels. As a consequence, the question of whether an eco-label provides incentives for better fisheries management, is a question that in general does not make sense. One has to qualify the question with respect to species, market and supply chain. This implies that eco-labels will most likely be an effective tool in some cases, but not in all.

References

- Asche, F. (2008). Farming the Sea. *Marine Resource Economics, Vol. 23*, 527-547.
- Asche, F., Gordon, D., & Hannesson, R. (2004). Tests for market integration and the law of one price: the market for whitefish in France. *Marine Resource Economics, Vol. 19*, 195-210.
- FAO. (2014). *The State of World Fisheries and Aquaculture 2014*. Rome: Food and Agriculture Organization of the United Nations.
- FAO. (2015). *FAO Fisheries and Aquaculture Department*. Retrieved from Online Query Panels: <http://www.fao.org/fishery/topic/16140/en> , accessed 21.12.2015
- FIZ. (2015). *Fischwirtschaft -Daten und Fakten 2014*. Retrieved from Fischinformationszentrum: <http://www.fischinfo.de>.
- MSC. (2015). *Marine Stewardship Council*. Retrieved from Certified sustainable seafood: <http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified>
- Smith, M. (2012). The new fisheries economics: Incentives across many margins. *Annual Review of Resource Economics, Vol. 4*, 379-402.

11. Kapitel

Methoden der Nachfrageanalyse

Ergänzend zu den vorangegangenen Beiträgen wird in diesem Kapitel die methodische Vorgehensweise der Nachfrageanalyse detailliert beschrieben, jedoch erhebt das Kapitel keinen Anspruch auf Vollständigkeit. Es wird zum einen auf Nachfragesysteme, das theoretische Modell des Almost Ideal Demand System (AIDS) und dessen Erweiterung, das Quadratic AIDS, sowie zum anderen auf die Methodik des Multinomial Logit und die erweiterte Form des Modells (MNL), das Mixed Logit Model (MIXL) eingegangen.

11.1 Nachfragesysteme

Die Wahl der funktionalen Form zur Spezifizierung der Nachfrage scheint unbegrenzt, dennoch haben sich in der Literatur einige Modelle zur Nachfrageschätzung durchsetzen können. Die ersten empirischen Studien zur Nachfrage nach Nahrungsmitteln konzentrieren sich primär auf die Schätzung von Elastizitäten und lassen die ökonomische Nachfragetheorie weitestgehend unberücksichtigt. Es werden in diesen Studien Eingleichungsmodelle spezifiziert, die linear in den Parametern sind. Bei dieser Art von Gleichungen erfolgt die Bestimmung der Ausgaben- und Preiselastizitäten, indem die nachgefragte Menge eines Gutes auf den Preis des Gutes, den Preis verbundener Güter sowie das Einkommen regressiert wird. Dabei finden doppellogarithmische Spezifikationen verbreitet Anwendung, da die Ausgaben- und Preiselastizitäten direkt bestimmt werden können. Ebenso kann der Preis als Funktion der Menge abgetragen werden. Diese inversen Nachfragekurven finden sich insbesondere in agrar- und fischökonomischen Studien, wenn die Menge durch Quoten oder andere Verordnungen begrenzt ist. Zu erwähnen sei, dass das Endogenitätsproblem der Preis- und Mengenvariablen in Nachfragestudien, in denen entweder der Preis oder die Menge als exogen angenommen wird, weitestgehend unberücksichtigt bleibt.⁴⁸

⁴⁸ In Haushaltsdaten spielt das Endogenitätsproblem jedoch weniger eine Rolle als bei Analysen, die auf makroökonomischen Daten beruhen. Der Preis eines Produktes ist für Konsumenten exogen.

Als wesentlicher Nachteile der Eingleichungsmodelle gilt die fehlende Berücksichtigung der ökonomischen Nachfragetheorie. Die doppellogarithmische Modellspezifikation ist beispielsweise nur dann theoretisch konsistent, wenn die Nachfrage unabhängig vom Einkommen ist, also homothetische Präferenzen vorliegen. Damit würde jedoch eine Verletzung des Engelschen Gesetzes vorliegen, welches besagt, dass der Ausgabenanteil (Nachfragemenge) für Nahrungsmittel von dem Gesamteinkommen abhängig ist. Somit kann allenfalls eine zufriedenstellende Approximation erreicht werden, wenn das Gesamteinkommen nicht zu stark variiert. Lineare Spezifikationen sowie die Anwendung der Box-Cox Transformation erreichen keine theoretische Konsistenz, da die Nachfragefunktionen nicht homogen vom Grad Null sind.

Eine wichtige methodische Weiterentwicklung stellt die Schätzung von Nachfragesystemen dar, welche die Nachfrage nach Gütern simultan betrachten. Zudem werden in Nachfragesystemen auch Aspekte der Dualitätstheorie berücksichtigt. Der duale Optimierungsansatz beachtet sowohl die Nutzenmaximierung unter Einhaltung der Budgetbeschränkung sowie die Kostenminimierung unter Einhaltung eines bestimmten Nutzenniveaus (Deaton und Muellbauer, 2009). Stone (1954) entwickelte mit dem Linearen Ausgabensystem (LES) erstmals ein reguläres System von Nachfragefunktionen, das die Restriktionen der Nachfragetheorie bei der Parameterspezifizierung erfüllt (Additivität, Homogenität und Symmetrie). Dennoch ist das LES mit einigen Beschränkungen verbunden, die bei der Interpretation beachtet werden müssen (Deaton und Muellbauer, 2009). Im LES können beispielsweise keine inferioren Güter vorkommen, da immer eine positive Einkommenselastizität gegeben ist, zudem liegen keinerlei komplementären Beziehungen zwischen den Gütern vor, so dass alle Substitutionseffekte positiv sind (Ronning, 1988).

