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Analysis

A Multi-regional Economic Impact Analysis of Alaska Salmon Fishery Failures

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ABSTRACT

Recently, the harvest of Chinook salmon (*Oncorhynchus tshawytscha*) in some areas of Alaska was severely curtailed due to a significant reduction in the salmon runs. This generated adverse economic impacts in the areas. Unlike previous studies of impacts of changes in fisheries, which often rely on single-region economic impact models, this study uses a multi-regional social accounting matrix (MRSAM) model of three US regions – Alaska, West Coast, and the rest of US – to calculate the multi-regional economic impacts of the Chinook salmon fishery failures, considering the countervailing effects of federal disaster funds paid to commercial salmon fishermen. To estimate the negative effects of the reduced salmon harvest, this study uses "adjusted demand-driven MRSAM model", which avoids the double-counting problem encountered when a demand-driven model is used to compute the effects of exogenous output change, and overcomes the weakness of Ghosh (1958) approach in estimating the forward-linkage effects. To calculate the positive effects of federal relief payments, this study uses a Leontief demand-driven MRSAM model. Results indicate that the salmon fishery failures have significant adverse economic impacts including both intra-regional (Alaska) and inter-regional (West Coast and the rest of US) impacts, and that the disaster relief mitigates only a small portion of the adverse impacts.

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1. Introduction

During the period from 2010 to 2012, several areas of Alaska saw a significant reduction in Chinook salmon (*Oncorhynchus tshawytscha*) runs. Many physical and biological factors may have contributed to the low Chinook salmon runs. Fluctuations in the survival of Chinook salmon smolts[1] can affect the strength of the salmon runs. It is also believed that juvenile salmon survival can be affected by environmental conditions such as precipitation, air and ocean temperatures, and water currents.[2] Scientists are investigating to identify the primary factors that caused the low salmon runs [Alaska Department of Fish and Game (ADFG), 2013].

The low Chinook salmon runs prompted the State of Alaska to lower the harvest levels of Chinook salmon allowed to be caught by commercial, recreational, and subsistence fishermen. The State of Alaska limited commercial and subsistence harvests of Chinook and co-occurring salmon species on the Yukon and Kuskokwim rivers. For many years prior to this, restrictions had also been placed on the harvest of Chinook in the Arctic-Yukon-Kuskokwim (AYK) region, which included the Shaktoolik and Unalakleet rivers. The main gear types used in the commercial and subsistence salmon fisheries in these areas include drift gillnets (or drift nets), set gillnets (or setnets), and fish wheel gear types. In Cook Inlet, the state closed commercial set gillnetting for much of the 2012 season, and imposed limitations on recreational fisheries for Chinook salmon in fresh and salt waters.

The low Chinook salmon runs and the ensuing government salmon harvest restrictions have adversely affected the commercial, recreational, and subsistence fishermen in the Yukon, Kuskokwim and Cook Inlet areas relying on the salmon fisheries. The annual average ex-vessel revenue from commercial harvest of Chinook salmon from the Yukon area was about $215,000 over the years from 2010 to 2012. The annual average ex-vessel revenue from the Kuskokwim area was about $240,000 for the same period. In the Yukon area, virtually no fish were caught from commercial Chinook salmon fisheries in 2012 (ADFG, 2015) and subsistence fisheries on these two rivers (Yukon and Kuskokwim) were severely reduced (Washington Examiner, 2012).

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[1] Salmon smolt is a young salmon about two years old which is covered with silvery scales and is ready to migrate from fresh water to the sea.

[2] Some other U.S. regions have also experienced salmon fishery disasters, e.g., the fishery disasters in Klamath River and Sacramento River areas in California. The Klamath River fishery disaster was caused by severe drought conditions and reduced salmon stocks in the upper Klamath basin during the period 2001 to 2005. The drought resulted in very low flows in the river and its tributaries, which made the fish vulnerable to diseases, and resulted in the death of many juvenile and adult Chinook salmon. This led to returns of Klamath River fall Chinook salmon falling significantly in 2004 and 2005. The fishery disaster in the Sacramento River area occurred mainly because of unfavorable ocean conditions. As a result, the survival rate of juvenile salmon fell drastically in 2005 and 2006. This brought about a collapse of the Sacramento River fall Chinook salmon run (Upton, 2013).

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In the Cook Inlet area, from 2007 to 2011, the average annual ex-vessel revenue from commercial salmon fisheries with setnet gear was about $13 million, while in 2012, total ex-vessel revenue for setnetters was about $2.5 million (CFEC). A State of Alaska (Alaska Department of Commerce, Community, and Economic Development and ADFG, 2012) estimate indicates that, for guided and unguided recreational fishing in fresh and salt water in the Cook Inlet area, the number of angler-days has declined by about 29,600 and the direct spending has been reduced by about $10.4 million in 2012, compared to what would have happened to the recreational fishing in the area in 2012 if the salmon disaster did not occur and the recreational fishing was not closed in the year. The harvest of Chinook salmon was restricted severely due to shortened seasons, and estimates of subsistence catch of salmon are not yet available. However, many subsistence salmon fishermen had the opportunity to catch more abundant but less desirable salmon species such as chum (*Oncorhynchus keta*), sockeye (*O. nerka*) and coho (*O. kisutch*) salmon (Washington Examiner, 2012).

