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Number 10. Measuring fishing dependency using Occupational Alternative Ratio - an application to Shetland whitefish industry

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Measuring fishing dependency using Occupational Alternative Ratio- an application to Shetland whitefish industry

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Abstract

In this paper Occupational Alternative Ratios (OAR) are applied to the 2003 employment survey data from Shetland to measure dependency on whitefish in individual communities as an alternative to traditional measures of fishing dependency, such as fishing employment and fisheries contribution to Gross Domestic Product (GDP). The OAR measure summarises the potential impact that the size of the whitefish industry has upon the supply of labour for alternative occupations within the local economy.

The results of the model indicate that Whalsay is the most whitefish dependent community, followed by Scalloway and Skerries while the least whitefish dependent community is West Mainland. The OAR indices depict a clear distinction between the most and least dependent communities, and historical attachment to demersal fishing support these differences. The use of OARs to measure and rank dependency provides a new way to conceptualise the significance of fishing to communities and their economies. The results of the study also show that the OAR route to measuring fisheries dependency could be useful for policy makers and managers to make informed decisions, formulate appropriate policies on resource use and contribute effectively to wider processes (e.g. international negotiations of fisheries resources).

1.0 Introduction

It is widely recognised that most fisheries around the world have been severely overexploited. This serious state of affairs is the result of a growing world demand for fish, backed by a fleet harvesting capacity that is increasing more rapidly the growth fish stocks. The EU takes the problem of fisheries resource overexploitation very seriously. In December 2002, EU Fisheries CFP. The new measures, which came into force in January 2003, have replaced the rules that governed the CFP since 1993. In the new CFP, capacity reduction is among several management objectives aimed at reducing fishing mortality of overexploited stocks not only for conserving the resource but also for improving profitability.

Fisheries management is a complex problem from an environmental perspective and as well as from economic, social, cultural and political viewpoints. Some of the complexity occurs from the desire to balance the regulatory objectives for stock conservation and the need for the well-being of fishing dependent communities. In most fisheries, attempts to reduce fishing pressure in order to conserve stocks are concomitant with a short-term reduction in both the number employed in fishing and incomes in order to enhance longer-term prospect. Imposing a policy that results in significant reductions in employment levels in areas heavily dependent on fishing and where alternative employment opportunities are generally poor may be considered unacceptable. However, biological advice may suggest that stock collapse may occur unless action is taken to reduce fishing. Both outcomes affect fishing communities harshly, although the effects and likelihood of occurrence of stock collapse on fishing communities is less certain than the effects of reducing fishing. The effects of stock collapse, if any, are more likely to occur in the future whereas reducing fishing which impact on employment levels impinges on the communities now.

Scotland has specific social and rural development objectives relevant to fishing communities, which are in general geared towards their development, diversification and the sustainability. The contribution of the fishing sector to coastal communities' economic and employment opportunities is recognised in the Strategic Framework for the Scottish Sea Fishing Industry, where support for fishing communities is among the five key themes. It emphasises the benefits of diversification of the economies of fishing dependent communities, but also states the Scottish Executive's commitment to sustaining employment opportunities in fishing dependent rural communities. Sustainability of fish stocks is central to the strategic agenda in order to secure the long-term future of the industry. The social and employment implications of establishing sustainable management of fisheries can be significant, especially during the transitional phase while fishing effort is being curtailed. This is particularly evident in coastal communities that depend mainly on fisheries for their livelihood. It is very important that the communities within regions whose economies are the most fisheries dependent are identified so that efforts to reduce the negative regulatory impact of capacity reductions can be effectively targeted.

Dependency on fishing is typically measured by economic indicators such as employment and income levels. Although non-economic indicators such as culture and other social factors may also be taken into account in determining fishing dependency. Therefore the assessment of regulatory policy impacts on fishing dependent communities consider not only the vulnerability of fishing communities but also look at how fishermen in a community could potentially move into fisheries-related work or take jobs in downstream sectors or move out of the fisheries sector altogether into alternative industries.

