

**STAR ATLAS**

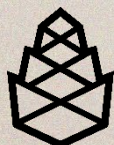
# State of the Economy

**ATMTA, Inc.**

Department of Economics

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## Executive Summary

The following economic paper will analyze the behaviors of participants in the Star Atlas ecosystem to date, namely through their interactions with the first gameplay module, Ship Commissions On Remote Expeditions ("S.C.O.R.E."). Over the past six months, the S.C.O.R.E. economy has experienced both successes and challenges as described in this paper.

We conclude that S.C.O.R.E. has proven resilient even as the broader market has experienced high volatility due to a variety of global pressures.

S.C.O.R.E. has provided the community with a home to begin their exploration of the Star Atlas metaverse. As a result, many are growing their fleets, diversifying into a variety of classes, and utilizing ATLAS earnings to purchase additional ships.

Key Highlights:

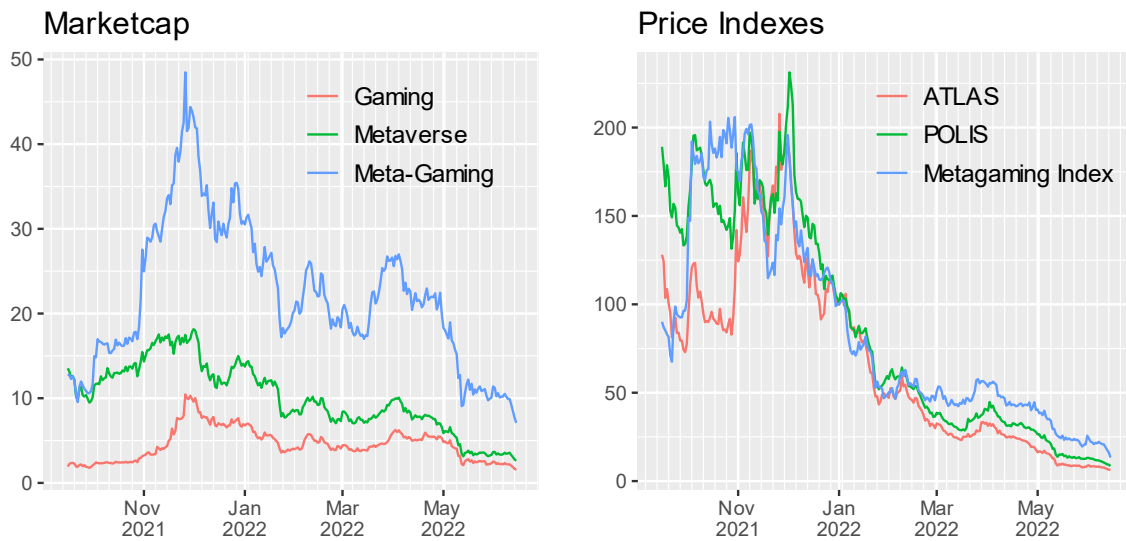
- Aggregate daily ATLAS wages grew by 18.1%
- The average wage per ship declined by 27.1%,
- The aggregate employment rate per ship decreased by 3.7%, and
- The size of the labor force grew by 49.1%.

The supply of new labor hours came from fleet deposits of XXS ships, which commanded low ATLAS wages per ship. Adding these ships into the capital stock lowered the average daily earnings per employed ship from around 22 ATLAS to 16.8 ATLAS.

## A whirlwind beginning

Last year the world experienced a metaverse gaming boom which ascended into what could easily be described as *mania*. The speed of its ascension and subsequent bust is historically remarkable but not unprecedented. One must look no further than the late-90s NASDAQ Tech Bubble to grasp the current post-bubble environment.

## Metaverse Crypto Performance



Source: Coinmarketcap.com and ATMTA, Inc. Economics Department. Notes: Marketcap is in billions of USD. The market weighted price indexes are equal to 100 at January 1, 2022. See appendix for details on index construction.

Each time financial or technological innovation strikes, there is bound to be some excitement. Post-bubble fall-outs are typically periods of scandal, contraction, and industry consolidation. One could argue that this time is no different. Despite the hardships, the Metaverse gaming sector is proving resilient. While the sector experienced initial capital inflows to the nascent technology of the Metaverse, its foundational contribution to society is real economic opportunity and employment. A bear market does not undermine such a fundamental contribution.