Weitere gängige Spezifikationen zur Analyse des Nachfrageverhaltens bilden u.a. das Rotterdam System, entwickelt von Theil (1965) und Barten (1968) und das Indirekte Translog Nachfragesystem (Christensen et al., 1975). Diese Modelle legen den Grundstein für das bis heute weit verbreitete und häufig angewendete Almost Ideal Demand System (AIDS) von Deaton und Muellbauer (1980). Das AIDS-Modell bietet eine Vielzahl an Vorteilen, die nach Deaton und Muellbauer (1980:312) wie folgt beschrieben werden:

„Our model, which we call the Almost Ideal Demand System (AIDS), gives an arbitrary first-order approximation to any demand system; it satisfies the axioms of choice exactly; it aggregates perfectly over consumers without invoking parallel linear Engel curves; it has a functional form which is consistent with known household budget data; it is simple to estimate, largely avoiding the need for non-linear estimation; and it can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters.”

11.1.1 Almost Ideal Demand System

Nach Deaton und Muellbauer (1980) lässt sich das AIDS aus folgender logarithmierter Kostenfunktion (c) in Abhängigkeit vom Nutzen (u) und den Preisen (p) spezifizieren⁴⁹:

$$\ln c(u, p) = \alpha_0 + \sum_k \alpha_k \ln p_k + \frac{1}{2} \sum_k \sum_j \gamma_{kj}^* \ln p_k \ln p_j + u \beta_0 \prod p_k^{\beta_1} \quad (11.1)$$

mit $k, j = 1, \dots, n$ und den Parametern α_i , β_i , und γ_{ij}^* . Aufgrund der Parameterrestriktionen $\sum_i \alpha_i = 1$, $\sum_j \gamma_{kj}^* = \sum_k \gamma_{kj}^* = \sum_j \beta_j = 0$ kann gezeigt werden, dass $c(u, p)$ linear homogen in den Preisen ist. Die zugrundeliegende Präferenzordnung wird als PIGLOG⁵⁰ bezeichnet, die den logarithmierten Fall der Präferenzen mit preisunabhängiger, verallgemeinerter Linearität (price invariate generalized linearity, PIGL) bezeichnet.

Die Minimierung der Kostenfunktion unter der Berücksichtigung der Budgetrestriktion ergibt die Bedingungen erster Ordnung und somit die Budgetanteile. Die Nachfragegleichungen lassen sich somit wie folgt ausdrücken:

$$\frac{p_i q_i}{x} \equiv w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln \left(\frac{x}{P} \right), i = 1, \dots, n, \quad (11.2)$$

wobei w_i den Budgetanteil für Gut i darstellt, p_j ist der Preis für Gut j und x sind die Gesamtausgaben. Der Preisindex P für alle Güter ist definiert als:

$$\ln P = \alpha_0 + \sum_k \alpha_k \ln p_k + \frac{1}{2} \sum_k \sum_j \gamma_{kj} \ln p_k \ln p_j. \quad (11.3)$$

⁴⁹ Die nachfolgende Darstellung des AIDS ist entnommen aus Deaton und Muellbauer (1980):313 ff..

⁵⁰ Nachfragesysteme der PIGLOG-Klasse erlauben die Analyse der Haushaltsnachfrage anhand aggregierter Konsumdaten. Dabei wird die Nachfrage als linear in einem repräsentativen Einkommen formuliert, das nicht notwendigerweise dem Durchschnittseinkommen entspricht und nicht mit den Preisen variiert. Für eine ausführliche Erläuterung wird u.a. auf Muellbauer (1975) sowie Deaton und Muellbauer (1980) verwiesen.

Die Nutzenmaximierung und die Budgetrestriktion der Konsumtheorie fordern, dass $x = \sum_i p_i q_i$ bzw. $\sum_i w_i = 1$ ist. Daraus resultieren die folgenden Bedingungen:

$$\text{Adding up:} \quad \sum_k \alpha_k = 1, \sum_k \beta_k = 0, \sum_k \gamma_{kj} = 0 \quad (11.4)$$

$$\text{Homogenität:} \quad \sum_j \gamma_{ij} = 0 \quad (11.5)$$

$$\text{Symmetrie:} \quad \gamma_{ij} = \gamma_{ji} \quad (11.6)$$

Die Negativitätsbedingung (Konkavitätseigenschaft der Ausgabenfunktion) stellt eine weitere Restriktion der Nachfragetheorie dar und ist erfüllt, wenn die Matrix K mit den Elementen k_{ij} negativ semidefiniert ist.

$$k_{ij} = \gamma_{ij} + \beta_i \beta_j \left(\ln \left(\frac{x}{p} \right) \right) - \delta_{ij} w_i + w_i w_j \quad (11.7)$$

mit δ_{ij} = Kroneckers Delta, wobei gilt $\delta_{ij}=0$ für alle $i \neq j$ und $\delta_{ij}=1$ für alle $i=j$.

Der Wechsel zum Linear Approximate Almost Ideal Demand System (LA/AIDS) wird erreicht, indem der Preisindex durch den Preisindex nach Stone (1954) ersetzt wird:

$$\ln P^* = \sum_k w_k \ln p_k. \quad (11.8)$$

Dabei gilt $P \cong P^*$; die Schätzung wird dadurch vereinfacht, dass das System durch die Verwendung des Stone Preisindexes linear in den Koeffizienten ist. Die entsprechende Gleichung lautet:

$$w_i = \alpha_i^* + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln \left(\frac{x}{P^*} \right). \quad (11.9)$$

Ausgehend von AIDS von Deaton und Muellbauer (1980) haben Banks et al. (1997) eine erweiterte Form des Modells, das Quadratic Almost Ideal Demand System (QUAIDS), entwickelt, indem die Annahme linearer Engelkurven aufgegeben wird und durch eine quadratische Funktion ersetzt wird. Zudem stellt das QUAIDS ein Nachfragesystem vom Rang 3 dar und erlaubt somit eine flexiblere Formulierung der Engelkurven.

11.1.2 Quadratic Almost Ideal Demand System

Das QUAIDS nach Banks et al. (1997) wird ebenfalls aus den PIGLOG Präferenzen abgeleitet.