Following Hall-Arber, Dyer, Poggie, Gagne and McNally (2001), the OAR is used as a measure and indicator of the level of dependency of Shetland on the whitefish catching industry. OAR is an attempt to summarise a standard array of independent occupational alternative ratios within regions in a manner that provides a single measure of the impact of the fishing industry upon the region in relation to other occupations available to people currently engaged in fishing. The OAR measure emphasises both the importance of fishing as an occupation to individual participants in the local labour force and the dependency of the local economy on the fishing industry. The use of OAR to measure and rank dependency on fishing provides a new way to conceptualise the significance of fishing to communities and their economies. This paper should thus be regarded as an innovative paper, since no other fisheries dependency analyses of this nature have been carried out for the United Kingdom or Europe.

The rest of the report is organised as follows. The next section provides an overview of fishing industry in Shetland. In section 3, the definitions of 'community' and 'fisheries dependency' are discussed. Section 4 discuses how this paper differs from other fisheries dependency studies in the UK. Section 5 reviews the OAR approach and the phases of analysis are outlined. The data are described, and results of the OAR analysis are presented and discussed in section 6. Finally, concluding remarks are drawn in section 7.

2.0 The Fishing Industry – an economic overview

Shetland comprises a group of over 100 islands situated in the North Sea, some 200 miles north of mainland UK, of which people inhabit 15 of the islands. The islands cover a total area of 1,468 square kilometres, with a long coastline stretching 1,450 km. The climate is cool, wet and windy. The Shetland Islands support a population of 21,988 (2001 Census).

Shetland's economy, which thrived from North Sea oil, has enjoyed considerable growth since the 1970s and had an unemployment rate of only 2% in 2004. Fishing is one of the main industries in Shetland, with 11% of all jobs in the fishing industry (600 in catching; 400 in Aquaculture; 900 processing) while 22% are in fisheries/fisheries related jobs (includes supplies and repairs)(SEERAD *cited in Brookfield et al 2004).*

In 1998, fish landings and fish processing were worth £85 million to the Shetland economy equivalent to 27% of Shetland's total income (Shetland Islands Council 1999). A study by the SIC Economic Development Unit on the structure of the Shetland Economy in 2003 found that the value of output of the fisheries sector[1] was £245m, equal to the value of the service sector. The value of fisheries output dwarfs the value of the third most important sector, oil £58m (SIC 2004)[2].

[1] Combined Fisheries Output includes Fish Catching, Fish Processing and Salmon Farming.

[2] These figures should be used with caution because they do not represent value added. They are derived from input-output tables and may include double counting since any output from the catching and farmed fish sectors that is processed locally will be counted twice. Fisheries output represents expenditure on the products of the fisheries sector. This is the sum of the sales of the fisheries sector,[2] to other Shetland sectors, plus consumer expenditure on this sector, government expenditure on this sector, tourist expenditure on this sector, stock changes in this sector, capital formation and exports of the sector.

The following section provides a general overview of the main industries that constitute the seafood sector. A more detailed overview of the captured fisheries industry is included as an annex to this paper.

Fish Catching

UK vessels landed 72,847 tonnes of fish in Shetland in 1998 with a total value of £24.7 million. Demersal landing constituted 30% by weight of these total landings of UK vessels into Shetland (Scottish Executive 2002). The total landings into Shetland represented about 20% and 11% by weight of total Scottish landings and total Scottish demersal landings respectively.

In 2002, UK vessels landed over 80,000 tonnes representing 11% increase since 1998. Despite an increase in total UK vessels landings into Shetland, demersal landings into Shetland decreased by more than 50% from 22,194 tones in 1998 to 10,719 tonnes in 2002 (Scottish Executive 2002). This trend reflects the effect of the policy measures in place to conserve the over-fished whitefish stocks. The majority of landings in Shetland are of fish caught in waters around Shetland. However, some fish caught in Shetland waters are not landed there and so are not represented in the figures discussed. This includes catches by Shetland, other Scottish and foreign vessels who land elsewhere in the UK or on continental Europe. In Scotland, Shetland was third only to Peterhead and Aberdeen in terms of quantity of whitefish/demersal landed in 1998, making it one of the most important whitefish landing districts in the UK. In 2002, Fraserburgh and Wick overtook Shetland and pushing it to 5th place in terms of weight of whitefish/demersal fish landed. The importance of Shetland in 1998 was a direct reflection of the importance of the fishing grounds in the waters around Shetland and the diminished importance in 2002 can be ascribed, in part, to severe overexploitation.