It is in this environment that we present this first State of the Economy report. We do not focus on or try to rationalize the external environment. Instead, we provide a comprehensive set of tools and data for thinking about how S.C.O.R.E. functions. The analysis views S.C.O.R.E. through its main economic drivers: the labor market and business fixed investment. The tools presented are often found in macroeconomic research departments. Of course, the first look at any economy can start anywhere, but we begin by taking a birds-eye view of the Star Atlas universe.

## Star Atlas Universe - SA Census

In what follows, it will be helpful to understand the motives of different people within the Star Atlas universe. It is presently unrealistic to obtain census data on everyone involved in Star Atlas to determine all of their underlying motives. So we rely on wallet holdings and participation in S.C.O.R.E. to classify people as nonresidents, residents, or citizens. The table below provides the exact conditions for each.

Roughly 37% of the people involved in Star Atlas only hold ATLAS. By holding ATLAS, they express their positive belief in the economy's viability. People that only hold ATLAS are **nonresident ATLAS holders**.<sup>1</sup>

<sup>1</sup> This is considered financial employment.

Table 1: Star Atlas Census (5-27-2022)

Class	Employed	Ship Owner	POLIS holder	ATLAS holder	Frequency	Share
<b>nonresident ATLAS</b>	0	0	0	1	50125	37.1
<b>nonresident Ship</b>	0	1	0	0	12457	9.2
	0	1	0	1	2862	2.1
	0	0	1	0	14975	11.1
<b>nonresident POLIS</b>	0	0	1	1	12604	9.3
	0	1	1	0	960	0.7
	0	1	1	1	1501	1.1
<b>Residents</b>	1	1	0	0	4644	3.4
	1	1	0	1	25369	18.8
<b>Citizens</b>	1	1	1	0	968	0.7
	1	1	1	1	8625	6.4

An additional 9.2% of nonresidents own ships, but no POLIS or ATLAS. 22.2% are **nonresident POLIS holders**. Non-employed POLIS holders maintain an opportunity to shape the future of Star Atlas.

75% of the Star Atlas population holds ATLAS, and 66% of these holders are not participating in S.C.O.R.E..

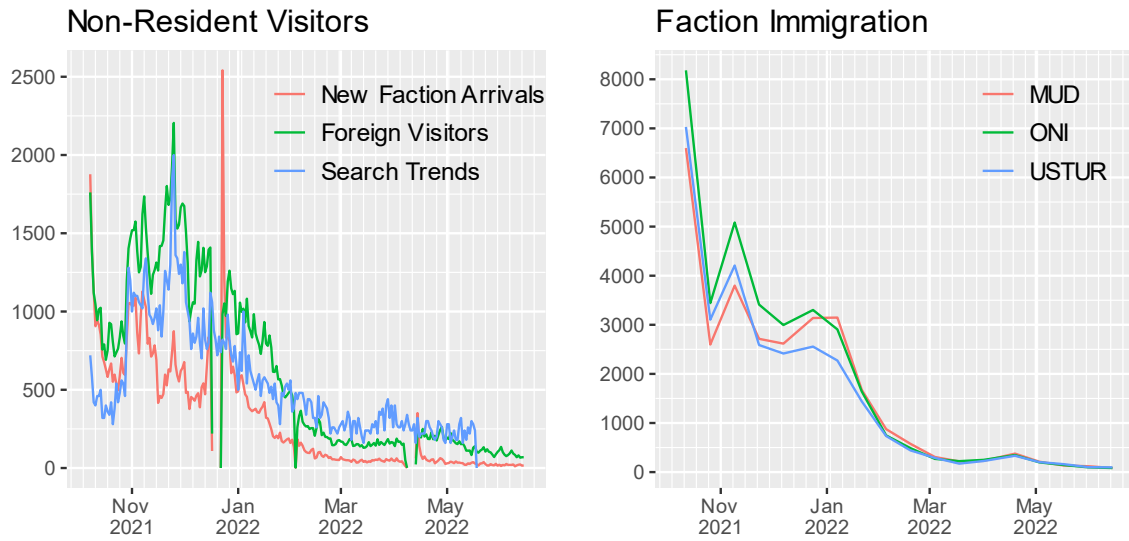
29.3% of the Star Atlas universe is employed and actively participating in S.C.O.R.E.. 76% of these are **Residents** of Star Atlas; they own ships and are actively engaged in non-financial employment (gameplay). The remaining 24% are **Citizens** - citizenship adds POLIS to the residency requirements. Citizens have the right to vote, while residents do not. The SA Census provides a snap-shot of the Star Atlas Universe at a given point in time. Tracking foreign non-visitor arrivals provides a means of describing how we got to these numbers.

