ACEI Working Paper Series

DEMOGRAPHIC AND ECONOMIC ANALYSIS OF ESPORTS – TRENDS, CAREER LONGEVITY, AND EARNINGS DYNAMICS

Thomas Newham
Tim R.L. Fry

AWP-04-2025

Date: August 2025

Demographic and Economic Analysis of Esports - Trends, Career Longevity, and Earnings Dynamics

Presented at the 23rd International Conference on Cultural Economics, Erasmus University Rotterdam

Author information

Dr. Thomas Newham, Nottingham Trent University (Department of Economics), Nottingham (Nottinghamshire), United Kingdom (corresponding author: tom.newham@ntu.ac.uk)
https://orcid.org/0000-0002-8349-5760

Dr. Tim R.L. Fry, Nottingham Trent University (Department of Economics), Nottingham (Nottinghamshire), United Kingdom
https://orcid.org/0000-0002-3763-5152

JEL Classification L83, J24, Z10, L86

Keywords Esports, Cultural Economics, Labour Markets, Demographics, Digital Transformation, Superstar Effect

Abstract
Esports has emerged as a significant facet of global culture and the creative economy, rivalling traditional sports in scale and economic impact. This paper provides a comprehensive analysis of the demographic and economic dimensions of competitive gaming, exploring its evolution as a cultural phenomenon. We investigate the role of cultural and geographic contexts in shaping the esports ecosystem, examining how regional preferences and socio-economic factors influence player representation and market dynamics. The global dispersion of esports players highlights the industry's ability to transcend traditional cultural boundaries, fostering diverse participation while reflecting unique regional characteristics. By analysing data from 846 players across sixty-five countries, the study uncovers patterns of cultural consumption and the economic impacts of esports in varying global contexts. These insights contribute to a deeper understanding of esports as both a localised and globalised cultural phenomenon with significant economic implications. The study employs fixed-effects regression models, to investigate player earnings trajectories, geographic diversity, and age-related career dynamics. Key findings include the identification of a non-linear relationship between age and earnings, with peak earnings around the mid-twenties, a decline in the mid-thirties, and a subsequent rise post-thirty-five, arguably driven by a "Superstar Effect." Additionally, the study explores how cultural factors influence the sustained success of older players in strategic and cognitively demanding games such as StarCraft and chess. These findings challenge conventional assumptions about career longevity in esports and offer nuanced insights into the interplay of talent, notoriety, and cultural capital.

1 Introduction

Esports, once a peripheral pursuit, has evolved into a major sector of the global entertainment industry, rivalling traditional sports in economic scale and cultural influence. Initially rooted in informal competitions and single-player experiences, esports has undergone rapid professionalisation, marked by the emergence of structured tournaments, sponsorships, and formal teams. Driven by revenue streams such as advertising, sponsorship, media rights, and merchandise, esports is expected to reach a global audience of 640 million by 2025, with revenues nearing $1.38 billion in 2022 (Fitch, 2022). This growth has enabled esports to transcend physical and geographic boundaries, attracting a diverse global audience. Esports now occupies a prominent position within the creative economy, blending elements of sport, entertainment, and digital innovation. Professional players have become cultural icons and influencers, shaping community norms and digital identities. Hamari and Sjöblom (2017) describe esports as "a form of sports where the primary aspects are facilitated by electronic systems", capturing its technologically mediated essence. In this space, competitors are also media figures and brand creators, contributing to a broader shift in how cultural capital is produced and distributed online. The esports workforce reflects broader trends within digital labour markets, characterised by precarity, competition, and self-exploitation. Johnson and Woodcock (2021) argue that esports has "created new labour processes and forms of work", echoing de Peuter's (2014) depiction of cultural workers as “self-reliant, risk-bearing, non-unionised, self-exploiting, always-on.” Most competitors are young men aged 18–34 (Sinclair, 2020), but gender and geographic diversity are increasing, particularly in regions such as China and South Korea (Yu et al., 2022; Nagorsky & Wiemeyer, 2020). The professionalisation of esports has created career pathways beyond playing**,** including coaching, analysis, event management and content creation though players face challenges such as mental strain, physical demands, and career brevity (DiFrancisco-Donoghue et al., 2019; Lee, 2022).
This paper analyses the demographic and economic dimensions of esports. Using data from 846 players across 65 countries, we examine patterns in earnings, career longevity, and geographic diversity. Applying fixed effects regression models, we identify key trends in age-related earnings and propose explanations for continued financial success among older players. These findings contribute to a deeper understanding of esports as both a cultural and economic phenomenon.

1.1 The Cultural and Sociological Impact of Online Gaming

Gaming has fundamentally transformed from simple entertainment into a cultural phenomenon that shapes how people interact, communicate, and form communities. Major games like World of Warcraft and Fortnite have become more than just games - they're social spaces where players build relationships and develop shared identities. The rise of virtual worlds and metaverses has pushed gaming even further beyond traditional boundaries, creating hubs for socializing and economic activity. As Cheng et al. (2022) and Hogan-Hennessy et al. (2022) demonstrate through their research, we can see this clearly in platforms like Roblox and Second Life, where vibrant virtual economies have emerged and become intertwined with broader cultural and financial systems.

The rise of platforms like Twitch and Discord has expanded gaming communities, fostering distinct languages, norms, and microcultures through ongoing interaction between streamers and audiences (Flores-Saviaga et al., 2020). These participatory environments have reshaped how online communities engage and form social bonds. The COVID-19 pandemic further accelerated this shift, with record-

breaking user activity on platforms like Steam during lockdowns, underscoring gaming's central role in digital leisure. An empirical analysis of Unity and Steam telemetry data confirms unprecedented global engagement levels during this period (Zendle et al., 2023). While this surge facilitated social connection and escapism, it also raised concerns about unregulated play and its psychological implications, as highlighted by contemporaneous academic discourse on disordered gaming.

Virtual gaming spaces now serve not only as entertainment hubs but also as venues for collaboration, creativity, and political discourse (Cheng et al., 2022). These broader gaming trends have directly influenced the esports landscape. The cultural momentum surrounding gaming has amplified esports' popularity and global reach, while increased online engagement has expanded both its audience and talent pool. The integration of virtual worlds and platforms into competitive gaming marks a significant evolution in how people experience esports, solidifying its position as an integral part of contemporary global culture.