Assessments of whitefish stocks have revealed that most are outside safe biological limits and cod is in a particularly precarious condition. This led the European Commission to launch its cod recovery measures for designated areas (CRZ) in the North Sea and the waters to the West of Scotland in early 2003. The measures include quota reductions and restriction of fishing vessels to a finite number of days at sea. The number of days depends on the type of fishing gear used in that period. The 2003 effort control measures have been amended and came into force in 2004. The amended effort control measure includes the enlargement of CRZ to cover previously unrestricted fishing zones. Areas of the enlarged CRZ fall within the traditional demersal fishing ground of Shetland, Orkney and other Northeast fishing fleets.

The Shetland fleet accounts for 8% of the total Scottish fleet. This fleet size ranges from under 10 metres to almost 75 metres in registered length. It has proportionately more smaller boats (under 10m) but fewer middle sized (15-25m) and more larger boats (over 25m) than in the Scottish fleet (SAC 1999). This size structure indicates the relative importance of the shellfish sector (which uses small boats) as in the rest of the Highlands and Islands, and the pelagic sector (users of large vessels. There is an under representation of the demersal fleet (medium boats) compared to the rest of Scotland. These medium sized vessels fish mainly offshore but will spend some of their time fishing in inshore waters in winter months and during periods of bad weather.

In 2002, 433 fishermen were employed in the Shetland fleet (Sea Fisheries Statistics, 2003) of which about 55% were full-time. The full-time employees are concentrated on the larger

vessels, while many of the smaller shellfish fishing vessels are operated on a part-time basis. In 2003, the number of fishermen employed increased marginally to 460 of which 59% were full-timers. Overall, the number of Shetland fishermen appears to have declined by 28% in 2003 from a level of employment of 637 in 2000 (Scottish Executive, 2000)

Fish Processing

In 1998 there were 22 fish processing factories in Shetland with 34 processing lines for salmon, shellfish and demersal and pelagic fish (Shetland Islands Council, 1999). Demersal fish processing only represented 10% of total fish processing output on the islands in 1999 as the vast majority of whitefish landed was shipped to the Scottish mainland unprocessed (Rommel, 1999). Processing employment (part time and full time) in Shetland fell at the end of the 1980s due to whitefish supply problems, but the industry survived due partly to diversification into salmon processing. However employment declined from 834 (FT and PT) in 1998 to just 336 (FT and PT) in 2003 representing a 60% fall in employment. This trend appears to have continued because latest figures from SIC indicate that there are now no whitefish processing lines in Shetland (SIC 2004 unpublished).

Finfish Farming

UK fish farming industry is mainly located in Scotland with Shetland contributing a significant proportion to the overall output. Although the industry is relatively new compared with captured fisheries, it has experienced considerable development and change. It has transformed itself from its nascent beginnings in the 1980s, when it was seen as subsistence, locally owned with low-intensity technology and small-scale, and has grown into a multi-million pound business. Most of the marine sites are located on the west coast, producing about 67% of the harvest. The remaining 33% is produced on the Orkney and Shetland Islands. At present, the vast majority of Shetland's farmed finfish production is based on salmon. There are some moves towards the farming of other species in Shetland such as sea trout and cod. There are also land-based salmon hatchery and smolt units.

Salmon production in Shetland has increased from 1,500 tonnes in 1986 to 33,404 tonnes in 1998 this was equivalent to 30% of total Scottish production (Fisheries Research Service, 2002). In 2002, output increased to 49,341 tonnes, an increase of 48% since 1998 and representing about 34% of Scottish production in 2002. The scale of Shetland's farmed salmon production mirrors the importance to the Scottish industry. In 2000, salmon farming in Shetland employed 258 full-time and 77 part-time employees, with an additional 339 employed in the ancillary industries such as hatcheries (Scottish Fish Farm Annual Production Survey, 2002).