## Immigration and Population growth

The last three months of 2021 saw an explosion of foreign visitor arrivals to Star Atlas. Analysis suggests that they came for the same reasons anyone travels abroad. Some just passed through on their way to another destination. Serious business travelers came to study the prospects for foreign direct investment, and currency traders arrived to gain an edge in the intergalactic token exchange markets. In addition, foreign arrivals joining a faction and obtaining non-financial employment entered the prospective residency program. Many are now permanent residents. This growth in visitors was non-trivial and internal estimates point to Star Atlas contributing roughly 1% to total global crypto adoption in December.<sup>2</sup>

<sup>2</sup> S.C.O.R.E. was released on December 17, 2021. See Appendix for details on crypto adoption.

## Foreign Arrivals and Immigration to Star Atlas



Source: Google Search Trends and ATMTA, Inc. Economics Department  
 Notes: Foreign arrivals comes from SA Immigration Form I-22. Faction immigration is the bi-weekly sum of the daily number of faction arrivals.

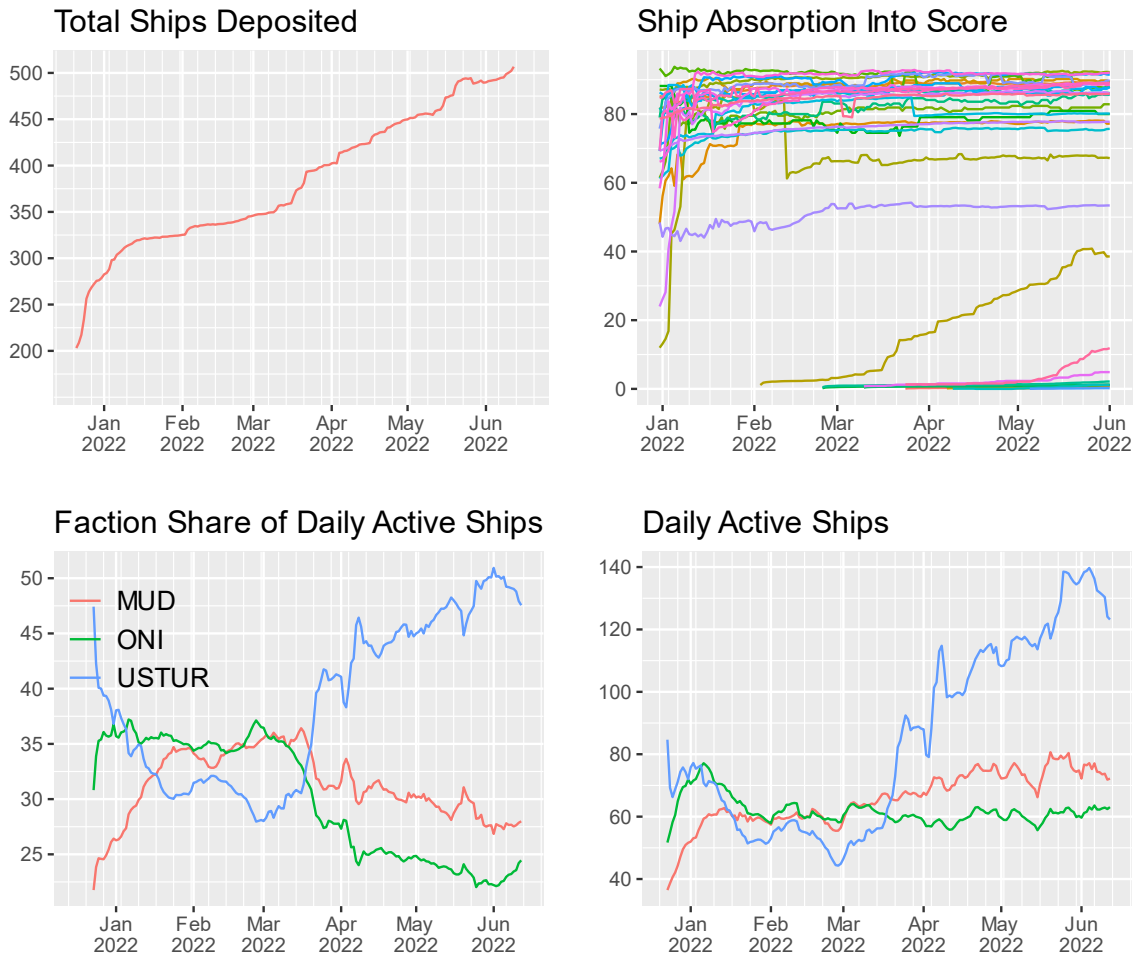
Significant market volatility and flight to safety from risk-on assets have reduced the appetite and available dry powder for all asset classes. It has also impacted the size of the active population. Immigration has slowed, and emigration has picked up. The trends have led to a decline in the total number of daily active players. The decline in active daily users and new users has slowed the adoption rate of newer ship issuance.