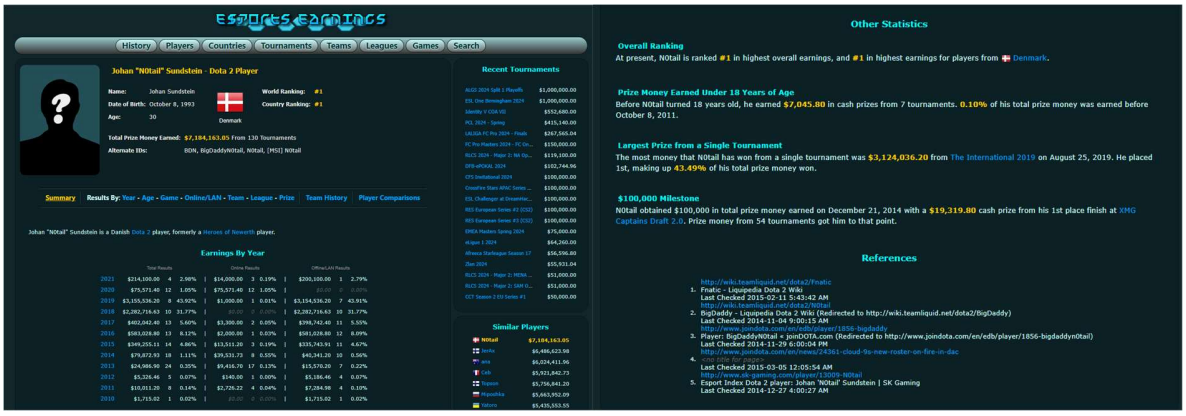
2 Esports and Data

Data availability in esports remains inconsistent and fragmented, complicating academic research. Definitions of what constitutes an "esports event" vary widely across platforms, with little consensus on inclusion criteria such as prize money thresholds, game format, or audience scale. Historical data, particularly prior to 2010, is sparse and irregularly categorised, which limits longitudinal analysis. Additionally, player statistics are often proprietary; companies like Activision-Blizzard rarely release full datasets on participation or performance.
This lack of standardisation is compounded by the industry's rapid evolution. New games, formats, and metrics emerge frequently, with fluctuating viewer and player engagement. The diversity of platforms and measurement criteria hinders reliable cross-comparison between titles, tournaments, and regions. These challenges underscore the need for more consistent, centralised data collection within the esports ecosystem.

One useful workaround is the crowd-sourced platform *esportsearnings.com*, which compiles tournament results, player profiles, and prize money figures across over 60,000 events. Though its community-driven model raises questions of accuracy, most data points are verified and transparently sourced. The site ranks games by total prize earnings, with *Dota 2* exceeding $347 million, followed by *Fortnite* and *Counter-Strike: Global Offensive*. These figures illustrate the industry's concentrated economic structure and its reliance on a small number of high-reward titles.

Player earnings profiles, available for over 130,000 individuals, provide valuable insights into the distribution of financial success. Top competitors such as Johan "N0tail" Sundstein and Kyle "Bugha" Giersdorf exemplify the economic potential of elite esports careers. A typical player profile includes total earnings, top games played, national origin, and individual tournament results, as shown in Figure 1 below. Despite some limitations, *esportsearnings.com* remains the most comprehensive public source for longitudinal esports earnings data, and serves as the backbone for the quantitative analysis in this paper.

Figure 1 – Esports Earnings Player Profile Example



3 Existing literature

The esports industry has increasingly drawn scholarly attention across economics, career development, and cultural studies. Economically, esports diverges from traditional sports in key ways. Mangeloja (2019) and Rosen (1981) highlight the prevalence of the “superstar effect,” whereby a small number of elite players attract disproportionate earnings and fan attention. Franck and Nüesch (2012) extend this by arguing that popularity can outweigh skill in determining financial outcomes, echoing Rosen and Sanderson’s (2000) broader analysis of labour markets in professional sports. Simmons (2022) supports this view, noting that granular performance metrics unique to esports allow for detailed insights into wage determination. Hodgson (2022) adds that affiliations with movements or subcultures can shape career success by reinforcing identity and brand capital, suggesting esports careers are situated within broader creative economies.

Career sustainability has also emerged as a critical area of concern. Esports professionals typically face shorter career spans than traditional athletes due to cognitive and physical demands. Smithies et al. (2020) suggest that the intense skill development involved may be transferrable to post-competitive careers, but career transitions remain fraught. Hong and Hong (2023) report difficulties players face in moving on from competition, while Meng-Lewis et al. (2022) apply Chaos Theory of Careers to illustrate the unpredictable and non-linear nature of career progression in esports. Mental health and burnout further complicate career longevity. Poulus et al. (2024) show that avoidance-based coping strategies are associated with burnout, while problem-focused approaches are linked to resilience. These findings mirror Hodgson’s (2011) research on artists' career trajectories, which suggests that external shocks and internal psychological responses shape long-term success in creative fields.

Beyond economics and career dynamics, esports operates as a cultural system. Hamari and Sjöblom (2017) identify spectatorship motives grounded in identity, community, and shared meaning. Online platforms have widened access and reduced barriers to entry, as shown by Nagorsky and Wiemeyer (2020), who find increasing demographic diversity among players and audiences. The incorporation of traditional games such as chess into esports (Taylor-Hill, 2022) highlights the convergence of digital and analogue cultures. Hodgson (2022) explores how group affiliation and collaboration influence success, resonating with esports' team-based models. Galbraith and Hodgson (2015) further demonstrate how public valuation of creative work evolves across a career, offering a useful parallel to fluctuating esports earnings and reputation.

Together, these studies underscore the interdisciplinary significance of esports. As a site of labour, identity, and innovation, esports mirrors broader shifts in how cultural work is performed and valued in a digital age.

4 General data analysis

This section analyses the demographic and participatory characteristics of 846 esports players, drawing insights from their birth year, games played, and nationalities. The data, sourced from the 'competitors' tab of esportsearnings.com (which provided 846 players with recorded birth dates out of the top 1000), has been categorized by game genre.

4.1 Demographics

The dataset of 846 esports players reveals significant trends in age distribution, as shown in Figure 2. Birth years range from 1981 to 2007, with most players born between 1990 and 2002. The most frequent birth year is 1998 (9.69% of the sample)

Figure 2 - Year of Birth Distribution of Esports Players.

Year Born	Frequency	Percent	Cumulative Percent
1981	1	0.12	0.12
1982	2	0.24	0.35
1984	2	0.24	0.59
1985	3	0.35	0.95
1986	5	0.59	1.54
1987	8	0.95	2.48
1988	13	1.54	4.02
1989	18	2.13	6.15
1990	26	3.07	9.22
1991	37	4.37	13.59
1992	43	5.08	18.68
1993	39	4.61	23.29
1994	64	7.57	30.85
1995	63	7.45	38.3
1996	48	5.67	43.97
1997	58	6.86	50.83
1998	82	9.69	60.52
1999	66	7.8	68.32
2000	65	7.68	76
2001	52	6.15	82.15
2002	55	6.5	88.65
2003	40	4.73	93.38
2004	27	3.19	96.57
2005	18	2.13	98.7
2006	8	0.95	99.65
2007	3	0.35	100

Game participation data from the dataset lists involvement across forty different titles, as shown in Figure 3. Dota 2 is the most popular game, played by 23.29% of the sample, followed by Counter-Strike 2 (12.53%) and League of Legends (6.86%). Some games, such as Assetto Corsa Competizione, StarCraft II, and Stormgate, have minimal representation with only one player each. This indicates a diverse range of interests within the esports community, though a few titles dominate the market

