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RETURNS ON RIGHTS: A 28-YEAR INVESTMENT ANALYSIS OF ICELAND'S ITQ QUOTAS

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Abstract. The present study analyses the return and risk profile of Permanent Quota Shares (PQS) in Iceland's Individual Transferable Quota (ITQ) fisheries management system between 1992 and 2019. The hypothetical "armchair fisherman" is defined as an investor who does not partake in fishing activities but holds PQS and leases out the associated catch entitlements. This construct was devised to assess the financial performance of quota ownership as a passive investment. PQS represent tradable rights to a fixed share of the Total Allowable Catch (TAC), with the potential to generate returns through both capital gains and annual lease income. The objective of this research is to examine PQS as investment instruments by comparing their performance to major domestic and international asset classes. The analysis uses a 28-year dataset covering Iceland's five most valuable demersal species – cod, haddock, saithe, redfish and Greenland halibut – to apply standard financial metrics, including average return, standard deviation and the Sharpe ratio. The results demonstrate that an investor adopting an armchair fishing strategy would have achieved an average annual return of 21.6%, with a Sharpe ratio of 0.72. This significantly outperforms equities, bonds, and other benchmarks. The analysis employs a 28-year dataset encompassing Iceland's five most valuable demersal species – cod, haddock, saithe, redfish and Greenland halibut – to implement standard financial metrics, including average return, standard deviation and the Sharpe ratio. The findings indicate that an investor who had adopted a passive investment approach would have attained an average annual return of 21.6%, with a Sharpe ratio of 0.72. This investment strategy has been shown to significantly outperform traditional benchmarks such as equities and bonds. The findings demonstrate the strong financial performance of PQS and emphasise the importance of governance structures in shaping the distribution of economic rents in rights-based fisheries systems.

Keywords: permanent quota shares, individual transferable quotas, Iceland, fisheries.

JEL Classification: Q22, G11, Q20

1. Introduction

Iceland has utilised a uniform individual transferable quota (ITQ) system for the management of its fishing resources since 1990 (Árnason, 1993). ITQ systems are a form of fisheries management in which the regulator establishes a species-specific Total Allowable Catch (TAC), which is subsequently divided into Permanent Quota Shares (PQS) allocated to individual fishing companies. These permanent quota shares are subject to purchase and sale, with the "T" in "ITQ" denoting their transferability. Moreover, the leasing of permanent quota shares, customarily for a period of one year, is generally permitted (Buck, 1995).

The implementation of ITQ systems was originally initiated in 1976 in the Netherlands (Hoof, 2013). As time has elapsed, an increasing number of countries have adopted this management system. New Zealand was the first country to implement a major management programme based on ITQ principles in 1986, followed by Iceland (Bess, 2005; Lock & Leslie, 2007). The rationale underpinning the utilisation of ITQ principles in the context of fisheries management is to enhance economic efficiency. The management systems result in what is termed "autonomous adjustment", whereby the size of the fishing fleet is adjusted to an efficient size (typically, this is substantially reduced) (Hoshino et al., 2020). The ITQ system has been demonstrated to reduce the cost of fishing and to lead to improved economic performance. Moreover, the principles of the ITQ management system generally result in increased profitability, as the incentive structure fosters enhancements in the value of landings, superior catch quality, and, consequently, elevated catch prices. The quota holder is incentivised

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to maximise revenue, which in turn drives improvements in landing quality and timing of landings to optimise prices and revenue (Birkenbach et al., 2023; Pincinato et al., 2022).

It is a commonly accepted academic premise that Permanent Quota Shares typically grant holders an indefinite right to harvest. In Iceland, each PQS represents a fixed percentage of the TAC, thereby effectively granting access to a scarce natural resource. Given the transferability and active trading of these shares, a market price is established where supply meets demand. This price is hypothesised to reflect the market's collective expectation of future profits from the species in question, discounted to account for risk. A study of New Zealand's ITQ-managed fisheries revealed a significant positive relationship between increased profitability and higher PQS prices (Newell et al., 2005). However, in his research on the Norwegian quota market, Hannesson (2017) found that the market price of permanent quotas was higher than could be explained by the profitability of the Norwegian fisheries.