Despite the declining active player counts, the number of ships in S.C.O.R.E. has nearly doubled. Ships that sold at the beginning have primarily persisted within the economy. Ship retention has been most evident for the higher-tier ships. Account closures have not resulted in a noticeable increase in fleet sales or marketplace inventories. Employed faction residents absorbed the ships withdrawn by players exiting the game. As a result, the average number of ships held by residents has nearly tripled since late February.

Faction-level fleet activity has varied markedly since January 1st. We use the seven-day average number of ships re-filled with food to account for active faction fleets. By our measure, daily active Ustur ships grew 55%, MUD 39%, and ONI declined by 11%.<sup>3</sup> The excess growth in USTUR fleet activity coincides with the introduction of the Fimbul Airbike.

<sup>3</sup> Through June 8th

## Ships in Score



Source: ATMTA, Inc. Economics Department and Flipside  
 Notes: Total ships deposited in thousands (data from Flipside). Ship counts by faction are expressed as a percentage of the total. Daily faction food deposits are used to measure the daily number of faction ships deposited and is shown in thousands as five-day moving averages. Score ship absorption is defined as the total ships in score as a percent of total ships outstanding.

## Main Economic Summary

Understanding how the labor market has changed since the inception of S.C.O.R.E. requires us to state three basic facts:

1. Wages are constant across time
2. Ship quantities decrease with a ship's class
3. ATLAS wage rates increase with a ship's class

The first fact means that fluctuations in aggregate employed hours will determine aggregate wages earned. The more everyone works, the more ATLAS is emitted. This point is important to understand, because it makes clear that ATLAS emissions are not fixed. The total amount of ATLAS distributed in S.C.O.R.E. is completely dependent on the size of the labor force and employment rates. The second fact implies that the lower ship classes heavily skew aggregate numbers. For example, the XXS class of ships will heavily influence any labor market statistic. If we exclude this class, it will be the Extra small class that will drive most of the variation. If we exclude these, the small class of ships will influence

most of the variation, and so on. This is because hours worked are not normalized by ship class: an hour worked using an XXS is equivalent to an hour worked for a Commander. The third fact indicates that higher-tier ships are more productive than lower-tier ships. This difference in productivity stems from the class differences in a ship's underlying components.<sup>4</sup>

## Defining Employment and Unemployment

Employment and unemployment are conceptually well-defined concepts. Employment and unemployment occur at the individual fleet level. A fleet consists of one or more ships of a specific type. For an individual player, when a fleet is earning ATLAS, that fleet is said to be employed. In order to earn ATLAS, ships must be enlisted and have a non-zero R4 balance. Although this is theoretically straightforward, data limitations complicate the measurement. The calculation of employment and unemployment is best illustrated with an example.

A player deposits food (We assume that the total food capacity of the ship is met). Each ship burns food at a rate that determines how long it will remain employed. The ship remains employed for this amount of time. If the fleet runs out of food before the following refill action, it enters unemployment. It remains unemployed until the next refill action.

Refill actions occur at all times of the day. The seconds employed are allocated to hourly periods. Assume a ship is employed for 8 hours on Saturday, runs out of food at noon on Sunday, and remains unemployed for the rest of the day. Then the time spent unemployed is 16 hrs on Saturday and 12 hours on Sunday. The ship's employment rate would be 33% on Saturday and 50% on Sunday.

Seconds spent unemployed and employed are aggregated for each ship type daily to produce aggregate employment and unemployment.