Figure 3 - Distribution of esports Players by Game Played

Game Played	Frequency	Percent	Cumulative Percent
Age of Empires	4	0.47	0.47
Apex Legends	10	1.18	1.65
Arena of Valor	51	6.03	7.68
Assetto Corsa Competizione	1	0.12	7.8
Battlegrounds Mobile	43	5.08	12.88
Brawl Stars	2	0.24	13.12
CS:GO	29	3.43	16.55
Call of Duty	39	4.61	21.16
Chess.com	7	0.83	21.99
Clash Royale	3	0.35	22.34
Counter-Strike 2	106	12.53	34.87
CrossFire	14	1.65	36.52
Dota 2	197	23.29	59.81
EA Sports FC 24	8	0.95	60.76
StarCraft II	1	0.12	60.87
Fighting Game	8	0.95	61.82
Fortnite	52	6.15	67.97
Free Fire	3	0.35	68.32
Gears 5	1	0.12	68.44
Halo	13	1.54	69.98
Hearthstone	2	0.24	70.21
Hyper Scape	1	0.12	70.33
League of Legends	58	6.86	77.19
Overwatch 2	7	0.83	78.01
PUBG	31	3.66	81.68
Quake	3	0.35	82.03
Rainbow Six Siege	34	4.02	86.05
Rennsport	3	0.35	86.41
Rocket League	37	4.37	90.78
SMITE	6	0.71	91.49
Shadowverse	2	0.24	91.73
Smash	4	0.47	92.2
Sports Video Game	1	0.12	92.32
StarCraft II	34	4.02	96.34
StarCraft: Remastered	8	0.95	97.28
Stormgate	1	0.12	97.4
Teamfight Tactics	1	0.12	97.52
VALORANT	13	1.54	99.05
WarCraft III: Reforged	6	0.71	99.76
ZeroSpace	2	0.24	100

The geographic analysis in Figure 4 shows that the 846 players represent 65 different nationalities, illustrating esports' global appeal. China (21.99%), the United States (14.66%), and the Republic of Korea (9.93%) which aligns with the well-established esports infrastructures, competitive success and formalisation in these countries. Conversely, countries like Armenia, Belarus, and Bolivia each have only one player. Substantial representation also comes from nations like Denmark (4.49%) and Brazil (3.19%). These trends underscore esports' global reach and potential for growth in developing regions.

Figure 4 - Geographic Distribution of Esports Players by Nationality

Nationality	Frequency	Percent	Cumulative Percent
Argentina	2	0.24	0.24
Armenia	1	0.12	0.35
Australia	9	1.06	1.42
Austria	2	0.24	1.65
Belarus	1	0.12	1.77
Belgium	1	0.12	1.89
Bolivia	1	0.12	2.01
Bosnia and Herzegovina	2	0.24	2.25
Brazil	27	3.19	5.44
Bulgaria	7	0.83	6.26
Canada	23	2.72	8.98
China	186	21.99	30.97
Croatia	1	0.12	31.09
Czech Republic	2	0.24	31.32
Denmark	38	4.49	35.82
Egypt	1	0.12	35.93
Estonia	2	0.24	36.17

Finland	10	1.18	37.35
France	34	4.02	41.37
Georgia	1	0.12	41.49
Germany	17	2.01	43.5
Hong Kong	2	0.24	43.74
Indonesia	4	0.47	44.21
Israel	4	0.47	44.68
Italy	1	0.12	44.8
Japan	11	1.3	46.1
Jordan	3	0.35	46.45
Kazakhstan	5	0.59	47.04
Korea, Republic of	84	9.93	56.97
Kyrgyzstan	1	0.12	57.09
Latvia	3	0.35	57.45
Lebanon	1	0.12	57.57
Macao	1	0.12	57.68
Malaysia	11	1.3	58.98
Mexico	4	0.47	59.46
Moldova, Republic of	1	0.12	59.57
Montenegro	1	0.12	59.69
Morocco	1	0.12	59.81
Netherlands	11	1.3	61.11
North Macedonia	1	0.12	61.23
Norway	8	0.95	62.17
Pakistan	3	0.35	62.53
Peru	7	0.83	63.36
Philippines	13	1.54	64.89
Poland	14	1.65	66.55
Romania	3	0.35	66.9
Russian Federation	50	5.91	72.81
Saudi Arabia	4	0.47	73.29
Serbia	3	0.35	73.64
Singapore	1	0.12	73.76
Slovakia	4	0.47	74.23
Slovenia	3	0.35	74.59
Spain	2	0.24	74.82
Sweden	32	3.78	78.61
Switzerland	1	0.12	78.72
Taiwan, Republic of China	5	0.59	79.31
Thailand	11	1.3	80.61
Turkey	2	0.24	80.85
Ukraine	20	2.36	83.22
United Kingdom	17	2.01	85.22
United States	124	14.66	99.88
Uzbekistan	1	0.12	100

4.2 Games by ranking: top 100 & top 500

Dota 2 dominates both the top 100 (72 players) and top 500 (156 players) player rankings (Figures 5 and 6). Counter-Strike 2, Arena of Valor, and Call of Duty are also prominent, reflecting competitive intensity and regional preferences, especially in the Asia-Pacific for Arena of Valor.

Figure 5 - Distribution of Top 100 Esports Players by Game Played.

Top 100 Players	
Game Played	Number
Arena of Valor	3
CS:GO	1
Call of Duty	4
Counter-Strike 2	11
Dota 2	72
Fortnite	6
League of Legends	1
StarCraft II	1
VALORANT	1

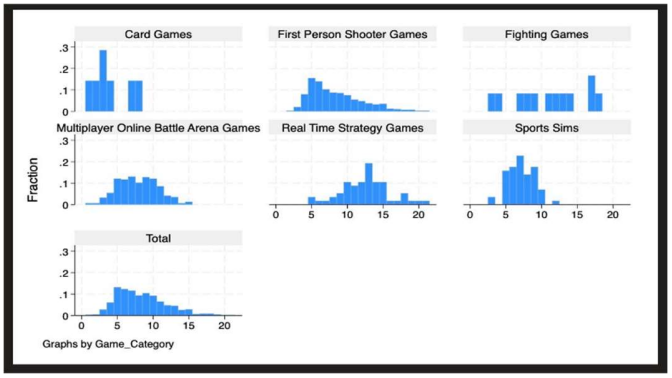
Expanding the scope to the top 500 players (Figure 6), the analysis shows a broader distribution across various esports titles, illustrating the diverse interests and competitive participation within the esports community. "Arena of Valor" emerges with a substantial presence of 41 players, highlighting its popularity in regions where mobile gaming is dominant, particularly in the Asia Pacific. This trend aligns with research that points to the rapid growth of mobile gaming and its impact on the esports industry in

these regions (Daniels, 2022). "Dota 2" continues to lead with 73 players, reinforcing its widespread appeal and robust competitive scene. The consistent performance across figures 4 and 5 indicate the game's deep-rooted influence and the effectiveness of its competitive structure. Other games such as "CS:GO" with 13 players and "Call of Duty" with 27 players demonstrate the diverse interests and varying levels of engagement across different esports titles, and the diversity in genres among the popular titles. The geographic distribution of top players, with strong representation in games popular in North America and Asia Pacific, underscores the global reach and multifaceted nature of the esports industry. The continuous growth and evolution of the esports ecosystem are driven by advancements in technology, increasing accessibility, and the development of professional infrastructures that support player development and competition (Seo, 2016).