Mussels are the main shellfish farmed in Shetland, in particular on moderately exposed coasts to the west of Shetland. This industry is based on the on growing of naturally settled spat on ropes suspended from rafts or lines. There is no significant farming of other shellfish species in Shetland although there is some interest in both scallops and oysters. Anecdotal evidence suggests that employment levels on mussel farms are currently low in Shetland, since mussel farming is non-labour intensive. However employment in shellfish farming is increasing with an expansion in shellfish farms from only 3 in 1994-95 to 158 in 2005 (www.fishupdate.com).

3.0 Defining community and fisheries dependence

Symes (2000) argued that the problem of fisheries dependence begins with its definition in terms of a community. The purpose of a definition is to aid the identification of those regions most at risk from both natural and policy induced decline in the level of fishing activity and the least well placed to absorb the impact of a reduction in employment income derived from fishing. The debate on the definition of community is not new as many definitions of communities can be found in the literature. In 1955, Hillery identified over 90 separate definitions of community that appeared in the classic and contemporary literature. If a current review of the community literature were conducted, many more definitions would be found. Murdock and Sutton (1974), Gusfield (1975), Warren (1978), Hassinger and Pinkerton (1986), Symes (2000) and many others have attempted to define critical elements of communities from the varied literature. In the early 1990s, Wilkinson (1991) identified three critical elements that are common in most "conventional" definitions of community, which are applicable to recent definitions. Most researchers would be comfortable with these essential elements identified by Wilkinson, which are: (a) a locality, (b) a local society, and (c) a process of locality-oriented collective actions. Locality, in this sense, would simply imply where people live and meet their daily needs. Local society emerges where people strive to meet common needs and express common interests. A local society addresses basic needs, and includes social groups, an economy, and other institutions that are formed within the locality. Wilkinson (1991) also argued that a process of locality-orientation led to the notion of collective action. Collective action is a mechanism to express mutual interests in the local society that are not driven by self-interest, but rather are for the good of the local society. At the individual level, Brown (1993) argued that such a process produces feelings of community attachment or solidarity. Taking the first two elements of community (i.e. locality and local society), Jacob 1997 pointed out that the third element (process or locality-oriented collective actions) is likely to emerge. (Explanation on creek level fits this definition) By relying on these three elements of community as a guide, we follow island base local community with main fishing ports/creeks to measure whitefish dependency as Brooke et al (2004) argued that it at the local level where dependence on fisheries is most acute. The fishing ports/creek in Shetland serves not only location to land fish but it is seen as the

Having adopted a definition for community, the next pertinent question to find an answer for is: What is fisheries dependence? The immediate answer to such a question is that where fishing constitutes a major proportion of jobs in a locality then the case for dependency is strong. However, Philipson (2000) argued that a large number of people employed in fishing industry in absolute term may not necessarily represent high dependency if there is diversity in employment opportunities within the region[3]. Fisheries dependence refers to a situation where a good proportion of communities and families rely on the fishing industry both economically and socio-culturally. Regional dependence considers fisheries as an economic entity with its contribution to socioeconomic cohesion in the regions. Regional dependency is clearly tied to region while fisheries dependence is seen to be detached taking into account economic influences outwith the region. For example, some may depend on fisheries while some fisheries economies may display little connection to the region in terms of trade. Thus, there is a clear distinction between regional dependence and fisheries dependence. PESCA

[3] 'Region' is a frequently used term in the fishing dependency literature, which is sometimes used interchangeably with 'community'. While more attention has been paid to providing definitions for 'community', defining 'region' has not attracted much attention. However 'region' is sometimes used in a context to refer to areas that contain communities.

guidelines of 1994 defines a fisheries-dependent area as 'an employment area where the contribution of the fishing sector to the economic activity (as measured in terms of jobs and value added) is such that the difficulties of the fisheries sector have resulted or will result in slackening of activity and job losses which seriously undermines the socio-economic fabric'(cited in Brookfield el, 2004). From the definitions presented so far it seems that fisheries dependence is tied mostly to economic terms such as employment and income. While fisheries dependency is tied mostly to income and employment share, it can also be argued that dependence is a relationship between two related but independent entities. A ratio between two dependent entities provides a unique relationship that can be described as a dependency ratio. Dependency ratios are useful because they allow one to make direct comparisons between independent groups rather than just describe an entity's proportionate share within the sample or universe of interest. An added advantage of the dependency ratio is that, they are statistically insensitive to population size and so allow for direct comparisons across regions or communities**.** Therefore, in this paper, fisheries dependency is the relationship between fish catching as an occupation and similar occupation with identical skill requirement in other sectors of a local economy.