Den Ausgangspunkt bildet folgende indirekte Nutzenfunktion⁵¹:

$$\ln V = \left\{ \left[\frac{\ln m - \ln a(\mathbf{p})}{b(\mathbf{p})} \right]^{-1} + \lambda(\mathbf{p}) \right\}^{-1} \quad (11.10)$$

wobei der Term $\left[\frac{\ln m - \ln a(\mathbf{p})}{b(\mathbf{p})} \right]$ die indirekte Nutzenfunktion des PIGLOG Nachfragesystems ist, m das Haushaltseinkommen, und $a(\mathbf{p})$, $b(\mathbf{p})$ und $\lambda(\mathbf{p})$ Funktionen des Preisvektors \mathbf{p} sind. Um die Homogenitätseigenschaft der indirekten Nutzenfunktion zu gewährleisten, muss $a(\mathbf{p})$ homogen vom Grad Eins und $b(\mathbf{p})$ und $\lambda(\mathbf{p})$ homogen vom Grad Null in \mathbf{p} sein. $\ln a(\mathbf{p})$ ist der Translog Preisindex:

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{i=1}^K \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^K \sum_{j=1}^K \gamma_{ij} \ln p_i \ln p_j, \quad (11.11)$$

mit $i=1, \dots, K$ Gütern,

$b(\mathbf{p})$ ist der Cobb-Douglas Preisaggregator:

$$b(\mathbf{p}) = \prod_{i=1}^K p_i^{\beta_i}, \quad (11.12)$$

und die spezifische Funktionsform von $\lambda(\mathbf{p})$ ist:

$$\lambda(\mathbf{p}) = \sum_{i=1}^K \lambda_i \ln p_i, \quad \text{wobei } \sum_{i=1}^K \lambda_i = 0. \quad (11.13)$$

Die zu schätzende Budgetgleichung des QUAIDS ergibt sich durch die Anwendung von Roy's Identity auf die indirekte Nutzenfunktion (11.10) und lässt sich wie folgt darstellen:

$$w_i = \alpha_i + \sum_{j=1}^K \gamma_{ij} \ln p_j + \beta_i \ln \left\{ \frac{m}{a(\mathbf{p})} \right\} + \frac{\lambda_i}{b(\mathbf{p})} \left[\ln \left\{ \frac{m}{a(\mathbf{p})} \right\} \right]^2, \quad (11.14)$$

α , β , γ und λ stellen die zu schätzenden Parameter dar. Es lässt sich erkennen, dass, wenn $\lambda_i=0 \forall i$ gilt, sich die Budgetgleichung auf die des AIDS reduziert.

⁵¹ Die Darstellung des QUAIDS ist entnommen aus Banks et al. (1997):532 ff.

Wie bereits beim AIDS dargestellt, wird auch beim QUAIDS, gemäß der mikroökonomischen Nachfragetheorie, die Erfüllung der Bedingungen der Homogenität (konstanter Preisanstieg verursacht konstanten Kostenanstieg), der Additivität (das Budget wird vollkommen ausgegeben) sowie der Symmetrie (Kreuzpreiseffekte der Hicksian Nachfrage sind symmetrisch) impliziert. Die Parameter des Nachfragesystems lassen sich anhand der Ausgaben- und Preiselastizitäten interpretieren.

Nach Banks et al. (1997) lassen sich die Preis- und Ausgabenelastizitäten nach Ableitung der Budgetgleichung (11.14) nach $\ln m$ und $\ln p$, also nach folgenden Formeln berechnen:

$$\mu_i \equiv \frac{\partial w_i}{\partial \ln m} = \beta_i + \frac{2\lambda_i}{b(p)} \left\{ \ln \left[\frac{m}{P(p)} \right] \right\} \quad (11.15)$$

$$\mu_{ij} \equiv \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i (\alpha_j + \sum_k \gamma_{jk} \ln p_k) - \frac{\lambda_i \beta_j}{b(p)} \left\{ \ln \left[\frac{m}{P(p)} \right] \right\}^2 \quad (11.16)$$

Die Ausgabenelastizität e_i ist:

$$e_i = \mu_i / w_i + 1 \quad (11.17)$$

Die unkompenzierte (Marshallian) Preiselastizität e^u , die sowohl den Einkommens- als auch den Substitutionseffekt berücksichtigt wird wie folgt berechnet:

$$e_{ij}^u = \mu_{ij} / w_i - \delta_{ij}, \quad \text{where: } \delta_{ij} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases} \quad (11.18)$$

Die kompenzierte (Hicksian) Preiselastizität e^c , die den Einkommenseffekt nicht widerspiegelt, wird berechnet als:

$$e_{ij}^c = e_{ij}^u + e_i w_j. \quad (11.19)$$

Zudem können Haushaltscharakteristika oder Sozioökonomische Variablen (hc_h) mit in das Nachfragesystem aufgenommen werden, die dann folgendermaßen in die Budgetanteilsgleichung integriert werden:

$$w_i = \alpha_i + \sum_{j=1}^K \gamma_{ij} \ln p_j + \beta_i \ln \left\{ \frac{m}{P(p)} \right\} + \frac{\lambda_i}{b(p)} \left[\ln \left\{ \frac{m}{P(p)} \right\} \right]^2 + \sum_{h=1}^H \theta_{ih} hc_h. \quad (11.20)$$

Die nachfolgende Restriktion vervollständigt die Restriktion der Additivität:

$$\sum_{i=1}^K \theta_{ih} = 0. \quad (11.21)$$

11.2 Random Utility Model

Obwohl Nachfragesysteme wie das AIDS und das QUAIDS theoretisch konsistent sind und als eine bewährte Methode zur Nachfrageschätzung von Nahrungsmitteln gelten, sind die Systeme weniger geeignet, wenn die Nachfrage nach stark differenzierten Produkten analysiert werden soll. Es muss für jedes Produkt (n) eine Gleichung in das Nachfragesystem eingefügt werden, so dass ohne weitere Restriktionen die Anzahl der zu schätzenden Parameter exponentiell steigt (mindestens n^2), was auch als Dimensionsproblem bezeichnet wird. Auch wenn die Bedingungen der Symmetrie und der Additivität auferlegt werden, ist die Schätzung in den meisten Fällen anhand klassischer Nachfragemodelle nicht möglich (Rasmussen, 2011).