Figure 6 - Distribution of Top 500 Esports Players by Game Played

Top 500 Players	
Game Played	**Number**
Apex Legends	4
Arena of Valor	41
Battlegrounds Mobile	10
CS:GO	13
Call of Duty	27
Chess.com	3
Clash Royale	2
Counter-Strike 2	57
CrossFire	8
Dota 2	156
EA Sports FC 24	4
Fighting Game	3
Fortnite	36
Halo	7
League of Legends	30
Overwatch 2	2
PUBG	15
Quake	1
Rainbow Six Siege	5
Rocket League	10
Shadowverse	2
Sports Video Game	1
StarCraft II	17
StarCraft: Remastered	2
VALORANT	7
WarCraft III: Reforged	3

Figure 7 – Genre histogram analysis



5 Specific data analysis

5.1 Number of years playing by game category

This section analyses player experience across esports game categories using histograms, revealing patterns in competitive dynamics and player retention. The investigation provides insights into the longevity and maturation of player engagement within different esports genres.

The histogram for "Card Games" shows a significant concentration of players with fewer years of experience, with a notable peak around 2-3 years. This suggests that card games have competitors who compete for a shorter amount of time than the average career in the dataset, which is 7.959 years. This is influenced, however, by card games only representing 7 of the 846 competitors with an age recorded on esports earnings.

"First Person Shooter Games" exhibit a broader distribution, with a gradual decline in the number of players as the years of experience increase. The peak around 5-7 years suggests that many players in this category have moderate experience, which could be attributed to the ongoing evolution and sustained popularity of shooter games in the esports ecosystem.

"Fighting Games" show a relatively flat distribution with peaks at various points, indicating a more evenly spread range of experience levels among players. This may reflect the niche but dedicated community of fighting game enthusiasts who maintain their participation over varying periods. Fighting games do however only represent a small cohort of 12 out of 846 competitors.

In the "Multiplayer Online Battle Arena Games" category, the histogram indicates a fairly even distribution with a slight peak around 5-8 years of experience. This reflects the competitive nature and longevity of games like "Dota 2" and "League of Legends," which have established extensive professional scenes that encourage long-term player engagement.

Real-Time Strategy (RTS) games exhibit a notable peak around 10-15 years of experience, indicating that this genre attracts highly experienced players. This long-term engagement is likely due to the strategic depth and complexity inherent in RTS games, which appeal to a dedicated and seasoned player base. Research has shown that RTS games, such as StarCraft, require players to manage multiple, evolving scenarios simultaneously, fostering an environment that rewards strategic thinking and long-term skill development. This engagement underscores the cognitive demands and strategic depth that maintain player interest over extended periods (Glass et al., 2013). Furthermore, the skills developed in RTS games, such as multitasking, strategic planning, and rapid decision-making, are highly transferrable and can positively impact career trajectories in various high-stakes environments.

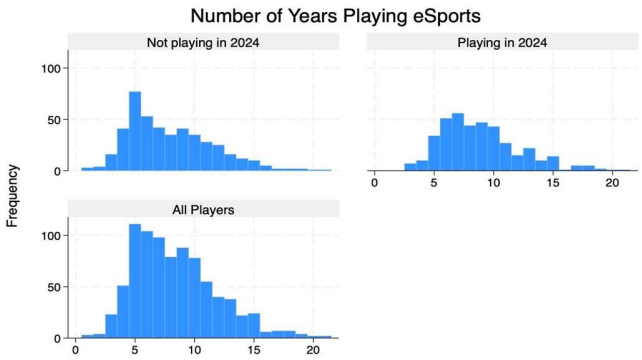
The "Sports Sims" category has a peak around 5-10 years, indicating a mid-range experience level for most players. Sports Sims represent just under 6.8% of the total competitors, the same as the RTS category. However, Sports Sims have a variety of sub-genres, with most coming from Rocket League, then a number coming from Football simulation games and racing games.

Overall, the "Total" histogram aggregates these distributions, highlighting a broader trend of player experience across all game categories. Notably, there is a significant concentration of players with 5-10 years of experience, which reflects the maturity and sustained engagement within the esports community. This trend contrasts with the common perception that esports primarily attracts young competitors. This comprehensive view underscores the diverse and evolving nature of esports, with different genres appealing to players across a wide range of experience levels.

5.2 Number of years playing esport

By examining the number of years players have been engaged in esports, we aim to uncover patterns and trends that reflect career longevity and participation dynamics. This analysis provides valuable insights into the factors influencing player retention and the evolving nature of esports careers, contributing to the broader understanding of the industry's sustainability and growth.

Figure 8 – Number of years playing esports



The histogram for players "Not playing in 2024" shows a significant concentration of individuals with fewer years of experience, with a notable peak around 3-5 years. This suggests that many players tend to exit the competitive scene relatively early in their careers. The distribution is heavily skewed towards fewer years of play, indicating a potential challenge in retaining players for longer durations within the esports industry. This observation aligns with findings from Bányai et al. (2019), who noted that eSports gamers, despite their higher motivation and significant time investment, often face psychiatric distress and gaming disorders, which could contribute to their shorter careers in the industry.

In contrast, the histogram for players "Playing in 2024" exhibits a more balanced distribution with peaks around 5-10 years of experience. This indicates that players who remain active in 2024 tend to have a moderate to high level of experience. The presence of a considerable number of players with over 10 years of experience reflects the stability and sustained engagement within the competitive scene for these individuals. This aligns with Poulus et al. (2020), who found that stress and coping mechanisms play significant roles in the longevity of esports athletes, and Pedraza-Ramirez et al. (2020), who highlighted the importance of psychological resilience in maintaining high performance over extended periods.

The "All Players" histogram aggregates these distributions, providing a comprehensive overview of player experience across the entire sample. The overall trend shows a concentration of players around 3-10 years of experience, with a notable peak around 5-7 years. This indicates that while there is a significant influx of new players, a substantial portion manages to remain active for an extended period.

This analysis underscores the dynamic nature of esports careers, with varying lengths of participation and experience among players, especially when considering genre differentials. The data suggests that while many players exit early, those who continue tend to build substantial careers, contributing to the depth and maturity of the esports ecosystem. Understanding these patterns is crucial for developing strategies to enhance player retention and career longevity in the rapidly evolving esports industry.