No published paper has analysed the Icelandic quota markets. However, a 2007 thesis examined the factors influencing the price of PQS for cod in Iceland between 1995 and 2007. The finding was that, from 1995 to 2005, the price of PQS was determined by the industry's profitability. This changed in 2001, when a credit bubble appeared in Iceland. This bubble flooded the Icelandic economy until it burst in 2008, causing the collapse of the Icelandic banking system. These studies concluded that the bubble and increased credit were the main factors leading to a significant rise in PQS prices between 2002 and 2007 (Sævaldsson, 2007).

The relationship between risk and return is a well-studied topic in financial economics. A fundamental principle is that investors require a higher expected return to compensate for taking on more risk (Asness, 2000; Derman, 2002; Fama & French, 2004). Risk is typically measured using the standard deviation of asset returns, which reflects the volatility or uncertainty associated with an investment. In accordance with the precepts of modern portfolio theory, assets characterised by higher variance are presumed to generate higher returns over time, thus offsetting the elevated risk involved (Atkins & Ng, 2014; Khagerty, n.d.). This is a fundamental concept in finance, aimed at rendering assets attractive to rational investors. Furthermore, the covariance of an asset's returns with those of other assets plays a crucial role in determining its contribution to the overall risk of a diversified portfolio (Hussain, n.d.). Markowitz realised that risk was an important factor in portfolio formation and used variance of return as an initial risk measure (Atkins & Ng, 2014). When applied to fisheries, and specifically to PQS within an ITQ system, these principles imply that the market value and return of PQS should reflect the expected profitability of the underlying fish stocks, as well as the risks associated with catch variability, price fluctuations and regulatory uncertainty. If PQS are treated as financial assets, their risk-return profiles should be comparable to those of other asset classes. Their performance over time, particularly with regard to return volatility and correlation with traditional investments, provides an indication of how market participants perceive and price fisheries-related risk.

In light of the aforementioned theoretical background, the objective of the present study is to evaluate the risk and return profile of permanent quota shares in Iceland's ITQ-managed fisheries over the period 1992 to 2019. This paper addresses three key research questions:

1. What was the annual return of PQS for the main demersal species in Iceland during the study period?
2. What level of risk was associated with these returns, as measured by the standard deviation of annual price changes?
3. How do these returns and risks compare with those of other major asset classes available to Icelandic investors, such as stocks, government bonds and bank deposits?

This study makes a significant contribution to the existing literature by virtue of the fact that it is the first to analyse the long-term return and risk characteristics of PQS in a major fishery governed by ITQ principles. Iceland, a nation that is globally prominent in the field of fishing and has adopted ITQ-based management systems at an early stage, provides a particularly pertinent case study. With an average annual catch of approximately 1.4 million metric tons over the past two decades, Iceland's fisheries are of both economic and ecological importance. The analysis draws on a 28-year dataset (1992–2019) and focuses on the five most valuable demersal species. The combination of the length and quality of the data with the maturity of Iceland's quota system offers a robust foundation for empirical analysis. The findings are of relevance not only to fisheries economists but also to scholars and policymakers interested in resource valuation, asset performance, and sustainable marine governance.

2. The Evolution of Iceland's ITQ System: Institutions, Incentives, and Industry Transformation

Iceland's fisheries management has undergone a fundamental transformation over the past five decades, shifting from an unregulated and ecologically vulnerable sector to a leading model of rights-based resource governance. The emergence of ITQs can be seen as a response to crises, as well as a deliberate effort to align economic incentives with long-term sustainability.

This transition commenced in the aftermath of the collapse of the Atlanto-Scandian herring stock in 1968, a development that precipitated the economic downturn and brought to the fore the perils associated with unregulated fishing (Sigurdsson, 2006). The crisis led to the introduction of a TAC for Icelandic herring in 1969, followed by individual quotas in 1975 to improve efficiency (Matthíasson, 2003). In 1976, Iceland extended its exclusive economic zone (EEZ) to 200 nautical miles, thereby securing sovereign control over its fisheries following the "Cod Wars" with the United Kingdom (Guðmundsson, 2006). Nevertheless, demersal fisheries, notably those targeting cod, persistently confronted challenges such as overfishing and economic inefficiencies (Gunnlaugsson & Valtýsson, 2022). The implementation of effort controls, including the imposition of restrictions on fishing days (skrapdagakerfið), has been demonstrated to be an ineffective measure. In 1984, vessel-specific Individual Quotas (IQs) were introduced, based on historical catches. However, the coexistence of IQs and effort-based rules limited their effectiveness (Daníelsson, 1997). A significant reform was instigated in 1990 with the implementation of a uniform ITQ system across the majority of commercial fisheries (Árnason, 1993). The new system eliminated effort-based alternatives and allowed quota transferability, thereby establishing a market for fishing rights (Oostdijk et al., 2019).