## Aggregate Wages and Employment

Aggregate daily employment is the total amount of ship seconds spent in employment for the day. This is equivalent to the employment rate multiplied by the labor force. The employment rate is defined as the seconds spent employed as a fraction of the total labor force (also in seconds). The total number of ships in S.C.O.R.E. sets an upper bound for total employment, which in turn sets an upper bound for the amount of ATLAS that can be earned in the economy. The employment rate is the fraction of the labor force that is actively earning ATLAS.

$$EMPL_t = empl_t^{rate} \times LF_t \quad (1)$$

Aggregate wages are defined as the sum of all ship seconds worked multiplied by the ship wages per second.

$$Wages_t = \sum_{s=1}^S EMPL_t^s \times w_t^s \quad (2)$$

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<sup>4</sup> Note: The components are not linearly additive. For example, two Small class maneuvering thrusters do not equate to a Medium size maneuvering thruster. In fact, two Small class components equate to roughly 73.5% of the output of one Medium component. The general rule of thumb is that component productivity increases by a factor of 2.7 with each class.



The daily average wage rate is then the aggregate ATLAS wage divided by the sum of all ship seconds employed.

$$w_t = \frac{Wages_t}{EMPL_t} \quad (3)$$

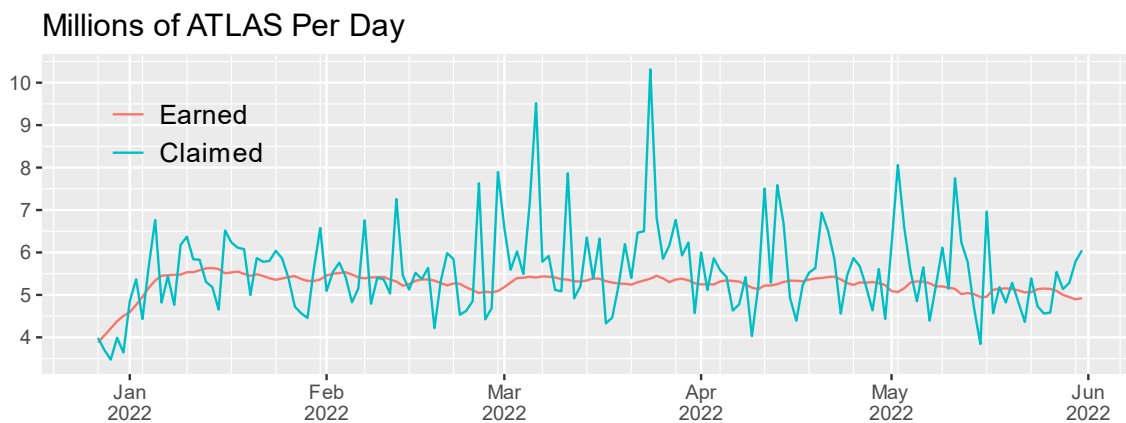
The total ATLAS earned is the average daily wage multiplied by the employment rate and the labor force.

$$Wages_t = w_t \times empl_t^{rate} \times LF_t \quad (4)$$

Total ATLAS earned is a function of the size of the labor force (capital stock), the labor market effort by residents to keep their ships earning, and the average wage rate of the employed ships. A total of 890 million ATLAS was claimed since the inception of S.C.O.R.E. through May 31, 2022.<sup>5</sup>

This is about 2.5% of the total lifetime supply of ATLAS. The average daily ATLAS earned was 5.1 million. Despite the dramatic underlying changes in ship composition and the challenging external environment, the average daily ATLAS earned has remained remarkably consistent.

### Aggregate ATLAS Earnings



Source: ATMTA, Inc. Economics Department

The last equation allows us to decompose aggregate daily ATLAS earnings growth. Aggregate daily ATLAS wages grew 18.1% from Jan 1 through May 31, 2022.<sup>6</sup> The average wage per ship declined by 27.1%, the aggregate employment rate per ship decreased by 3.7%, and the size of the labor force grew by a whopping 49.1%. The supply of new labor hours came from fleet deposits of XXS ships, which commanded low ATLAS wages per ship. The addition of these ships into the capital stock lowered the average daily earnings per employed ship from around 22 ATLAS to 16.8 ATLAS.

<sup>5</sup> See <https://galaxy.staratlas.com/tokens/atlas> for ATLAS, and <https://galaxy.staratlas.com/tokens/polis> for POLIS in circulation

<sup>6</sup> Using the 7-day rolling mean for labor aggregates

Table 2: Aggregate Daily ATLAS Earnings Growth Decomposition

Date	$Wages_t$	$w_t$	$empl_t^{rate}$	$LF_t$
2022-01-01	4.19 M	22.02	0.85	0.224
2022-05-31	5.02 M	16.79	0.82	0.365
log change	18.1%	-27.08%	- 3.7%	+ 49.06%

## Net ATLAS Earnings by Class

The above decomposition of the growth in ATLAS earned provides a high-level summary of the changes that occurred in S.C.O.R.E. since the beginning of the year. As of January 1st, S.C.O.R.E. was growing rapidly, and ships were still being deposited. Including the early days in the aggregate wage growth calculation misses the actual evolution of the economy.