5.3 Regressions & Fixed Effects:

The graph titled "Predicted annual earnings by age from fixed effects quartic" (Figure 9) shows a clear peak in earnings around the age of 24-25, with a sharp increase from age 15 to this peak, followed by a gradual decline until the mid-30s, and then a subsequent rise after age 35. This suggests that esports players typically reach their peak earning potential in their mid-20s, after which their earnings generally decline. The rise in earnings after age 35 is likely linked to the 'Superstar Effect' (Rosen, 1981), where players leverage their established fan base and marketability to secure lucrative opportunities despite a decline in competitive performance. Even as their competitive performance may wane, these players can command higher earnings through direct participation in high-profile tournaments, leveraging their fame and marketability to secure positions and sponsorships. This phenomenon is supported by the literature on sports economics, where the earning potential of athletes is often influenced by their public profile and media presence. Franck and Nüesch (2012) noted that talent and popularity are key factors in achieving superstar status, which in turn significantly boosts earning potential. In esports, players who achieve notoriety not only benefit from prize money but also from sponsorship deals, brand endorsements, and participation fees in invitational tournaments, all of which contribute to sustaining high earnings even as their in-game performance declines.

In summary, the "Superstar Effect" provides a potential explanation for the observed earnings trajectory in esports, where peak earnings in the mid-20s are followed by a decline, and then a resurgence driven by the enduring marketability and fame of the players. Understanding this dynamic is crucial for stakeholders in the esports industry to develop strategies that maximize the career longevity and financial stability of esports professionals.

To enhance the economic stability and career longevity of esports players, there are valuable lessons to be learned from traditional sports like baseball. In baseball, the use of signing bonuses and human capital contracts helps to manage the financial futures of players by securing them early on in their careers and providing long-term financial planning. These mechanisms allow baseball teams to invest in young talent while mitigating financial risks and ensuring that players have financial security even after their peak performance years (Hodgson, 2022). As Hodgson notes, "the economic principles of signing bonuses and human capital contracts provide a structured approach to managing the financial futures of young athletes, ensuring stability and long-term planning." Similarly, the esports industry could benefit from adopting such financial structures, which would help in managing the short career spans typical of professional gamers. Implementing strategies akin to human capital contracts could provide esports players with better financial stability and career transition support, ultimately contributing to a more sustainable professional environment.

Figure 9 – Predicted annual earnings by age from fixed effects quartic

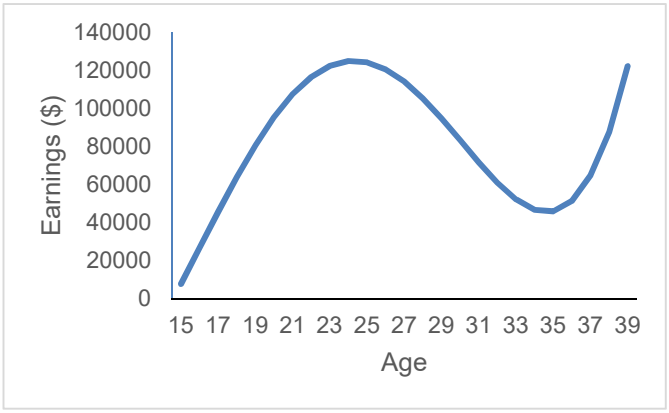


Figure 10 - Predicted Annual Earnings of Esports Players by Age Using Fixed Effects Quartic Model

Age	Age^2	Age^3	Age^4	
12	144	1728	20736	-37025.2433
13	169	2197	28561	-25398.2481
14	196	2744	38416	-10083.4538
15	225	3375	50625	7610.09938
16	256	4096	65536	26508.9839
17	289	4913	83521	45575.3853
18	324	5832	104976	63907.1021
19	361	6859	130321	80737.5455
20	400	8000	160000	95435.74
21	441	9261	194481	107506.323
22	484	10648	234256	116589.544
23	529	12167	279841	122461.267
24	576	13824	331776	125032.967
25	625	15625	390625	124351.734
26	676	17576	456976	120600.27
27	729	19683	531441	114096.889
28	784	21952	614656	105295.52
29	841	24389	707281	94785.702
30	900	27000	810000	83292.59
31	961	29791	923521	71676.9503
32	1024	32768	1048576	60935.1625
33	1089	35937	1185921	52199.2189
34	1156	39304	1336336	46736.7251
35	1225	42875	1500625	45950.8994
36	1296	46656	1679616	51380.573
37	1369	50653	1874161	64700.1903
38	1444	54872	2085136	87719.8083
39	1521	59319	2313441	122385.097
40	1600	64000	2560000	170777.34
41	1681	68921	2825761	235113.433
42	1764	74088	3111696	317745.884

The table accompanying the graph (figure 10) provides the detailed coefficients for the quartic model used to predict earnings. The coefficients are as follows: -200094.6 (constant), 16517.4 (Age^2), -523.3025 (Age^3), and 5.650539 (Age^4). These coefficients were applied to ages ranging from 12 to 42 to calculate the predicted earnings at each age. The values show a substantial increase in earnings from age 15 to 24, peaking at around $126,000, before declining significantly through the 30s, reaching a low around $35,000 at age 35, and then rising again.

The quadratic and higher-order terms in the model capture the non-linear relationship between age and earnings, reflecting the reality that esports careers are often short-lived with peak performance occurring relatively early. This is consistent with findings in esports literature, which highlight the intense physical and mental demands of competitive gaming that lead to earlier peaks and shorter career spans compared

to traditional sports, with Martončik (2015) highlighting training regimes and Bányai et al. (2019) suggesting training, practice, and physical and mental states are all significant.

The analysis illustrates that while esports players can achieve substantial earnings in their early to mid-20s, their earnings potential tends to decline significantly as they age, with some potential for recovery in later years as they transition to different roles within the industry. Understanding these earnings trajectories is crucial for stakeholders in the esports ecosystem to develop support systems that enhance career longevity and financial stability for players.

5.4 Analysis of Panel Fixed Effects Earnings Models

The fixed effects panel regressions applied to esports earnings data provide a comprehensive understanding of how age and its higher-order terms (squared, cubed, and to the fourth power) affect earnings among different subsets of the player population, including all players, the top 500 players, and the top 100 players.

For all players, the descriptive statistics reveal an average earnings of $96,872.66 with a wide standard deviation of $228,431.6, indicating significant variability in earnings among players. The mean age is approximately 22.63 years, suggesting a relatively young player base.

5.4.1 Regression Results

The fixed effects regression for all players shows that age and its higher-order terms significantly impact earnings:

- Age: Coefficient = -201118.9 ($p = 0.135$)
- Age^2: Coefficient = 16590.75 ($p = 0.045$)
- Age^3: Coefficient = -525.3535 ($p = 0.018$)
- Age^4: Coefficient = 5.669984 ($p = 0.009$)

The negative coefficient for age and age cubed, combined with the positive coefficients for age squared and age to the fourth power, suggest a complex, non-linear relationship where earnings peak around the mid-20s, decline, and then experience a secondary rise.