The unexpected low Chinook salmon runs and the drastic decreases in the fish harvest prompted the Governor of Alaska to request fishery disaster determinations under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) for commercial and subsistence fisheries on the Yukon and Kuskokwim Rivers, and commercial and recreational fisheries in Cook Inlet region. In response to the request, in September 2012, the U.S. Secretary of Commerce determined that a commercial fishery failure caused by a fishery resource disaster did exist for those three regions. Following the declaration of the fishery disaster, Congress allocated funds for fishery disaster relief. If a fishery disaster is declared, the federal government must determine the amount of economic damage incurred by the affected stakeholders. Federal law requires the federal government to compare the commercial fishery revenues in the disaster years to revenues for the five previous years.

In August 2014, the first round of fisheries disaster relief applications in the amount of $7.8 million was approved by the federal government (National Marine Fisheries Service's Alaska Regional Office) to help fishermen suffering from the 2012 commercial fisheries failure for the Yukon Chinook fishery, Kuskokwim Chinook fishery, and the Cook Inlet salmon fishery. Direct payments of $3.2 million and $4.6 million were made to commercial fishermen from the Yukon-Kuskokwim Region and the Cook Inlet Region, respectively. The allocations of the relief funds to these two regions were determined by the relative losses in the ex-vessel revenues arising from the disaster in the two regions (National Marine Fisheries Service, 2014). However, the allocation of disaster relief payments is calculated based only on a permit holder's gross receipts, not on their net income levels. The allocation does not consider income losses for crew members, input suppliers and seafood processors in affected communities.

In January 2015, the federal government approved the second round of relief funds, totaling $13 million, to be awarded to businesses and governments in the regions. Of this, $4.5 million will be paid to the recreational fishing sector (sport fishing guides and related businesses), $7.5 million for disaster research, restoration, education, gear replacement/modification, and outreach ($6.4 million for the Yukon/Kuskokwim region and $1.1 million for Cook Inlet), and $700,000 to commercial buying stations and salmon buyers in the Cook Inlet area (National Marine Fisheries Service, 2015).

The salmon failures and the federal relief payments will generate two different types of effects on the economies of the regions depending the salmon fisheries. The salmon failures will lead to reduced fish harvesting and processing activities, and produce negative economic impacts. The negative economic impacts will occur not only in the Alaska communities that rely on the fisheries but in non-Alaska regions which export a large quantity of inputs to the salmon fishing industry (and other fishing industries) in Alaska. For example, if a fishing vessel buys nets directly from a company in Seattle or if a processing plant in Alaska purchases boxes from a company in Seattle, then this will generate economic impacts in the Seattle area. Also, if a processing worker spends most of his/her income earned from working in Alaska in his/her home state of Washington, the economic impacts will be produced in that state. In this case, a single-region model for Alaska would not be able to calculate the economic impacts occurring in the non-Alaska regions.

However, the federal relief payment to the stakeholders affected by the fishery failures will generate some positive economic impacts. These impacts will occur in Alaska and elsewhere in the country because not all of the fishermen (permit holders) who receive a relief payment live in Alaska, and therefore, the spending of the federal relief funds will occur both in Alaska and non-Alaska regions in United States. In this case, a single-region model would be the wrong tool to calculate the full (i.e., the total US) economic impacts from the federal relief payment because the impacts will not be limited only to Alaska.

Many previous studies of the economic impacts of fishery management and exogenous shocks use a single-region model (e.g., Seung et al., 2016). The serious limitation of a single-region model is that the model cannot estimate the economic impacts of an initial shock occurring in the regions that have strong economic ties with the original region. Therefore, the objective of this study is to calculate the multi-regional economic impacts of the commercial Chinook salmon fishery failures by using a multi-regional social accounting matrix (MRSAM) model, thereby overcoming the limitation of a single-region model.[3] In doing so, this study takes into account the effects of the first round of the federal relief funds ($7.8 million) paid to commercial salmon permit holders. Thus, this study calculates, first, the economic impacts of salmon failures only, and, then the net impacts of both salmon failures and federal disaster relief payments to permit holders. The MRSAM model has three separate regions – Alaska, West Coast (WC), and the rest of US (RUS). The regional economic impacts calculated in this study include changes in output, employment, and other variables.

The structure of MRSAM model is described in the next section. Section 3 describes the data used and Section 4 discusses the results, followed by the final section which offers some conclusions.

2. Method

2.1. Previous Approaches

The Leontief input-output (IO) model is a major tool that has been used for economic impact analysis. The model includes the transactions of intermediate inputs among industries, and so captures a major portion of linkages in a regional economy. The model is a demand-driven model in that the impacts of changes in final demand are computed. However, the demand-driven model produces biased results if used to compute the impacts from an exogenous output change without any adjustment to the model. This led some researchers (e.g., Leung and Pooley, 2002) to use a mixed endogenous-exogenous (MEE, Miller and Blair, 1985) version of the IO model, based on the argument that an MEE version of the model is a more appropriate tool than a Leontief demand-driven IO model when the output level for an industry (e.g., harvest level in fisheries) is exogenously changed and no information is available about the associated change in the final demand. Some studies used an MEE version of SAM model in order to quantify the distributional effects of policies or exogenous shocks (e.g., Roberts, 1994).

In calculating the forward-linkage effects using the MEE approach (whether they use IO or SAM framework), some studies ignore the effects because the effects are negligible while other studies use the Ghosh approach (Ghosh, 1958) to calculate the forward-linkage effects. However, the Ghosh approach has been criticized due to a serious

[3] Also, the SAM framework used in this study enables investigation of distributional effects, thereby overcoming the limitation of an input-output (IO) model.