4.0 How this paper differs from other UK fisheries dependency studies?

The analysis presented here differs from those in other studies looking at fishing industry's contribution to employment and regional economy for the reason that we have restricted our analysis to dependence on whitefish catching sector in terms of employment and its relation to other similar employment in Shetland.

Unlike other studies in the UK, this study also uses a different geographic level with the objective of looking at local communities at creek level such that dependence of whitefish can be compared across communities. Other studies have typically used TTWAs. TTWAs could have been possible criteria to conduct the analysis but due to the remoteness of some of the communities, it is virtually impractical for people to commute to work between some areas of Shetland. TTWA gives an idea of the distance most people in the area travel to go to work and the boundaries are usually demarcated using commuting patterns from national census data. They are formed by grouping wards together to create areas with at least 20,000 people, grouped so that at least 70% of the workforce live in the TTWA , and within which at least 70% of those who work in the TTWA live there. This criteria need to be modified to account for the special characteristics of areas with low population density such as Shetland. In most cases, Travel To Work Areas is adjusted to a minimum working population of 3,500 people, and at least 75% of people working in the TTWA also live there. This criterion would hardly be meet by the wards in Shetland whose population is well below the 3,500 mark with the exception of Lerwick. Therefore, TTWA is not well suited for this kind of analysis. As many people do not travel beyond the ward in which they live for work, we feel that ports at creek level are a meaningful analysis of employment dependency on whitefish.

In addition, the current TTWA boundaries, which were published in May 1998 is based on information collected on commuting patterns from the 1991 Census. In theory, TTWAs can be argued to be approximations to self-contained labour markets based on commuting to work patterns. In practice, it is impossible to divide the whole country into entirely separate labour market areas. Furthermore, given the nature by which census data are collected means that they are produced at interval of 10 years and the time it takes for updating boundary information adds several years to the problem. It is obvious to suggest that commuting patterns in the UK have changed since 1991 due to opening and closing of workplaces, the develop-

ment of residential areas and changes to transport facilities. Along these changes, economic characteristics would have changed a great deal. This makes TTWA as a geographic level of analysis prone to errors and misrepresentations.

Some studies on fisheries dependency study use European level data such as NUTS. NUTS was drawn up by the EU to be a single, cohesive system of territorial groupings for the compilation of EU regional statistics. The NUTS divisions do not necessarily correspond to administrative divisions within the country and therefore the statistics derived at this level treats the basic parameter of employment in the fishing industry in a non-standard form. A data set of this nature constructed at macro level would most likely conceal fisheries dependence rather than expose it. For example, Shetland falls within Highland and Islands at NUTS level 2. This in effect amalgamates Shetland with all areas in the Highlands including the city of Inverness. This is an inequitable situation, not only because the Shetland is physically separated from the mainland, but because there are such significant differences between the economies. This amalgamation distorts the Island's true fisheries economic position. It can be argued that it is only at the local level that the reality fishing dependence can be easily discerned.

Recognising the importance of local level data for policy analysis, in July 2003 the EU introduced LAU which replace NUTS 4 & 5. Eurostat is still in the initial stage of compiling data at LAU level. When data at LAU level is available, it could be probably suitable for fisheries dependency analysis.

5.0 Approach and Methodology

The measurement of fishery dependence is vital to fisheries management goals but it is an area that has been largely ignored. Many studies in the UK largely use indicators such as fisheries share to regional GDP[4] or share of fisheries employment in total regional employment or share of fishery activities in the value added of a region. While these measurements can be very useful in giving indications to fisheries dependency, the estimates are usually fraught with calculation difficulties that make comparison impossible or where estimates are made they tend to mask the importance of fisheries. For example, regional GDP is measured in current prices, which means that increases over time reflect inflation as well as real growth. Trends in GDP cannot be analysed easily without deflating the data. However, there are no regional prices that could be used to remove the effect of inflation from the figures. Comparison can therefore be misleading if the rate of inflation in any region is different from the national average.