For the top 500 players, the descriptive statistics show higher average earnings of $133,851.5 with a standard deviation of $290,720.3, reflecting the elite status of these players. The regression results indicate similar patterns but with more pronounced coefficients:

- Age: Coefficient = -545960.1 ($p = 0.047$)
- Age^2: Coefficient = 39915.56 ($p = 0.020$)
- Age^3: Coefficient = -1194.074 ($p = 0.010$)
- Age^4: Coefficient = 12.56168 ($p = 0.007$)

The higher magnitude of these coefficients reflects the significant impact of age on the earnings of top players, with a marked peak and subsequent decline, followed by a noticeable secondary rise in later years.

For the top 100 players, the average earnings are even higher at $265,408.4, with a substantial standard deviation of $515,896.6. The regression results for this group show:

- Age: Coefficient = -1877391 (p = 0.268)
- Age²: Coefficient = 130904.7 (p = 0.233)
- Age³: Coefficient = -3827.413 (p = 0.218)
- Age⁴: Coefficient = 39.96485 (p = 0.218)

Although the p-values are not all below the conventional significance threshold of 0.05, the pattern remains consistent with a peak in earnings around the mid-20s, a decline, and a secondary rise, underscoring the importance of age in determining earnings even among the top echelon of players.

The process of adjusting earnings to 1983 USD to account for inflation is also undertaken. The patterns observed are consistent across these adjusted earnings, reinforcing the robustness of the findings. For example, for the top 500 players, the adjusted coefficients are:

- Age: Coefficient = -213856.7 (p = 0.045)
- Age²: Coefficient = 15592.84 (p = 0.019)
- Age³: Coefficient = -467.0086 (p = 0.010)
- Age⁴: Coefficient = 4.922982 (p = 0.006)

These results corroborate the earlier findings, showing a non-linear relationship between age and earnings with peaks and troughs reflecting career stages.

5.5 Summary

The fixed effects panel regression results indicate a clear, non-linear relationship between age and earnings for esports players, with earnings peaking in the mid-20s, declining, and then showing a secondary rise in later years. This pattern is observed across all players and becomes more pronounced among the top 500 and top 100 players. The findings highlight the significant impact of age on earnings and the variability in earnings potential throughout an esports career.

5.6 Age Cncome profiles

Annual earnings for a player are given by a fourth order polynomial (quartic) in their age (in years). We use a fixed effects specification:

$$y_{it} = \alpha_i + \beta_1 age + \beta_2 age^2 + \beta_3 age^3 + \beta_4 age^4 + u_i + e_{it},$$

where i=1,⋯,n players each with t=1,⋯,Ti years playing.

5.7 Key Components of the Model

Fixed Effects (αi): This term accounts for individual-specific characteristics that are constant over time but vary across players. It captures the unique baseline earnings potential of each player that is not explained by age.

Age Polynomial Terms ($\beta_1$age+$\beta_2$age^2+$\beta_3$age^3+$\beta_4$age^4): These terms model the relationship between age and earnings, allowing for a flexible, non-linear relationship. The inclusion of higher-order terms (squared, cubed, and quartic) enables the model to capture the peak, plateau, and decline in earnings as players age.

Random Error Terms (ui and eit): The term ui represents unobserved individual-specific effects, while eit captures random shocks to earnings at different points in time for each player.

5.8 Analysis of the Model

The model suggests that the relationship between age and earnings is not linear, as esports careers exhibit distinct phases: rapid growth, peak performance, decline, and potential resurgence. This is in line with the typical career trajectory observed in many high-performance domains, including traditional sports and esports.

- Early Career (Age 15-24): The positive coefficients for the linear ($\beta 1$) and squared ($\beta 2$) terms suggest that earnings increase rapidly as players gain experience and improve their skills. This period is characterized by growth and rising fame, leading to higher earnings.
- Peak Performance (Age 24-25): The cubic ($\beta 3$) and quartic ($\beta 4$) terms enable the model to capture the peak in earnings around this age. Players are at the height of their skills and marketability, attracting maximum earnings from tournament winnings, sponsorships, and endorsements.
- Decline Phase (Age 25-35): The negative coefficients for the higher-order terms reflect a decline in earnings as players age beyond their peak performance years. Factors such as reduced reflexes, increased competition from younger players, and potential burnout contribute to this decline.
- Later Career (Age 35+): The slight rise in earnings after age 35 could be due to the "Superstar Effect," where well-known players continue to earn from their established reputation and participation in high-profile tournaments.

5.9 Implications

The quartic model effectively captures the complex earnings trajectory of esports players, emphasizing the importance of age in determining earnings potential. Understanding this relationship is crucial for players, teams, and industry stakeholders to make informed decisions about career management, talent development, and financial planning.

6 Discussion

6.1 Evolution of Dota 2 and Prize Pools

Dota 2, developed by Valve Corporation, has long been a cornerstone of the esports industry, renowned for its high-stakes tournaments and substantial prize pools. The game’s flagship event, The International (TI), has consistently set records for esports prize money. Since its inception, The International has been a marquee event in the esports calendar. The crowdfunded prize pool model, introduced by Valve in 2013 with the release of the "Compendium," allowed the community to contribute to the prize pool. This innovative approach significantly boosted the prize money, with each Compendium sale adding to the total pool. As a result, TI10 in 2021 offered over $40 million, the largest in esports history (Carlson, 2013; dota2.prizetrac.kr, n.d.). Despite these peaks, recent years have seen a decline in the size of Dota

2's prize pools. Several factors may contribute to this trend. Market saturation is one such factor, as the esports market has become increasingly crowded with numerous games vying for attention and investment. Economic conditions also play a significant role; global economic factors, including the impact of the COVID-19 pandemic, have affected sponsorship and investment in esports. Additionally, community engagement has waned, as the initial novelty of contributing to prize pools may have diminished, impacting the amount raised through crowdfunding. With the 2023 edition of "The International", the prize pool was historically low, primarily due to changes in Valve's funding model and a decline in the game's popularity. The replacement of the traditional Battle Pass with a new Compendium has led to slower sales, resulting in the lowest prize pool since 2015 (Stubbs, 2023).