As the opening section about the economy mentions, mixing all classes of ships with each other will miss the underlying details.<sup>7</sup> We complement the table above with an additional decomposition centered on the class of ships. This analysis differs in that it picks January 15th as the start date. We pick this date because we consider this the end of the initial ship deployment phase. The additional two extra weeks allow for an analysis of a more mature economy. This time frame is ideal for studying the effects of a perfect storm to crypto on the general economic activity within S.C.O.R.E. without mixing in the effects of the initial faction immigration.

Another difference is that we net out the cost of the R4 consumed while in employment. Net ATLAS earned is the amount of ATLAS players earn less the costs to purchase R4. Lastly, we drop the 7-day moving average from the calculated figures so that the numbers correspond directly to January 15th and May 31st.<sup>8</sup>

Over this sample, XXS ships were the only class to experience growth in net ATLAS earnings. As mentioned earlier, this was largely due to the introduction of the Fimbul Airbike. Personal disposable income grew by 49%, with 51.1% of that coming from additions to the labor force, a 10.9% increase in the employment rate, and netting out the 12.9% decline in the average after-tax wage. With the exception of the XXS class, daily average take-home ATLAS wages within ship classes remained fairly constant.

For all the other classes, the reduction in the size of the labor force was the largest factor driving the decline in personal disposable income. These results are not surprising given the decline in resident wealth. Less dry powder is available for fixed capital deployment, and new purchase spending typically dries up when expected utility is perceived to be low. This low expected utility is associated with the past performance in the price of ATLAS and Solana. The capital stock decline has not resulted from a material increase in the rate of fleet withdrawals. Instead, new capital outlays dried up.

<sup>7</sup> The smallest classes will dominate the aggregate numbers.

<sup>8</sup> Table definitions: New wages are the daily aggregate ATLAS earnings less the ATLAS cost of R4 burned in millions of ATLAS. The average net wage is the daily average wage of ships in that class net of R4 in ATLAS. The employment rate is employment seconds as a fraction of the total labor force seconds. The labor force is in millions of days.

Table 3: After-tax ATLAS Earnings By Class

Class	Source	Percent Change	Jan 15, 2022	May 31, 2022
<b>Capital</b>	Net Wages	-6.3	0.8224	0.7719
	Avg Net Wage	0.3	1073.2354	1075.9396
	Employment Rate	-2.5	0.9491	0.9257
	Labor Force	-4.1	0.0008	0.0008
<b>Commander</b>	Net Wages	-14.5	0.7704	0.6667
	Avg Net Wage	-0.3	3190.9476	3180.8320
	Employment Rate	-2.7	0.9829	0.9572
	Labor Force	-11.5	0.0002	0.0002
<b>Large</b>	Net Wages	-11.3	0.7878	0.7036
	Avg Net Wage	1.0	321.5333	324.8782
	Employment Rate	-3.6	0.9323	0.8991
	Labor Force	-8.7	0.0026	0.0024
<b>Medium</b>	Net Wages	-17.5	0.8764	0.7358
	Avg Net Wage	0.2	93.6380	93.8261
	Employment Rate	-7.1	0.9235	0.8599
	Labor Force	-10.6	0.0101	0.0091
<b>Small</b>	Net Wages	-17.8	1.0713	0.8967
	Avg Net Wage	-0.3	31.4334	31.3447
	Employment Rate	-8.0	0.9476	0.8744
	Labor Force	-9.5	0.0360	0.0327
<b>Extra Small</b>	Net Wages	-36.4	0.2512	0.1746
	Avg Net Wage	-2.6	7.1072	6.9235
	Employment Rate	-11.4	0.8456	0.7549
	Labor Force	-22.4	0.0418	0.0334
<b>Extra-Extra Small</b>	Net Wages	49.0	0.0898	0.1467
	Avg Net Wage	-12.9	0.7043	0.6189
	Employment Rate	10.9	0.7624	0.8501
	Labor Force	51.1	0.1673	0.2788

Higher unemployment rates also contributed to lower aggregate income. Unemployment is a choice in S.C.O.R.E.. When wages fall below reservation wages, time spent not working will increase. A fraction of the labor force currently places a higher value on doing things outside of the game. This effect is witnessed in the cross-section. The decline in employment rates was smallest for Capital, Commander, and Large ships and largest for Small and Extra small ships.<sup>9</sup>

Extra small ships fared the worst, with aggregate take-home earnings declining by 36.4%. Conversely, higher-class ships experienced the most stability. For example, Capital ships experienced the smallest decline at 6.3%.