Zudem kann weder mit dem AIDS noch mit dem QUAIDS die Heterogenität der Verbraucherpräferenzen im vollen Maße modelliert werden. Aufgrund der Tatsache, dass wir Lebensmittelmärkte und Fischmärkte beobachten, die sich immer weiter differenzieren, kann davon ausgegangen werden, dass Modelle, welche die Nachfrage auf Basis aggregierter Produkte oder des durchschnittlichen Konsumenten analysieren (wie das AIDS und QUAIDS) zu anderen Ergebnissen und Implikationen führen als Modelle, welche die individuelle Heterogenität der Konsumenten berücksichtigen können (Nevo, 2001). Auch Greene (2012) stellt heraus, dass die Aufnahme von Präferenzheterogenität ein wichtiger Bestandteil der Erklärung des Entscheidungsverhaltens von Verbrauchern ist. Durch die Aufnahme der Heterogenität der Konsumenten in das zu schätzende Nachfragemodel wird nicht der durchschnittliche Einfluss modelliert, sondern es werden die Parameter geschätzt, welche die Verteilung der Vorlieben der Konsumenten beschreiben; z.B. ist anzunehmen, dass einige Verbraucher preissensibler sind als andere und jeder Verbraucher unterschiedliche Produktattribute mit einem unterschiedlichen Nutzen gewichtet.

Durch die Schätzung von Discrete Choice Modellen kann die Anzahl der zu schätzenden Parameter deutlich reduziert werden, da diese auf eine explizite Schätzung von Kreuzeffekten verzichten. Zudem unterstellen die Modelle konsumentenspezifische Nutzenfunktionen und ermöglichen somit eine explizite Berücksichtigung heterogener Präferenzen und

Entscheidungen. Zu den Discrete Choice Modellen zählen u.a. das Multinomial Logit Modell sowie das Mixed Logit Modell.

Die Grundlage für Discrete Choice Modelle bildet einerseits die „Characteristics Theory of Value“ von Lancaster (1966) sowie andererseits die „Random Utility Theory“ von McFadden (1974). Lancasters Theory besagt, dass ein Gut einem Verbraucher per se noch keinen Nutzen stiftet. Es besteht hingegen aus verschiedenen Gütereigenschaften (Attributen), aus denen der Verbraucher einen Nutzen zieht (Charakteristikaansatz). Dabei kann nach McFadden (1974) der Gesamtnutzen als eine Summe des beobachteten Anteils und des nicht direkt beobachteten Anteils beschrieben werden (Zufallsnutzenkonzept). Die grundlegende Annahme dieser Modelle ist nutzenmaximierendes Verhalten der Verbraucher.

Der Gesamtnutzen U_{jn} einer Alternative j für eine Person n setzt sich additiv aus einer deterministischen Komponente V_{jn} sowie einer stochastischen Komponente ε_{jn} zusammen:

$$U_{jn} = V_{jn} + \varepsilon_{jn} \quad (11.23)$$

Es wird angenommen, dass der Konsument n den Nutzen U_{jn} , der von verschiedenen Alternativen j generiert wird, vergleicht und das Produkt wählt, das ihm den größten Nutzen stiftet. Der Konsument n wählt i :

$$\text{iff } U_{in} > U_{jn} \quad \text{für alle } i \neq j. \quad (11.22)$$

Wird auch hier der Zufallsnutzen in einen deterministischen und einen zufälligen Teil aufgeteilt, so ergibt sich:

$$V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn} \quad \text{bzw.} \quad V_{in} - V_{jn} > \varepsilon_{jn} - \varepsilon_{in} \quad (11.23)$$

Durch wahrscheinlichkeitstheoretische Umformung kann die Wahrscheinlichkeit, dass Person n die Alternative i aus einem Set von k Alternativen wählt, wie folgt definiert werden (Train, 2009):

$$P_{in} = \text{prob} (V_{in} - V_{jn} > \varepsilon_{jn} - \varepsilon_{in}); i \neq j \forall j \in k \quad (11.24)$$

Entscheidungsträger wählen die entsprechend Alternative, die ihnen den größten Nutzen stiftet, dieser Nutzen kann von Verbraucher zu Verbraucher variieren. Die deterministische Komponente V_{jn} enthält beobachtbare Einflussfaktoren des Nutzens und kann als eine Funktion des Parametervektors X_{jn} dargestellt werden. Am Beispiel von Fischprodukten können diese beobachtbaren Einflussgrößen zum Beispiel der Preis, die Fischart, die Prozessform, die Herkunft und die Packungsgröße sein. In der Regel wird V_{jn} als lineare Funktion der Attribute X_{jn} modelliert.

$$V_{jn} = \beta_0 + \beta_1 X_{jn}^1 + \beta_2 X_{jn}^2 + \dots + \beta_K X_{jn}^K \quad (11.25)$$

wobei die Koeffizienten β mit Hilfe des Maximum Likelihood Verfahrens⁵² mit verschiedenen Modellen empirisch geschätzt werden. Die Variable ε_{jn} ist hingegen zufällig und nicht beobachtbar, je nach Modell werden bestimmte Verteilungsannahmen über die Störterme ε_{jn} getroffen. Die Modelle werden der Klasse der Discrete-Choice Modelle zugerechnet (Hensher et al., 2005).

Beim MNL Modell sowie beim MIXL Modell wird von einer Extremwertverteilung (oder Gumble I Verteilung) der Störterme ausgegangen, beim Probit Model hingegen von einer Normalverteilung des Störterms. Aufgrund der einfachen Schätzung ist das MNL das bekannteste und am häufigsten verwendete Discrete-Choice Model (Train, 2009). Ferner kann die Erweiterung des MNL Modells, das MIXL Modell, alle anderen Discrete-Choice Modelle beliebig genau approximieren (McFadden und Train, 2000). Aufgrund dessen wird im Folgenden nur auf das MNL- sowie das MIXL Modell eingegangen.