6.2 Career Longevity, the Superstar Effect, and Comparative Perspectives

Esports careers are often characterised by early peaks in performance and earnings, followed by sharp declines as physical and cognitive demands take their toll. However, a secondary rise in income has been observed among some older players, a pattern consistent with the "Superstar Effect" described by Rosen (1981). As players accumulate notoriety, media presence, and fan engagement, they can continue to generate income beyond their competitive prime through sponsorships, streaming, and branded appearances. Franck and Nüesch (2012) similarly argue that talent and popularity interact to create market value, meaning that brand capital may substitute for declining performance in sustaining earnings. This phenomenon parallels findings in traditional sports. Tanaka and Toussaint (2023) show that most athletes peak in their 20s and early 30s, after which performance declines, yet earnings may remain high due to endorsement deals and legacy appeal. López et al. (2020) note that team sport athletes tend to retire later and transition more smoothly into post-playing careers than those in individual sports. These insights have relevance for esports, where hybrid models of competition, content creation, and audience engagement increasingly blur the lines between performance and persona. While the Superstar Effect explains much of the earnings recovery in later years, certain game genres and structures also provide additional space for extended careers. Fighting games, for example, are less physically intensive and often rely more on pattern recognition, timing, and mental endurance. Players like Daigo Umehara and Justin Wong have remained competitive well into their 30s, supported by a loyal fanbase and deep mastery of mechanics (Summers, 2020). Similarly, the resurgence of online chess, boosted by Twitch, Chess.com, and cultural moments like *The Queen's Gambit* has enabled older players such as Hikaru Nakamura and Magnus Carlsen to earn significant prize money and audience attention in esports-classified events (Taylor-Hill, 2022). These examples suggest that esports careers are not solely constrained by physical age, but shaped by a complex interplay of genre, branding, and community positioning. Future research should investigate how these different factors interact, particularly across platforms and content types, to influence post-peak career longevity.

Strategic Longevity and National Context in StarCraft

The dataset reveals a notable concentration of competitors aged over 30 achieving substantial earnings in StarCraft and StarCraft: Remastered. The franchise holds a unique position within esports history, particularly in South Korea, where it is widely regarded as a "national pastime" (O'Keefe, 2021). This cultural embeddedness is reflected in the data: of the 42 competitors listed in StarCraft, 32 are from the Republic of Korea. The game's strategic depth and high skill ceiling demand extensive experience and mastery, which may explain the sustained success of older players. In the dataset analysed, over 20 StarCraft II and StarCraft: Remastered players above the age of 30 have recorded prize earnings. By

contrast, a similarly sized title such as Call of Duty includes only four competitors in that age bracket. These findings challenge the assumption that esports careers are inherently short-lived and instead suggest that, in certain genres, experience and tactical sophistication can enable longevity in both performance and income.

6.3 Extended Careers in Niche and Strategic Esports

While most esports careers peak in early adulthood, certain genres allow for extended longevity, largely due to their emphasis on strategic thinking and mental endurance over rapid reflexes. Fighting games and online chess are two prominent examples that illustrate how individual mastery, genre-specific mechanics, and cultural context can sustain competitive relevance into later life.

Fighting games, characterised by intricate mechanics and direct one-on-one formats, reward long-term skill development, pattern recognition, and psychological resilience. Notable competitors such as Daigo Umehara and Justin Wong have remained successful well into their thirties, supported by loyal fanbases and sustained technical excellence (Summers, 2020). In the dataset, five of the twelve fighting game competitors had recorded prize earnings beyond the age of 30, with the oldest being 38. Similarly, the rise of online chess highlights how traditional games can intersect with esports through digital platforms. The pandemic catalysed a surge in chess viewership on Twitch and Chess.com, driven by events like PogChamps and cultural moments such as *The Queen's Gambit*. Grandmasters Hikaru Nakamura and Magnus Carlsen have earned substantial prize money in online events increasingly considered part of the esports ecosystem (Taylor-Hill, 2022). In the dataset, Nakamura earned $184,748.11 at age 35 and Carlsen $286,537.74 at age 32. The low physical strain of chess, paired with its emphasis on strategic endurance, enables prolonged competitive participation. These cases challenge the prevailing assumption that esports is strictly a young person's domain. Instead, they suggest that genre, cognitive demands, and platform dynamics play a more decisive role in shaping the contours of career longevity.

7 Conclusion

Esports has rapidly evolved into a global industry, offering both cultural significance and economic opportunity. This paper has explored its demographic composition, earnings distribution, and career longevity, showing that while peak earnings typically occur in the mid-20s, a secondary rise in later years can be explained by factors such as the "Superstar Effect" and game-specific dynamics. The persistence of older players in games like *StarCraft*, fighting games, and online chess challenges the assumption of early burnout, highlighting the value of strategic depth and brand capital in sustaining careers. These findings suggest that esports should not be seen solely as a youth-dominated domain but as an ecosystem with diverse pathways and longer-term potential. Beyond labour and earnings, esports must also be understood as a cultural movement. As Hamari and Sjöblom (2017) note, it fosters identity, belonging, and digital community. Recognising esports as both an economic and cultural force enables a more nuanced understanding of its role in the creative economy. Future research should investigate how media presence, platform engagement, and institutional support influence post-peak career trajectories. Comparative studies with traditional sports and other creative industries may also yield insights into how notoriety, adaptability, and community capital shape long-term success. As the industry continues to professionalise, stakeholders must consider how to support sustainable careers, balance performance with wellbeing, and leverage cultural engagement for broader social value.

8 References

Bányai, F., Griffiths, M. D., Király, O., & Demetrovics, Z. (2019). The psychology of esports: A systematic literature review. *Journal of Gambling Studies*, 35, 351–365. https://doi.org/10.1007/s10899-018-9763-1

Carlson, P. (2013). Dota 2's The International prize breakdown announced. https://www.pcgamer.com/dota-2s-the-international-prize-breakdown-announced/. Accessed 12 Apr 2025.

Cheng, X., Zhang, S., Fu, S., Liu, W., Guan, C., Mou, J., Ye, Q., & Huang, C. (2022). Exploring the metaverse in the digital economy: An overview and research framework. *Journal of Economic and Business Development in the Digital Economy*, 1(1), 206–224.

Daniels, T. (2022). Mobile miracles: The rise and reign of mobile esports in Southeast Asia. https://esportsinsider.com/2022/07/mobile-esports-sea-growth. Accessed 18 Jun 2025.

DiFrancisco-Donoghue, J., Balentine, J., Schmidt, G., & Zwibel, H. (2019). Managing the health of the eSport athlete: An integrated health management model. *BMJ Open Sport & Exercise Medicine*, 5, e000467. https://doi.org/10.1136/bmjsem-2018-000467

dota2.prizetrac.kr (n.d.). Dota 2 Prize Pool Tracker. https://dota2.prizetrac.kr/. Accessed 30 May 2025.

Fitch, A. (n.d.). Esports to generate $1.38B in 2022, Newzoo report estimates. *Hitmarker.* https://hitmarker.net/news/esports-industry-newzoo-report-2022-895091. Accessed 14 Jun 2025

Flores-Saviaga, C., Hammer, J., Flores, J. P., Seering, J., Reeves, S., & Savage, S. (2020). Audience and streamer participation at scale on Twitch. *arXiv preprint arXiv:2012.00215*. https://arxiv.org/abs/2012.00215. Accessed 22 Apr 2025.