## Labor-Force Transitions and Fixed-Business Investment

The labor force is the most critical concept to understand. As shown in the previous section, the growth in the labor force drove aggregate daily ATLAS earnings to increase by 18% since the beginning

<sup>9</sup> The classical model argues that when wages decline, people will allocate less of their time toward working. Even though ATLAS wage rates have not declined, the price of ATLAS relative to USD has.

of the year. Furthermore, the decline in the labor force proved to be the dominant factor reducing aggregate atlas earned for Extra small through Commander ships.

The size and composition of the labor force determine the potential ATLAS output of the economy and average daily wages per ship.

The labor force's size is the economy's domestic capital stock. The capital-to-labor ratio is equal to 1. Each ship deposited equals one unit of labor added to the labor force. Fleet deposits represent new business fixed investment, which adds to the existing capital stock, increasing the potential output of the economy.

A fleet withdrawal represents a decrease in the domestic capital stock, which reduces the economy's potential output. The capital-to-output ratio is the aggregate stock of capital valued at the when-issued ATLAS price relative to gross ATLAS wages.

The labor-force participation rate is defined as the total ships in S.C.O.R.E. as a fraction of total ships outstanding.<sup>10</sup>

$$lfpr_t = \frac{ships_t^{Score}}{ships_t^{total}} \quad (5)$$

The size of the labor force is the fraction of ships that have made their way into S.C.O.R.E. multiplied by the total ships outstanding. Labor force growth occurs when

1. new ship production and issuance increase the total stock of ships outstanding, and
2. when there is an increase in ship absorption rates (i.e., labor-force participation rate growth).

$$LF_t = lfpr_t \times ships_t^{total} \quad (6)$$

The labor force size is limited by how many ships are outstanding (potential jobs available). Labor force growth is constrained when the demand for jobs exceeds the supply of jobs available. Factors impacting the labor-force participation rate include barriers to entry such as inadequate human capital and the physical cost of capital. The human capital required in training involves familiarizing oneself with setting up a Solana-based wallet and navigating the labor market opportunities.

The growth in the labor-force participation rate comes from new initial fleet deposits by existing faction members and new faction members and the growth in partial fleet deposits by existing faction residents. Faction immigration plays a crucial role in first-time fleet deposits (initial fleet deposits initiated by a new wallet address).