Developing comparative dependency ratios is one solution to the measurement of fishery dependence. A number of ratios are commonly used to analyse and compare independent population units with different age, income or social structures. A dependency ratio is a unique application of the ratio approach that provides a summary measure of the relationship or dependency between two related but independent populations (Hall-Arber et al (2001)).

Griffith and Dyer (1996) developed a Fishery Dependence Index (FDI) to measure fishery dependence in US[5] using measures of infrastructure and support related to fishing such as numbers of repair and supply facilities and fish dealers and processors; the presence or ab-

[4] Gross Domestic Product (GDP) is the sum of the monetary value of all economic activity that takes place in a country in given period.

[5] New England and the Mid-Atlantic communities

sence of religious and secular art and architecture dedicated to fishing; and numbers of fishing permits and vessels. Variation in fishery dependency both between and within ports was also measured. Ports that were found to be more isolated and less flexible in terms of ability to move to other fish stocks and gear types were more fisheries dependent; ports where particular classes of fishermen within the industry were not well integrated into other fisheries or economic entities (e.g. tourism) were ranked more dependent on fishery. Ports with historical and cultural indicators of reliance on fishing (mariner museums etc.) were ranked more dependent. Competition and conflict amongst participants reflected perceptions that the resource was scarce and, therefore, that the participants were more dependent on it.

Wilson et. al (1998) measured fishery dependence by examining demographic variables, percentage of employment in fishery related industries, income for those industries, landings by species, and fishing related businesses (marinas, boat rental shops, dive shops, boat dockage and repair facilities, tackle and bait shops, tourism related to fishing). They also documented the social capital of the fishing community by counting numbers of recreational or commercial fishing associations and fisherman participation in each. This study identified several fishing dependent communities along the Gulf of Mexico coast in US. These communities were designated as dependent on the billfish fishery.

In summary, many of these studies used economic data such as landings, numbers of vessels, license information, and employment characteristics to identify the location of the community under analysis. Once a location is identified, the second stage is measuring fishing dependency. The dependency is measured as social, psychological (identity), and/or economic. Economic dependency refers to economic vulnerability or the ability of fishermen to find alternative employment given the social and physical capital of the area (Lucas, 2001).

Hall-Arber et al (2001) developed the Occupational Alternative Ratio (OAR) to measure and rank fishing dependency across five states in USA. The approach draws upon the age dependency ratio (ADR) commonly used in demography as an indicator of the dependency burden in a population. The ADR of a population at a given point in time is defined as the ratio of the population in the ages below 15 (P_{15}) and over 65 (P_{65}) to the population between ages 15 and 65 ($P_{15\text{-}65}$). That is age dependency is estimated as $(P_{15}+P_{65})/P_{15\text{-}65}$. This ratio aims to measure how many “dependents” there are for each person in the "working" age groups. Obviously, not every person below 15 and over 65 is a dependent and not every person between ages 15 and 65 is at work, but despite the crudeness of this indicator it has enjoyed widespread use by economists[6], ecologists and resource management researchers[7] to document broad trends in the age composition and dependency burden. Analogously, Hall-Arber et al (2001) constructed OAR in the following stages.

First, a series of OARs are estimated for a predetermined set of occupations. These OAR measures represent a set of alternative occupation that are compatible with the basis skills and training that are part of the fishing occupation. Here it is assumed that fishermen can take up any one of these occupations but chooses not to due to the satisfaction with their current position as fishers. The alternative occupations identified and employed in this analysis consist of 10 occupations thus:

[6] Horrell and Humphries (1992)
[7] Johnson and Carpenter (1994)

- Aquaculture labourer
- Fish Processor
- Pelagic fishing
- Terrestrial farming
- Wholesaler
- Construction worker
- Mechanics
- Shell fishing
- Truck driver
- Retailer