11.2.1 Multinomial Logit Model

Das MNL wurde von Theil (1969) und McFadden (1974) entwickelt. Das Modell nimmt an, dass die Störterme ε_{ij} stets der identischen Verteilung folgen und unabhängig⁵³ von der Existenz weiterer Alternativen sind. In der Literatur wird dies auch als IIA Annahme bezeichnet (independence of irrelevant alternatives). Ausgehend von der Gleichung (11.25) wird das

⁵² Eine detaillierte Beschreibung der Ableitung und Verwendung des Maximum Likelihood Verfahrens findet sich bei Greene (2012:670 ff.)

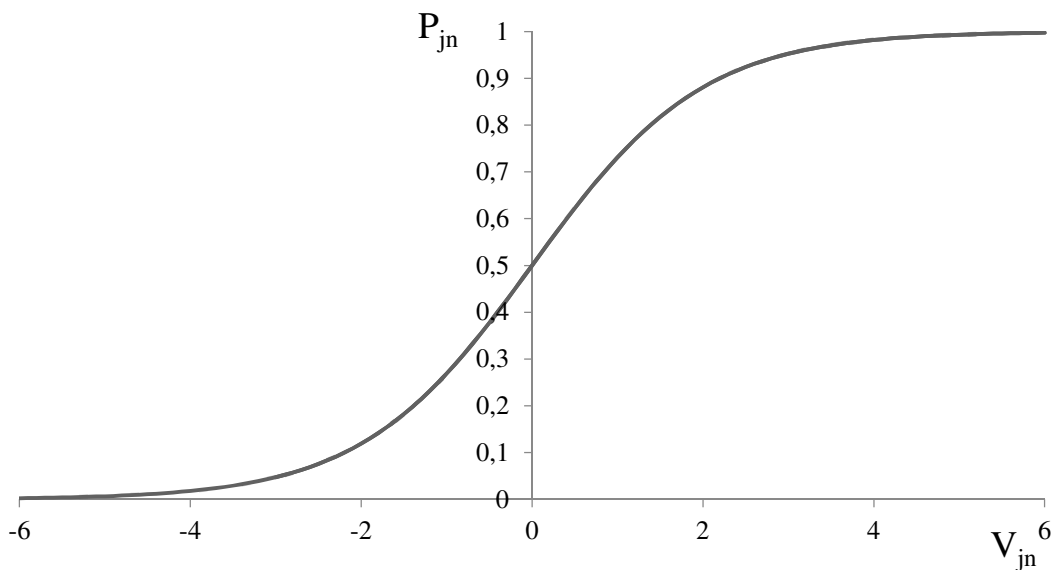
⁵³ Bei einer unabhängigen Verteilung sind die Störterme alternativen-spezifisch und somit unabhängig davon, ob noch weitere Produkte zur Auswahl stehen. Eine identische Verteilung der Störterme bedeutet, dass zwei Produkte immer im selben Verhältnis zueinander ausgewählt werden, unabhängig davon, wie viele und welche weiteren Produkte zur Auswahl stehen.

folgende allgemeine Logit-Modell spezifiziert, das einer logistischen Verteilungsfunktion folgt (hier $\varepsilon_{jn} - \varepsilon_{in}$):

$$P_{jn} = \frac{e^{\beta x_{ni}}}{\sum_j e^{\beta x_{nj}}} \quad (11.26)$$

Wobei alle geschätzten Wahrscheinlichkeiten zwischen Null und Eins liegen und sich zu Eins summieren. Per Definition der Exponentialfunktion sind jedoch alle Wahrscheinlichkeiten größer als Null, so dass jede Alternative eine gewisse Wahrscheinlichkeit hat, gewählt zu werden. Der Graph der Funktion beschreibt einen s-förmigen Verlauf der Kurve, die erste Ableitung ist um die Ordinatenachse symmetrisch und ihr Wendepunkt befindet sich an der Stelle 0,5. Marginale Änderungen des beobachtbaren Nutzenanteils führen zu marginalen Änderungen der gewählten Wahrscheinlichkeit. Entsprechend kann bezüglich des Effektes einer Variable x auf die Wahrscheinlichkeit einer der Ausprägungen nur die statistische Signifikanz verlässlich interpretiert werden, nicht aber Vorzeichen und Größe der Koeffizienten. Diese Tatsache muss bei der Interpretation der geschätzten Koeffizienten berücksichtigt werden und stattdessen die marginalen Effekte berechnet werden (Winkelmann und Boes, 2010).

Die Abbildung 11.1 zeigt den typischen Verlauf einer logistischen Funktionskurve, die den Verlauf der Einflussbeziehungen aller Alternativen auf die Kaufwahrscheinlichkeit beschreibt.

Abbildung 11.1: Verlauf der logistischen Funktion

Quelle: Eigene Darstellung.

Ein wesentlicher Nachteil des MNL ist, dass es keine Möglichkeit bietet, unbeobachtete Heterogenität zu messen, es werden homogene Präferenzen der Entscheider vorausgesetzt. Der Parametervektor β ist in diesem Modell über alle Entscheidungsträger identisch, somit kann das Modell nur beobachtete Unterschiede in der Nutzenfunktion berücksichtigen, nicht aber nicht beobachtbare Einflussgrößen. In der Realität sind jedoch die Präferenzen einzelner Alternativen, die zur Kaufentscheidung einzelner Produkte führen, von Individuum zu Individuum verschieden. Dies führt zu einer Verzerrung der geschätzten Parameter (Train, 2009).

11.2.2 Mixed Logit Model

Die IIA Annahme stellt eine wesentliche Schwachstelle des MNL dar. Diese Annahme unterstellt, dass die zugrunde liegenden Wahlalternativen untereinander nicht korreliert sind. Diese Annahme ist insbesondere auf hoch differenzierten Produktmärkten als unrealistisch anzusehen, da einige Produkte stärker miteinander korreliert sind als andere. Damit kann die IIA Annahme zu inkonsistenten Schätzern führen. Das Mixed Logit Modell, das nach Hensher et al. (2005) auch unter dem Namen Random Parameters Modell bekannt ist, stellt eine Erweiterung des MNL dar, das die restriktive IIA Annahme aufhebt und zudem die Modellierung unbeobachteter Heterogenität ermöglicht. Ferner bietet das MIXL Modell eine Möglichkeit die Korrelation von unbeobachteten Faktoren über die Zeit zu berücksichtigen, wie

z.B. bei wiederholten Entscheidungen von Haushalten (Revelt und Train, 1998). Bei der Analyse von Haushalts Scannerdaten (bspw. GfK Daten), kommt es beispielsweise vor, dass derselbe Haushalt wiederholte Entscheidungen über den Kauf von Fischprodukten trifft. Das MIXL Modell löst somit alle entscheidenden Schwachstellen des MNL Modells.