Transferability has been shown to facilitate more efficient allocation by enabling productive firms to consolidate quotas and expand operations. This dynamic has precipitated the emergence of larger, vertically integrated enterprises that engage in self-fishing, processing, and marketing of their own quota. These firms gained control over the entire value chain, from harvesting to final sale, thereby reducing seasonality, stabilising supply, and improving product quality. These developments were supported by institutional reforms. The introduction of deregulated fish auctions in 1986 has been demonstrated to engender enhanced price transparency and coordination. Despite the fact that only 20–30% of demersal landings are auctioned, these markets have exerted a significant influence on pricing and logistics. The combination of ITQs and auctions has been demonstrated to encourage specialisation and enable producers to target premium export markets, especially in Europe (Knútsson et al., 2016).

Iceland's transition from a crisis-ridden fisheries management model to a rights-based one exemplifies the transformative power of ITQs. By aligning economic incentives with sustainability, the sector has been revitalised. A key outcome has been the creation of PQS, which can be considered a distinct asset class. As this paper demonstrates, PQS have delivered higher returns than many traditional investments, highlighting the economic and ecological value of a well-designed ITQ system.

3. Literature Review

In recent decades, Individual Transferable Quotas (ITQs) have become a prominent fisheries management strategy (Squires et al., 1995; Hoshino et al., 2020). The objective of these systems is to mitigate the issue of overfishing and enhance efficiency by allocating long-term, tradable harvesting rights to individuals, vessels or firms (Hoshino et al., 2020). Several countries, including New Zealand and Iceland, have adopted ITQs with the objective of promoting sustainability and improving economic outcomes (Árnason, 1993; Gunnlaugsson et al., 2021; Lock & Leslie, 2007; Mace et al., 2014). In Iceland, the majority of fisheries have been subject to ITQs since 1990, resulting in substantial improvements in economic efficiency (Árnason, 1993).

A significant area of research has been the economic impact of ITQs. Research indicates that such systems can enhance operational efficiency, promote consolidation, and result in increased profits through optimised vessel utilisation and enhanced product quality (Hoshino et al., 2020). In Iceland, studies have found that the introduction of ITQs helped reduce excess fishing effort and contributed to a more profitable and professionalised fishing industry (Árnason, 1993; Knútsson et al., 2016).

The pricing of PQS in quota markets has also been explored. Research in New Zealand found that the value of quota shares closely tracked the expected future profitability of fishing operations (Newell et al., 2005, 2007). However, it has been suggested that quota prices in Norway were sometimes higher than could be justified by actual earnings, potentially indicating the influence of factors beyond immediate profitability (Hannesson, 2017). Sævaldsson (2007) observed comparable trends in Iceland, where quota prices increased rapidly during the early to mid-2000s. This was probably due to a credit boom rather than actual profitability.

Another important feature of ITQ systems is the leasing of quotas. This enables quota owners to generate income without fishing themselves while granting others access to catch rights. Studies have shown that lease prices reflect both short-term market conditions and the biological state of fish stocks (León et al., 2015). This means that, similar to how some real assets behave, quota ownership can produce two sources of return: capital appreciation and lease income. However, the economic benefits and impacts of quota leasing are highly controversial subjects of ongoing discussion (Pinkerton & Edwards, 2009).

Nevertheless, there are significant differences between quota shares and financial assets. PQS

represent access rights to a public resource and are subject to rules that do not apply to stocks or bonds. In Iceland, for example, the Veiðiskylda rule requires quota holders to actively fish over 50% of their quota, thereby limiting purely speculative holdings. Some scholars have highlighted that the regulatory and ecological context of ITQs distinguishes them significantly from standard securities (Hoshino et al., 2020). In light of these distinctive features and the growing significance of PQS as capital assets, a thorough empirical investigation of their investment performance is warranted.