While this occupation set is not argued to be exhaustive, but it is felt to represent a reasonable approximation of the potential occupation set open to fishermen in Shetland. For example records provided by the Shetland Development Trust indicates that between February 2003 to January 2005, a total of 9 whitefish vessels have been decommissioned with a total crew number of 47 being affected. At least 81% of the crew of affected have taken alternative occupation as labourers in the aquaculture industry as aquaculturists, shopkeepers, ferry workers, or painters. The list of alternative occupation presented above is not exhaustive but it reasonable to suggest that the list is a good representation of the potential occupation open to fishermen leaving the industry. The OAR measures are calculated from the standard formula for the calculation of dependency in the following relations:

$$\mathrm{OAR} = \frac{\sum \mathrm{F}_{\mathrm{whitefish}}}{AO_i} \tag{1}$$

Where $\mathrm{F}_{\mathrm{whitefish}}$ is the total number of individuals in a specific sub-sector of the whitefish industry
$\mathrm{AO_i}$ is the total number of individuals engaged in the i^{th} alternative occupation

After the estimation of the OAR measure in equation (1) the resulting ratios are then summed into a single measure of the total impact of whitefish on fisheries economy of community thus:

$$\frac{\sum_{\mathrm{n}}^{1} \mathrm{OAR}}{\mathrm{OARs} = \mathrm{N}} \times 100 \tag{2}$$

Where N is the number of related occupational groups.

The OARs measure summarises the average potential impact that the size of the whitefish industry has upon the supply of labour for alternative occupations within the fisheries industry. The OARs measure provides two valuable insights into the importance of the whitefish industry.

First, it highlights the relative significance of the whitefish industry within the fishing industry. Thus, the higher the OARs index the more important whitefish is as an economic occupation within the fishing industry compared to compatible alternative occupation set. A score of 100 or greater suggests that, on average, fishing serves as the primary employment for as many individuals as are employed in any one of the typical alternative occupations. A score below 100 suggests that, on average, fishing does not serve as the primary employment for fewer individuals than are working in any one of the typical alternative occupations. Second, the OARs score would inform the potential impact on the local labour force of a specific region if whitefish jobs should suddenly cease as viable occupation.

6.0 Data and results

The data used in the analysis is derived from both published and unpublished sources. The 2003 annual employment survey conducted by Shetland Island Council provide the bulk of the data used in the calculations. Given that this survey was not meant for this work, the survey returns were revisited to extract the necessary information for the calculations. The next section details results obtained from the application of OAR methodology.

Table 1 provides a summary of the estimated OAR index.

Table 1: OAR indices for fishing ports in Shetland

Creeks/fishing ports	OAR	Rank
Centre Mainland	65.39	4th
Lerwick	58.12	5th
Northmavine	39.61	8th
S mainland & Fair Isle	36.05	7th
Scalloway	179.66	2nd
Skerries	82.50	3rd
West mainland	24.70	9th
Whalsay	311.20	1st
Yell, Fetlar & Unst	46.60	6th

The result indicates that Whalsay has an OAR index of 311.20, indicating the powerful impact that whitefish catching has on the community as a primary occupation. The index indicates that if fishing should suddenly cease however, the OAR implies that there would be approximately 3.1 fishermen for every individual working in a single alternative occupation on average. Therefore, if any one occupational alternative were more attractive to former fishermen, then the labour supply for this occupation would immediately be saturated. This could potentially result in the driving down of wages and depressing the overall labour market as fishermen sought alternative but less attractive occupations. The fishing port of the island of Whalsay is on the East Coast of Shetland. The island is 5 miles (8 km.) long by 2 miles (3.2 km.) wide and has a resident population of 1034 (2001 census). The main hub of fishing activity is around its harbour area in Symbister that has recently benefited from expansion and modernisation of its facilities. Whalsay's tradition and culture is deeply ingrained in sea fishing and related activities. There is some crofting, but more than half of the 349 people in employment in 2003 was engaged in the seafood industry.

The index for Scalloway shows that it is the second most dependent region after Whalsay while Skerries is ranked third. It is worth noting that Lerwick is ranked 5th despite having relatively higher number people employed in whitefish catching. This is due to higher number of alternative employment in Lerwick compared to other regions. Also worthy of note is that Northmavine with only three people employed in whitefish catching is ranked 8th out of the nine communities as the least dependent on whitefish catching. This further indicates that the OAR methodology does not only take into account the numerical strength of the work force in whitefish catching but depends on alternative jobs they could potentially take should employment in whitefish catching ceases to be viable.