Wie auch das MNL Modell wird das MIXL Modell aus der Random Utility Theorie abgeleitet. Der Unterschied besteht darin, dass es modelliert werden kann, dass sich einige Variablen des Parametervektors X_{nj} von Individuum zu Individuum unterscheiden. Resultierend besteht der einzige Unterschied zur Random Utility Theorie in der deterministischen Nutzenkomponente V_{nj} (siehe Gleichung 11.25). Der hinzugekommene Index n impliziert nun, dass der Koeffizient β_n über die Konsumenten variiert und t entspricht dem Entscheidungszeitpunkt. ε_{njt} ist ein unbeobachteter zufällig identisch und unabhängig verteilter Störterm, der einer Gumble Verteilung folgt.

$$V_{njt} = \beta_n x_{njt} \quad (11.27)$$

$$U_{njt} = V_{njt} + \varepsilon_{njt} = \beta_n x_{njt} + \varepsilon_{njt} \quad (11.28)$$

Wenn β_n bekannt bzw. beobachtbar wäre, würde die Entscheidungswahrscheinlichkeit identisch dem herkömmlichen Logit Modell sein. Die konditionale Logit Spezifikation, dass der Konsument n Alternative i in der Entscheidungssituation t wählt, bedingt auf β_n ist:

$$L_{nit}(\beta_n) = \frac{e^{\beta_n x_{nit}}}{\sum_j e^{\beta_n x_{njt}}}. \quad (11.29)$$

Jedoch ist β_n nicht bekannt. Somit ist die bedingte Wahrscheinlichkeit das Integral über alle möglichen Werte von β_n , die von der angenommenen Verteilung für β_n abhängt und lautet nach (Train, 2009):

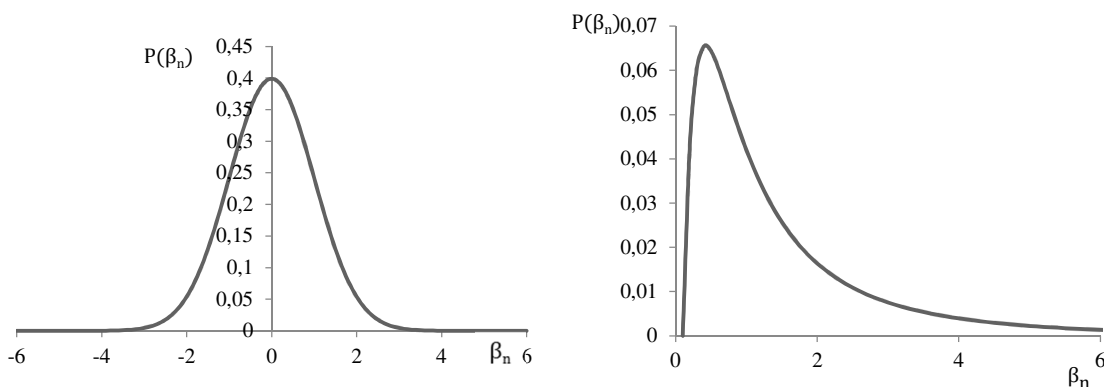
$$P_{nit} = \int \left(\frac{e^{\beta_n x_{nit}}}{\sum_j e^{\beta_n x_{njt}}} \right) f(\beta_n | \theta) d\beta_n. \quad (11.30)$$

Der Koeffizient β_n variiert in der Population mit der Dichtefunktion ($\beta_n|\theta$), wobei θ ein Vektor einer kontinuierlichen Populationsverteilung ist. Somit ist β_n nicht fix, sondern variiert über die Individuen durch die Einführung der kontinuierlichen Populationsverteilung, wodurch die Heterogenität der Individuen mit in das Modell aufgenommen wird (Train, 2009).

Ausgenommen den Schätzkoeffizienten für die Preisvariable, der in der Regel fix ist, können alle Schätzkoeffizienten der Attributvariablen mit einer Standardabweichung zufällig variieren, so dass die Heterogenität der Grundgesamtheit berücksichtigt wird (Hensher et al., 2005).

Für jede Studie muss die Verteilung für β_n gewählt werden. Typische Verteilungsannahmen sind die Normalverteilung, die Log-Normalverteilung, die Dreiecksverteilung sowie die Gleichverteilung. Dabei ist es grundsätzlich möglich, für unterschiedliche Parameter verschiedene Spezifikationen zu wählen. In der nachfolgenden Abbildung 11.2 sind eine Normalverteilung sowie eine Log-Normalverteilung graphisch dargestellt.

Abbildung 11.2: Normalverteilung und Log-Normalverteilung



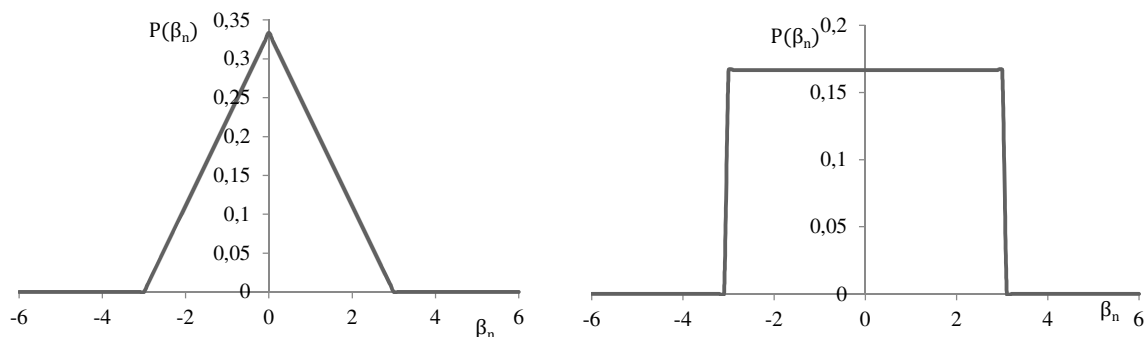
Quelle: Eigene Darstellung.