Despite the growing prevalence and acceptance of ITQs, there is a continued need for critical examinations of their distributional effects, ecological impacts and long-term socio-economic consequences. Beyond economics, there is also an increasing discussion about the social and political implications of ITQs. Some researchers argue that these systems can lead to the concentration of wealth and access rights, particularly when quotas are permanent and fully tradable (Byrne et al., 2024; Eythórsson, 1996). In Iceland, concerns have been raised for years that the value generated from fishing may not be shared fairly with the public (Lebedef & Chambers, 2023). The concentration of quota holdings has increased (Agnarsson et al., 2016; Byrne et al., 2020), raising questions about equity, public benefit and the legitimacy of privatised access to a shared natural resource. In the absence of redistributive measures, the gains accrue directly to private holders.

In recent years, scholars have begun using tools from financial economics to gain a better understanding of natural resource assets. Measures such as the Sharpe ratio and return volatility provide insight into how investors perceive risk and value in fisheries. The Sharpe ratio is a widely used tool for evaluating investment performance (Rivin, 2018). Nevertheless, long-term studies are rare and little research has been conducted into how quota returns in fisheries compare with other asset classes over time. This study aims to address this by analysing a 28-year dataset on Iceland's demersal quotas, with a focus on both returns and risk.

4. Methodology and Data

The present study has evaluated the financial performance of Permanent Quota Shares (PQS) in Iceland's ITQ-managed demersal fisheries from 1992 to 2019. The concept of a hypothetical "armchair fisherman" is posited, which is defined as an investor who does not partake in fishing activities but holds PQS and leases out all of the associated catch entitlements. The purpose of his return is to evaluate the financial performance of quota ownership as a passive investment. The present study sets out to compare the returns of PQS with those of five different asset classes available to investors in Iceland. These classes include domestic equities, long-term government bonds, short-term bank deposits, U.S. Treasury bills (converted to Icelandic krona (ISK)), and international equities (in ISK). The key financial metrics that are employed in this study include average annual return, standard deviation, and Sharpe ratio.

In Iceland, each PQS represents a fixed share s of the Total Allowable Catch (TAC) for a given species. This study calculates the return from holding a 1% quota share annually for each species. The corresponding harvestable volume in year t is given by:

$$Q_t = 0.01 * TAC_t$$

where Q_t is the number of kilograms tied to 1% of the TAC in year t, and TAC_t is the total allowable of the species catch set by fisheries authorities. The total return from PQS is composed of two parts: capital gains, which reflect changes in the market value of the quota due to fluctuations in TAC and the price per kilogram, and lease income, derived from leasing the quota to active fishers.

The capital return in year *t* is defined as:

$$R_t^{capital} = (Q_t \times P_t) / (Q_{t-1} \times P_{t-1}) - 1$$

where P_t is the market price per kilogram of quota at the end of year *t;* Q_t is the quota volume in kilograms associated with a 1% share in year *t* and $Q_{t-1} \times P_{t-1}$ is the market value of the 1% share in the previous year. The total return also includes lease income received over the year. Let L_t be the average lease price per kilogram in year *t*. The lease yield component is:

$$R_t^{lease} = (Q_t \times L_t) / (Q_{t-1} \times P_{t-1})$$

The total return from holding a 1% PQS is:

$$R_t = (1+R_t^{capital}) \times (1+R_t^{lease}) - 1$$

This formulation captures both price and quantity changes over time and reflects the dual-income nature of PQS: capital appreciation and lease revenue.

Price and lease data were compiled from a variety of sources, including the Central Bank of Iceland, the Directorate of Fisheries, government documents, institutional archives, and industry bulletins. In the absence of a central historical quota price database, particularly in the early years, data reconstruction involved cross-verification and interpolation techniques. The finalised dataset encompasses a 28-year period, encompassing five key demersal species: cod, haddock, saithe, redfish, and Greenland halibut. The asset class comparison data were obtained from Nasdaq Iceland, the Central Bank of Iceland, and Bloomberg. The returns on Icelandic stocks and bonds were derived from official indices and yield data. The REIBID interest rate was established as the domestic risk-free rate. The returns on U.S. Treasury bills and the MSCI World Index were converted to ISK at the prevailing annual exchange rates. It is imperative to note that all returns are of a nominal nature.

In order to evaluate risk-adjusted performance, the Sharpe ratio was calculated.