The three communities in the high dependency cluster share some characteristics that give them strong links to the fisheries resources of Shetland. Whalsay and Skerries share a com-

mon topography and isolation from other parts of Shetland. Scalloway, located on the Atlantic coast with a hilly topography to the west and the east and islands to the south provides a sheltered natural harbour. Like Whalsay, Scalloway harbour facilities have been extensively redeveloped and expanded to serve the fishing communities as well as commercial vessels. The landings at the port are now mainly haddock, whiting and cod and have replaced pelagic landings that have all but disappeared. One of Shetland's two fish markets is now located in Scalloway which further show the area's attachment to the fishing industry. The fishing tradition and culture in Scalloway made it a preferable location for Shetland's North Atlantic Fisheries College.

At the other end of the scale, West Mainland with an OAR index of only 24.7 shows that whitefish catching has little impact on the overall economic strength of the community. If whitefish catching were to end or all whitefish boat decommissioned then the redundant fishermen would represent an increase in the labour pool of only 2.5 per 10 workers in any average alternative occupation. In this case, fishermen could be relatively easily absorbed into the existing labour force without significant disruptions in the community labour supply. The West Mainland is a predominantly crofting area, with large areas of open moorland punctuated with scores of freshwater lochs. Fishing activity in the area is now limited to a few small inshore boats. In Sandness, Shetland's only spinning mill employs a number of local people. In recent years, the village of Walls has developed as a local centre for the aquaculture industry employing a good proportion of local people. Though West Mainland has a population of under 1000 people, its economy is sufficiently diversified taking pressure off fishing as a means of livelihood. However, it pertinent to balance this argument by the fact that local conditions appear to favours the development of the aquaculture sector.

7.0 Conclusions and Discussions

This analysis provides new information for evaluation of whitefish fishing dependence in communities in Shetland. The analysis provides an empirical estimate of the degree of whitefish dependence that might occur in the harvesting sector of the industry. The OAR approach provides information about the importance of fishing and the disruptions that might occur if whitefish catching ceases to exist in the communities.

As already mentioned in the introduction, we believe that the measurements of the dependence on whitefish in Shetland based on measures such regional GDP and employment ratios are also indicative of the importance of the fishing industries. The actual dependence on fisheries can be measured by the alternative opportunities open to those who participate in the industry. Though actual data from Shetland indicates that some redundant fishermen have actually taken jobs in down stream sectors or have move out of the industry completely to pursue other careers in non-related industries, it does not necessarily imply that demersal fisheries labour is sufficiently mobile. In addition, the methodological approach adopted in this paper can be employed to investigate to rank fishing dependency in all regions of Scotland and other down stream jobs along the value chain can also be analysed, provided of course the necessary data is available.

The diversity of fishing creeks/districts in Shetland means that no two areas have identical needs. Therefore, policy should enable a flexible application with targeting of measures to address the needs of specific areas to ameliorate the impact of changes in quota arrangements. The economic case for targeting of support rests on the greater marginal return to

spending in those areas most affected by loss of fishing opportunities. The measures to be adopted will depend substantially on alternative employment opportunities in each location. They can be linked to other regional development initiatives, in terms of the targeted design of re-training opportunities, transitional support for re-training, provision of re-location support and similar activities. This approach also maximises scope for local consultation and hence the likelihood that any measures proposed be accepted by regional fishing communities.

The OAR index is a straightforward and easily interpreted measure but it represents only a summary measure that fails to capture the richness of the cultural life that underlies fishing as an occupation. Specifically, the OAR does not address the question of labour stickiness. While the movement of fishermen to other occupational roles is clearly possible, OAR implicitly assumes that the skills involved in fishing are readily transferable. As we have discussed, this assumption is contrary to the characteristics of fishermen and the nature of their community dependencies. In fact, this is more so evident in Shetland since, unlike in the rest of Scotland, anecdotal evidence suggests that 57% of fishermen are owners of their boats which makes changing occupations less than straightforward.

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