Franck, E., & Nüesch, S. (2012). Talent and/or popularity: What does it take to be a superstar? *Economic Inquiry*, 50(1), 202–216. https://doi.org/10.1111/j.1465-7295.2010.00360.x

Galbraith, J. W., & Hodgson, D. J. (2015). Innovation, experience and artists' age-valuation profiles: Evidence from eighteenth-century rococo and neoclassical painters. *Journal of Cultural Economics*, 39, 259–275. https://doi.org/10.1007/s10824-014-9231-4

Glass, B. D., Maddox, W. T., & Love, B. C. (2013). Real-time strategy game training: Emergence of a cognitive flexibility trait. *PLOS ONE*, 8, e70350. https://doi.org/10.1371/journal.pone.0070350

Hamari, J., & Sjöblom, M. (2017). What is esports and why do people watch it? *Internet Research*, 27(2), 211–232. https://doi.org/10.1108/IntR-04-2016-0085

Hodgson, D. J. (2011). Age–price profiles for Canadian painters at auction. *Journal of Cultural Economics*, 35, 287–308. https://doi.org/10.1007/s10824-011-9150-6

Hodgson, D. J. (2022). Artistic movement membership and the career profiles of Canadian painters. *Poetics*, 90, 101595. https://doi.org/10.1016/j.poetic.2021.101595

Hogan-Hennessy, S., Xenopoulos, P., & Silva, C. (2022). Market interventions in a large-scale virtual economy. *arXiv preprint arXiv:2210.07970*. https://arxiv.org/abs/2210.07970. Accessed 04 May 2025.

Hong, H. J., & Hong, S. H. (2023). Esports players' transition out of esports: Is there life after esports? https://doi.org/10.24251/HICSS.2023.475. Accessed 27 May 2025.

Johnson, M. R., & Woodcock, J. (2021). Work, play, and precariousness: An overview of the labour ecosystem of esports. *Media, Culture & Society*, 43(8), 1449–1465. https://doi.org/10.1177/01634437211011555

Lee, J. (2022). Esports stars have shorter careers than NFL players. Here's why. *The Washington Post.* https://www.washingtonpost.com/video-games/esports/2022/04/19/esports-age-retirement/ Accessed 09 Apr 2025.

López de Subijana, C., Galatti, L., Moreno, R., & Chamorro, J. L. (2020). Analysis of the athletic career and retirement depending on the type of sport: A comparison between individual and team sports. *International Journal of Environmental Research and Public Health*, 17(24), 9265. https://doi.org/10.3390/ijerph17249265

Mangeloja, E. (2019). Economics of esports. *Electronic Journal of Business Ethics and Organization Studies*, 24.

Martončik, M. (2015). e-Sports: Playing just for fun or playing to satisfy life goals? *Computers in Human Behavior*, 48, 208–211. https://doi.org/10.1016/j.chb.2015.01.056

Meng-Lewis, Y., Wong, D., Zhao, Y., & Lewis, G. (2022). Understanding complexity and dynamics in the career development of esports athletes. *Sport Management Review*, 25, 106–133. https://doi.org/10.1016/j.smr.2020.08.003

Nagorsky, E., & Wiemeyer, J. (2020). The structure of performance and training in esports. *PLOS ONE*, 15, e0237584. https://doi.org/10.1371/journal.pone.0237584

O'Keefe, D. (2018). How Blizzard's StarCraft became South Korea's national pastime. *The Esports Observer.* https://archive.esportsobserver.com/starcraft-ii-esports-essentials/. Accessed 06 Jun 2025.

Pedraza-Ramirez, I., Musculus, L., Raab, M., & Laborde, S. (2020). Setting the scientific stage for esports psychology: A systematic review. *International Review of Sport and Exercise Psychology*, 13(1), 319–352. https://doi.org/10.1080/1750984X.2020.1723122

de Peuter, G. (2014). Beyond the model worker: Surveying a creative precariat. *Culture Unbound*, 6(1), 263–284. https://doi.org/10.3384/cu.2000.1525.146263

Poulus, D., Coulter, T. J., Trotter, M. G., & Polman, R. (2020). Stress and coping in esports and the influence of mental toughness. *Frontiers in Psychology*, 11. https://doi.org/10.3389/fpsyg.2020.00628

Poulus, D. R., Sargeant, J., Zarate, D., Griffiths, M. D., & Stavropoulos, V. (2024). Burnout, resilience, and coping among esports players: A network analysis approach. *Computers in Human Behavior*, 153, 108139. https://doi.org/10.1016/j.chb.2024.108139

Rosen, S. (1981). The economics of superstars. *The American Economic Review*, 71, 845–858.

Rosen, S., & Sanderson, A. (2000). Labor markets in professional sports. *Working Paper Series*. https://doi.org/10.3386/w7573. Accessed 15 Apr 2025.

Seo, Y. (2016). Professionalized consumption and identity transformations in the field of esports. *Journal of Business Research*, 69, 264–272. https://doi.org/10.1016/j.jbusres.2015.07.039

Simmons, R. (2022). Professional labor markets in the *Journal of Sports Economics*. *Journal of Sports Economics*, 23, 728–748. https://doi.org/10.1177/15270025211051062

Sinclair, B. (2020). 72% of esports audience is male, says report. *GamesIndustry.biz.* https://www.gamesindustry.biz/72-of-esports-audience-is-male-says-report Accessed 20 Jun 2025.

Smithies, T. D., Toth, A. J., Conroy, E., Ramsbottom, N., Kowal, M., & Campbell, M. J. (2020). Life after esports: A grand field challenge. *Frontiers in Psychology*, 11. https://doi.org/10.3389/fpsyg.2020.00883

Stubbs, M. (2023). The 'Dota 2' International 12 prize pool is historically low. *Forbes.* https://www.forbes.com/sites/mikestubbs/2023/09/29/the-dota-2-international-12-prize-pool-is-historically-low/ Accessed 30 Apr 2025.

Summers, N. (2020). The esports elders defying their age. *Engadget.* https://www.engadget.com/2020-03-09-the-esports-elders-defying-their-age.html Accessed 06 May 2025.

Tanaka, H., & Toussaint, J.-F. (2023). Editorial: Growth, peaking, and aging of competitive athletes. *Frontiers in Physiology*, 14. https://doi.org/10.3389/fphys.2023.1165223

Taylor-Hill, G. (2025). The surprising rise of chess esports: Why is chess growing on Twitch? https://www.esports.net/news/chess-esports-growth/. Accessed 03 Jun 2025.

Yu, B., Brison, N. T., & Bennett, G. (2022). Why do women watch esports? A social role perspective on spectating motives and points of attachment. *Computers in Human Behavior*, 127, 107055. https://doi.org/10.1016/j.chb.2021.107055

Zendle, D., Flick, C., Halgarth, D., Ballou, N., Cutting, J., & Drachen, A. (2023). The relationship between lockdowns and video game playtime: Multilevel time-series analysis using massive-scale data telemetry. *Journal of Medical Internet Research*, 25, e40190. https://doi.org/10.2196/4019