$S = (\bar{R} - R_f) / \sigma$

where $\bar{R}$ is the average annual return on the asset; R_f is the average annual risk-free rate (REIBID) and σ is the standard deviation of returns. The Sharpe ratio is a standard measure of return per unit of risk and allows direct comparison between PQS and conventional financial assets.

A fundamental constraint pertains to the reconstructed nature of the PQS price and lease series. Despite the meticulous efforts made to ensure the accuracy of the data, a certain degree of estimation error is inevitable, particularly with regard to the early 1990s. Furthermore, the liquidity of quota markets was found to vary over time, thereby impacting the reliability of prices. Notwithstanding, the present study provides the first long-term empirical analysis of PQS as financial assets under a mature ITQ regime.

5. Results

Table 1 summarises the performance of a hypothetical investor who maintained an equally weighted portfolio of PQS across five demersal species (cod, haddock, saithe, redfish and Greenland halibut) between 1992 and 2019. The returns are broken down into capital appreciation (price changes) and rental income (lease yield). The table also shows the standard deviation of annual returns to illustrate risk, and calculates the Sharpe ratio using the Icelandic risk-free rate (REIBID) as a benchmark.

These results reveal several notable trends. Firstly, PQS performed remarkably well as an investment, delivering an average annual return of 21.6% over the entire 28-year period. This figure is particularly striking when compared to that of traditional financial assets, as will be discussed later. Secondly, both components of the total return – price appreciation and lease yield – contributed significantly. The mean proportion of returns attributable to capital gains was 8.2 percentage points, whereas the mean proportion attributable to lease yield was 12.4 percentage points. This relatively even split serves to emphasise the dual-income nature of PQS, bearing resemblance to dividend-paying stocks in that they offer both growth potential and a steady cash flow.

Thirdly, significant variation was observed across sub-periods. The highest returns were recorded in the early years of the ITQ system. This is likely to have reflected the initial phase of efficiency gains and structural adjustments, as well as positive investor sentiment as the market matured. The perception that the ITQ system was permanent also reduced risk, thus increasing the prices of the PQS. The worst period for performance was 2006–2012, which was dominated by the global financial crisis and the collapse of the Icelandic banking system in 2008. During this time, PQS prices collapsed, though leasing income remained relatively stable, which offset the downturn to some extent. Notably, the period from 1999 to 2005 saw a high return (25.6%) alongside very low volatility (a standard deviation of just 4.9%), resulting in an exceptionally high Sharpe ratio of 3.52.

Table 2 shows the disaggregated return data for the five demersal species analysed in this study. The results show that the average returns are relatively similar across species, with cod yielding the highest and saithe the lowest. Cod is the most economically significant species in Icelandic fisheries, forming the basis of much fishing activity. Its high profitability has led to intense demand for quotas, with vessels often facing constraints due to scarcity. Sometimes, they even have to avoid catching cod in order to remain within legal limits. In contrast, saithe is more challenging to harvest, and the Icelandic fleet has failed to catch the full total allowable catch (TAC) for this species in several years. This underutilisation likely explains the comparatively low return on saithe PQS.

In the context of the study, cod was identified as the most attractive individual asset, offering the highest return (23.8%) and the lowest risk among the five species. Cod is the cornerstone of Icelandic fisheries, accounting for over one-third of total catch value. Its consistent economic performance underlines its dominant role in the quota market. By contrast, redfish exhibited an unusually high lease yield (15.7%), but the lowest capital appreciation (3.6%). Saithe and haddock had similar profiles, with moderate capital growth

Table 1
Performance of an Equally Weighted PQS Portfolio, 1992–2019

Period	Total return	Capital return	Lease return	Std. dev.	Sharpe ratio
1992–1998	28.1%	10.8%	15.6%	22.9%	0.90
1999–2005	25.6%	12.3%	11.8%	4.9%	3.52
2006–2012	18.2%	4.3%	13.3%	28.5%	0.32
2013–2019	20.8%	10.6%	9.2%	17.8%	0.92
1992–2019	21.6%	8.2%	12.4%	20.0%	0.72

Sources: author's calculations based on data from the Directorate of Fisheries, Central Bank of Iceland, and reconstructed quota and lease price series from public and industry records

Table 2
Return characteristics by demersal species, 1992–2019

Species	Total return	Capital return	Lease return	Std. dev.
Cod	23.8%	10.8%	11.8%	25.3%
Haddock	20.6%	8.6%	11.1%	27.7%
Saithe	19.6%	8.7%	10.0%	30.4%
Redfish	19.9%	3.6%	15.7%	30.2%
Greenland halibut	22.5%	8.0%	13.5%	34.4%

Sources: author's calculations based on data from the Directorate of Fisheries, Central Bank of Iceland, and reconstructed quota and lease price series from public and industry records

and stable lease yields. Greenland halibut showed the highest risk.