Durch die Schätzung wird sowohl der Mittelwert als auch die Standardabweichung der Parameter ermittelt, so dass sich die Normalverteilung als geeignetste Verteilungsform erwiesen hat und die gebräuchlichste Spezifikation darstellt. Die Verteilung ist nicht begrenzt und lässt somit auch Extremwerte zu. Die Log-Normalverteilung ist vorteilhaft, wenn erwartet wird, dass die Koeffizienten für alle Individuen dasselbe Vorzeichen aufweisen. Beispielsweise wird angenommen, dass Konsumenten eine Präferenz für einen niedrigen Preis haben. Der negative Koeffizient kann durch Multiplikation der Variablen mit -1 erzwungen werden (Hensher und Greene, 2003; Train, 2009). Auch wenn es möglich ist, das gewünschte Vorzeichen durch eine Log-Normalverteilung zu erhalten, hat sich diese Verteilungsform als

problematisch erwiesen. Nach Revelt und Train (1998) erschwert die Log-Normalverteilung die Schätzung und durch die fehlende Begrenzung nach oben sind sehr hohe Werte theoretisch möglich.

Die Abbildung 11.3 zeigt die Dreiecks- und Gleichverteilung. Der Vorteil dieser Verteilungen liegt darin, dass sie zu beiden Seiten begrenzt sind und dadurch unrealistisch hohe oder niedrige Koeffizienten unmöglich sind. Die Anwendung der Dreiecks- oder Gleichverteilung hat sich in der Literatur jedoch nicht durchgesetzt.

Abbildung 11.3: Dreiecksverteilung und Gleichverteilung



Quelle: Eigene Darstellung.

Nach Wahl der geeigneten Verteilungsfunktion für die stochastischen Parameter werden diese durch Maximierung der Log-Likelihood Funktion geschätzt. Die Gleichung (11.30) stellt kein Integral in geschlossener Form dar, wodurch eine exakte Maximum Likelihood Schätzung nicht möglich ist. Stattdessen müssen die Populationsparameter θ (Mittelwert und Standardabweichung) durch eine Simulation und Maximierung einer simulierten Maximum Likelihood Funktion bestimmt werden (Revelt und Train, 1998), die nachfolgend dargestellt ist:

$$SLL(\theta) = \sum_{k=1}^K \ln[SP_n(\theta)] \quad (11.31)$$

In vielen Anwendungen wurde das Integral mittels zufälliger Ziehungen (random draws) ermittelt, diese sind jedoch sehr zeitintensiv. Die Schätzprozedur kann durch die Verwendung von Halton Ziehungen (Halton draws) deutlich verringert werden (Train, 1998; Bhat, 2001). Diese Methode findet auch in den Beiträgen dieser Dissertation Anwendung. Ferner wird

Beiträgen zur Schätzung der MIXL Modelle die programmierte STATA Syntax von Hole (2007) verwendet.

Aus den erhaltenen Schätzergebnissen lassen sich die marginalen Effekte bestimmen, aus denen sich die marginalen Zahlungsbereitschaften (Willingness to Pay (WTP)) ableiten lassen. Nach Train (2009) lassen sich diese als negatives Verhältnis der Attributkoeffizienten ($\beta_{attribute}$) und dem Preiskoeffizienten (β_{price}) berechnen. Aufgrund der Annahme des fixen Preiskoeffizienten bekommen wir:

$$E(WTP^{attribute}) = -\frac{E(\beta_{attribute})}{\beta_{price}} \quad (11.32)$$

Die marginalen WTP geben an, wie viel den Konsumenten bestimmte Attributausprägungen der Alternativen wert sind. Sie geben gute Hinweise auf die Wichtigkeit einzelner Attribute und sind leicht zu interpretieren.

Literaturverzeichnis

- Banks, J., Blundell, R., & Lewbel, A. (1997). Quadratic Engel Curves and Consumer Demand. *The Review of Economics and Statistics*, Vol. 79, 527-539.
- Barten, A. (1968). Estimating Demand Equations. *Econometrica*, Vol. 36, 213-251.
- Bhat, C. (2001). Quasi-random maximum simulated likelihood estimation of mixed multinomial logit model. *Transportation Research Part B*, Vol. 35, 677-693.
- Christensen, L., Jorgenson, D., & Lau, L. (1975). Transcendental Logarithmic Utility Functions. *American Economic Review*, Vol. 65, 367-383.
- Deaton, A. S., & Muellbauer, J. (1980). An Almost Ideal Demand System. *American Economic Review*, Vol. 70, 359-368.
- Deaton, A., & Muellbauer, J. (2009). *Economics and consumer behaviour*. 24. Auflage. New York: Cambridge University Press.
- Greene, W. (2012). *Econometric Analysis*. 7th Edition. Edinburgh: Pearson.
- Hausman, J., & McFadden, D. (1984). Specification Tests for the Multinomial Logit Model. *Econometrica*, Vol. 52, 1219-1240.
- Hensher, D., & Greene, W. (2003). The Mixed Logit model: The state of practice. *Transportation*, Vol. 30, 133-176.
- Hensher, D., Rose, J., & Greene, W. (2005). *Applied Choice Analysis*, 1st ed. Cambridge, UK: Cambridge University Press.
- Hole, A. (2007). Estimating mixed logit models using maximum simulated likelihood. *Stata Journal*, Vol. 7, 388-401.
- Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economics*, Vol. 74, 132-157.
- McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka, *Frontiers of Econometrics*. New York: Academic Press.
- McFadden, D., & Train, K. (2000). Mixed MNL models for discrete response. *Journal of Applied Econometrics*, Vol. 15, 447-470.