Table 3 benchmarks the performance of PQS against that of major alternative investments in both the Icelandic and international contexts. Several key insights emerge from this comparison. Firstly, PQS substantially outperformed all other asset classes in terms of average annual return. The closest competitor, international stocks (in ISK), offered a return of just 10.8%, less than half that of PQS. Secondly, PQS also delivered robust risk-adjusted returns, as evidenced by its Sharpe ratio of 0.72, surpassing all other asset classes by a significant margin.

The performance of the Icelandic stock market between 1992 and 2019 was notable for its volatility. The collapse of the banking sector in 2008, which saw the main stock index decline by 94.4%, severely affected long-term returns. This reduced the average annual return on Icelandic equities to just 2.5%, producing a negative Sharpe ratio of -0.15. Excluding 2008, the average return increases significantly to 14.1%, but remains well below the returns generated by PQS. U.S. Treasury bills, which are usually considered a safe investment, performed poorly in Icelandic krónur due to currency fluctuations. This highlights the risks of holding foreign-currency assets in a volatile macroeconomic environment.

6. Discussion

The findings of this study reveal that Permanent Quota Shares (PQS) in Iceland's The Individual Transferable Quota (ITQ) fisheries system yielded remarkably high financial returns over the 1992–2019 period. Utilising a robust statistical framework, this study finds that PQS exhibited an average annual return of 21.6% and a Sharpe ratio of 0.72. This performance surpassed that of all major domestic and international benchmarks, including equities and bonds. These figures underscore the potential of quota rights to function as investment-grade assets. However, PQS are not conventional securities. These rights are predicated on conditions and the utilisation of a public resource, and are embedded withina legal and ecological management regime. As Árnason (1993) and Daníelsson (1997) emphasise, Iceland's ITQ system was designed to promote economic efficiency while preserving resource sustainability, and includes constraints such as the veiðiskylda, which mandates that a large share of quota holdings must be fished by the owner or associated operators. This obligation serves to limit the scope of speculative ownership, thereby contributing to an understanding of why PQS, despite their financial profitability, remain firmly embedded within regulatory and operational constraints.

The robust performance evident in this study should not be interpreted in isolation. This phenomenon is indicative of broader structural and economic developments in Icelandic fisheries. It is evident that over the past three decades, the sector has experienced a period of sustained profitability. This can be attributed to three key factors: firstly, technological modernisation; secondly, industry consolidation; and thirdly, enhanced market orientation. Gunnlaugsson and Valtýsson (2022) observe that the ITQ system

Table 3
PQS vs. benchmark asset classes, 1992–2019

Asset class	Avg. return	Std. dev.	Sharpe ratio
International stocks (ISK)	10.8%	15.4%	0.23
Icelandic stocks (incl. 2008)	2.5%	32.4%	-0.15
Icelandic stocks (excl. 2008)	14.1%	25.2%	0.27
Risk-free (REIBID)	7.3%	3.1%	—
Icelandic gov. bonds (long-term)	8.8%	4.8%	0.31
U.S. T-bills (ISK)	5.2%	21.8%	-0.10
Equally Weighted PQS Portfolio,	21.6%	20.0%	0.72

Source: author's calculations based on Nasdaq Iceland indices, Central Bank of Iceland Bloomberg (for international assets), and official exchange rates

has been successful in generating wealth and ensuring biological sustainability. However, these gains have not been universally welcomed across Icelandic society. As Knútsson et al. (2016) also demonstrate, improvements in value-chain efficiency and export prices are identified as key drivers of enhanced economic returns. These developments were capitalised into quota prices, particularly during periods of cheap credit. The high returns calculated for the hypothetical "armchair fisherman" are therefore not anomalies, but rather a financial reflection of an increasingly profitable and industrialised sector.

Nevertheless, there are manifest indications that these exceptional returns may not persist indefinitely. It is evident that the economic efficiency gains from the ITQ reform process have already been realised, and total allowable catches (TACs) for key species are stable. As the sector matures, the potential for further capital appreciation in quota prices is likely to diminish. Byrne et al. (2024) posit that Iceland's quota system manifests features indicative of a transitional gains trap, wherein early adopters accrue substantial windfall benefits that subsequent participants are unable to replicate. This framework suggests that the era of double-digit capital gains for PQS holders may be drawing to a close, replaced by more modest returns aligned with stable biological and operational conditions. Conversely, it is anticipated that lease income will continue to serve as a dependable source of return on investment. Nevertheless, the financialisation of quota rights gives rise to significant distributional concerns. Eythórsson (1996) was among the first to issue a warning that the ITQ system risked marginalising coastal communities and concentrating benefits among absentee owners. Subsequent studies by Agnarsson et al. (2016) and Byrne et al. (2020) have confirmed these dynamics, showing a high degree of quota concentration.

The 'armchair fisherman' created in this study is a hypothetical figure designed to evaluate the financial returns of quota ownership, independent of fishing activity. While this model illustrates the investment characteristics of PQS, it does not represent the typical Icelandic quota holder. The veiðiskylda rule, which requires that a significant proportion of allocated quota be fished, limits the extent to which purely passive ownership is permissible under current legislation. Consequently, the armchair fisherman remains an analytical exception rather than a common feature of the system. Nevertheless, this scenario highlights ongoing debates about quota leasing, absentee ownership and the distribution of resource rents within the ITQ framework.

More broadly, the findings highlight the strengths and ongoing challenges of Iceland's rights-based fisheries management approach. The ITQ system has delivered notable benefits, including increased profitability, greater biological sustainability and improved operational efficiency. However, these gains have coincided with increased quota concentration. Although passive rent extraction is structurally constrained, perceptions of inequity, especially in coastal communities, remain politically salient. As the sector matures with slower capital growth, there may be greater scope for policy to address distributional imbalances without undermining the system's core efficiency. Tools such as rent taxation, community-based quota allocations or targeted redistributive measures could help to align private returns more closely with the public interest, thereby strengthening the long-term legitimacy of the ITQ regime.

These results also have implications for future research. It is necessary to gain a better understanding of the long-term financial dynamics of quota systems under stable conditions, including how market expectations adapt when growth potential plateaus. Moreover, comparative work on leasing markets, rent distribution, and governance responses across ITQ regimes (e.g., New Zealand or Norway) has the potential to illuminate policy pathways for maintaining legitimacy in mature fisheries systems. The Icelandic case demonstrates that even a quota system that has achieved global acclaim must evolve if it is to maintain its broad-based support in an era of consolidation and capital saturation.

7. Conclusions

The present paper is an inaugural attempt to undertake a comprehensive financial evaluation of Permanent Quota Shares (PQS) in Iceland's ITQ-regulated demersal fisheries. This evaluation encompasses a longitudinal perspective, extending from 1992 to 2019. The analysis demonstrates that PQS consistently yielded high returns over a period of nearly three decades, with average annual returns of 21.6%. This return was driven by rising asset values and stable lease income, and it surpassed the performance of all other major asset classes available to Icelandic investors, including equities and government bonds.

The results at the species level confirm that PQS returns were strong across all five demersal stocks analysed. The analysis indicates that cod quota shares delivered the highest returns with relatively low volatility, reflecting the species' ecological resilience and central role in Iceland's catch profile. Greenland halibut and redfish PQS exhibited higher yield-based income but more modest capital gains, indicating divergent risk-return profiles among different species.

The findings of this study suggest that, within the context of a well-established ITQ system, quota shares have the potential to function as high-performing real assets. The evidence presented in this paper further validates the economic rationale underpinning

ITQ-based governance, demonstrating that by assigning secure, tradable harvest rights, the system has attracted investment, encouraged operational efficiency, and delivered consistent economic returns.

In conclusion, PQS represent a form of access right with the potential to mature into a distinct asset class. The long-term performance of these fisheries provides a compelling illustration of the potential of rights-based fisheries management to not only ensure the sustainability of fish stocks but also to generate significant private returns. The experience of Iceland serves as a valuable point of reference for policymakers and researchers assessing the financial and governance dimensions of transferable quota systems.

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