- Muellbauer, J. (1975). Aggregation, income distribution and consumer demand. *The Review of Economic Studies*, Vol. 42, 525-543.
- Nevo, A. (2001). Measuring market power in the ready-to-eat cereal industry. *Econometrics*, Vol. 69, 307-342.
- Rasmussen, E. (2011). *The BLP method of demand curve estimation in industrial organization*. Retrieved from <http://www.rasmusen.org>: <http://www.rasmusen.org/papers/blp-rasmusen>.
- Revelt, D., & Train, K. (1998). Mixed Logit with Repeated Choices: Households' Choices of Appliance Efficiency Level. *Review of Economics and Statistics*, Vol., 647-657.
- Ronning, G. (1988). Möglichkeiten und Grenzen der ökonometrischen Nachfrageanalyse. *Wirtschaftswissenschaftliches Studium*, Vol. 17, 65-72.
- Stone, J. (1954). Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand. *Economic Journal*, Vol. 64, 511-527.
- Theil, H. (1965). The information approach to demand analysis. *Econometrica*, Vol. 33, 67-87.
- Train, K. (1998). *Halton Sequences for Mixed Logit*. Von UC Berkley: Department of Economics: <http://eml.berkeley.edu/wp/train0899.pdf>, aufgerufen am 22.01.2016 abgerufen
- Train, K. (2009). *Discrete Choice Methods with Simulation*. Cambridge, UK.: Cambridge University Press.
- Winkelmann, R., & Boes, S. (2010). *Analysis of Microdata, Second Edition*. Heidelberg: Springer.

Lebenslauf von Julia Bronnmann geb. Wiegand

Persönliche Angaben

Geburtsdatum	12.01.1984
Geburtsort	Kiel
Staatsangehörigkeit	deutsch
Familienstand	verheiratet

Tätigkeiten

09/2015 -04/2016	Wissenschaftliche Mitarbeiterin mit Sonderaufgaben in der Lehre Institut für Agrarökonomie Abteilung Marktlehre Prof. Dr. Loy Christian- Albrechts- Universität zu Kiel
01/2014 – 04/2014	Wissenschaftliche Mitarbeiterin Institut für Regionalforschung Abteilung Internationale und Regionale Wirtschaftsbeziehungen Prof. Dr. Bröcker Christian- Albrechts- Universität zu Kiel
02/2013 – 12/2014	Hilfswissenschaftliche Mitarbeiterin Institut für Arbeitsmarkt- und Berufsforschung IAB Nord, Prof. Dr. Niebuhr Forschungseinrichtung der Bundesagentur für Arbeit
08/2012 – heute	Wissenschaftliche Mitarbeiterin Institut für Agrarökonomie Abteilung Marktlehre Prof. Dr. Loy Christian- Albrechts- Universität zu Kiel

Ausbildung

10/2010 – 07/2012

Master Studium Agrarökonomie und Agribusiness

Christian- Albrechts- Universität zu Kiel

Abschluss: Master of Science

04/2007 – 02/2011

Bachelor Studium Agrarwissenschaften

Christian- Albrechts- Universität zu Kiel

Abschluss: Bachelor of Science

Veröffentlichungen

Harder, V.; Peters, C.; Wiegand, J.; Herrmann, H.; Lüth, H.; Bauer, B.; Ollech, D.; Niebuhr, A. (2014): Analyse der Übergänge aus Arbeitsuche in Beschäftigung in der Arbeitsmarktregion Lübeck. Befunde für die Teilregion Stadt Lübeck. IAB-Regional. *Berichte und Analysen aus dem Regionalen Forschungsnetz*. IAB Regional Nord, 01/2014, Nürnberg.

Harder, V.; Peters, C.; Wiegand, J.; Herrmann, H.; Lüth, H.; Bauer, B.; Ollech, D.; Niebuhr, A. (2014): Analyse der Übergänge aus Arbeitsuche in Beschäftigung in der Arbeitsmarktregion Lübeck. Befunde für die Teilregion Ostholstein. IAB-Regional. *Berichte und Analysen aus dem Regionalen Forschungsnetz*. IAB Regional Nord, 02/2014, Nürnberg.

Harder, V.; Peters, C.; Wiegand, J.; Herrmann, H.; Lüth, H.; Bauer, B.; Ollech, D.; Niebuhr, A. (2014): Analyse der Übergänge aus Arbeitsuche in Beschäftigung in der Region Schleswig-Holstein Süd-West. Befunde für die Teilregion Kreis Steinburg. IAB-Regional. *Berichte und Analysen aus dem Regionalen Forschungsnetz*. IAB Regional Nord, 04/2014, Nürnberg.

Harder, V.; Peters, C.; Wiegand, J.; Herrmann, H.; Lüth, H.; Bauer, B.; Ollech, D.; Niebuhr, A. (2014): Analyse der Übergänge aus Arbeitsuche in Beschäftigung in der Region

Schleswig-Holstein Süd-West. Befunde für die Teilregion Kreis Dithmarschen. IAB-Regional. *Berichte und Analysen aus dem Regionalen Forschungsnetz*. IAB Regional Nord, 04/2014, Nürnberg.

Bronnmann, J. und Asche, F. (2015): The Value of Product Attributes, Brands and Private Labels: An Analysis of Frozen Seafood in Germany. *Journal of Agricultural Economics*, Vol. 67, 231-244

Bronnmann, J.; Loy, J.-P.; Schroder, K.J. (2016): Characteristics of Demand Structure and Preferences for Wild and Farmed Seafood in Germany: An Application of QUAIDS Modeling with Correction for Sample Selection. *Marine Resource Economics*, Vol. 31 (3) DOI:10.1086/686692

Bronnmann, J.; Ankamah-Yeboah, I.; Nielsen, M. (2016): Market Integration between farmed and wild fish: Evidence from the Whitefish market in Germany, *Marine Resource Economics*, forthcoming

Bronnmann, J. (2016): The German Whitefish Market: An Application of the LA/AIDS Model using Retail-Scanner-Data, *Aquaculture Economics and Management*, forthcoming

Gutachtertätigkeit

Marine Resource Economics

Kiel, Mai 2016