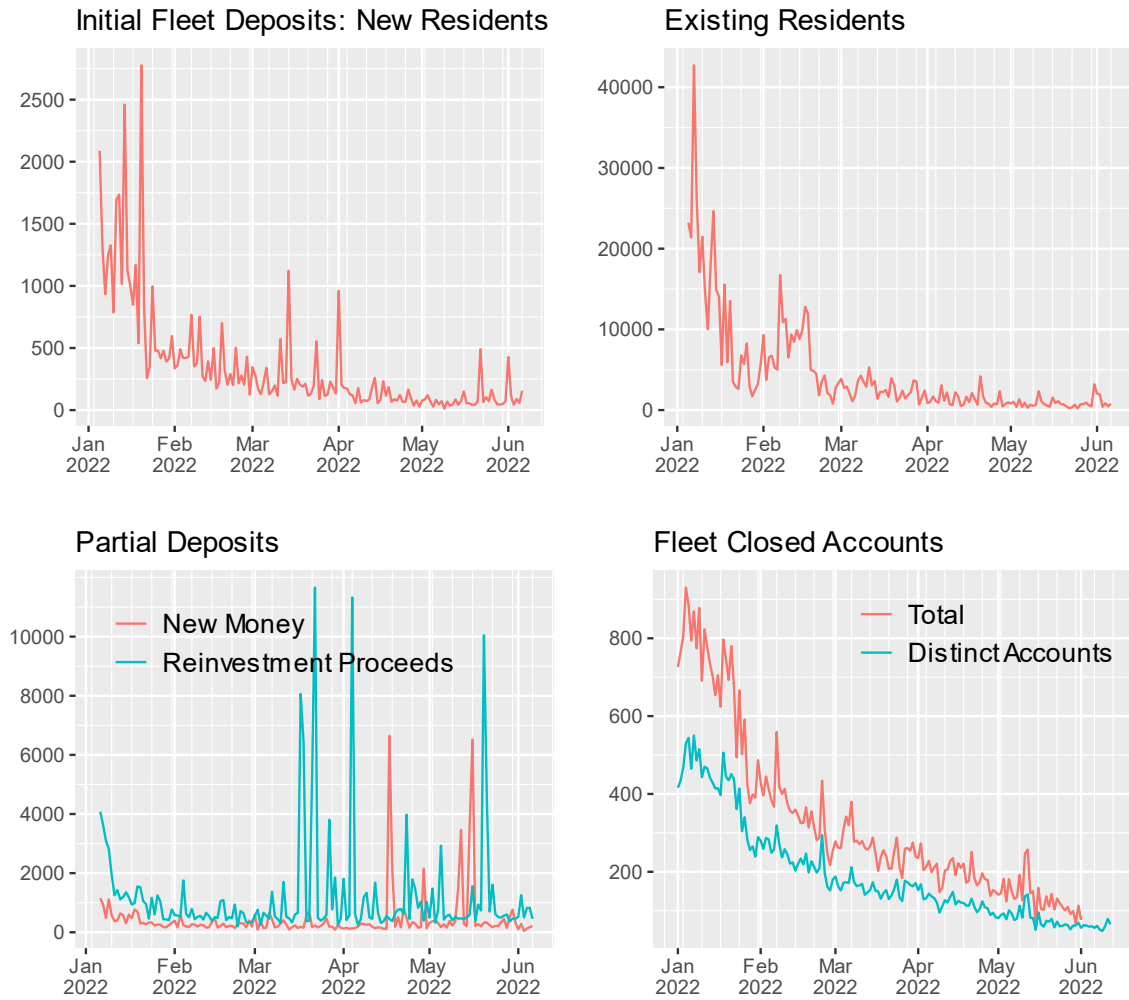
Partial fleet deposits are ships added to an existing fleet. Partial fleet deposits associated with a wallet address that claimed ATLAS that day represent reinvested ATLAS earnings.

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<sup>10</sup> This includes all unsold and sold ships. We have already seen it as ship absorption in figure 3.

Deposits not associated with ATLAS claims are considered to be capital inflows. All fleet deposits represent fixed investments and will increase the LFPR and the capital stock. When a fleet is withdrawn and closed, that represents a decline in labor force participation (and the domestic capital stock).<sup>11</sup>

### Labor Force Flows and Business Fixed Investment



Source: ATMTA, Inc. Economics Department and Flipside  
 Notes: Net Change in The Labor Force is defined in terms of Ships and is equal to Initial Deposits + Partial Deposits - Closed Fleet Accounts. In the figure, Fleet Closed Accounts is the number of closed accounts. Distinct Closed Accounts are first-time fleet withdrawals.

<sup>11</sup> Early estimates of account closures appear to under-represent actual closures, which can overestimate the growth in the labor force.

Table 4: Accounting for changes in the Labor Force

Labor Force	Labor force component
$LF_{t-1}$	Labor Force last period
$+IFD_t^{NR}$	Initial Fleet Deposit (New Residents)
$+IFD_t^{Existing}$	Initial Fleet Deposit (Existing Residents)
$+PFD_t^{NM}$	Partial Fleet Deposits from new money (Players that did not claim ATLAS that day)
$+PFD_t^{RINV}$	Partial Fleet Deposits from reinvestment (Players that claimed ATLAS that day)
$-Withdrawals_t$	Fleet Withdrawals and Account Closures from Score

The important metric here is the net change in the labor force, which shows the flows into and out of the labor force as a percentage of the previous day's number of ships in S.C.O.R.E.

$$\Delta LF_{t,t-1} = IFD_t^{NR} + IFD_t^{Existing} + PFD_t^{NM} + PFD_t^{RINV} - Withdrawals \quad (7)$$

$$lf_t^{net} = \frac{\Delta LF_{t,t-1}}{LF_{t-1}} \quad (8)$$

## Reinvested ATLAS wages

Reinvested ATLAS wages represent a vital contribution to the growth in the labor force and labor force participation. This factor has arguably sustained ATLAS earnings throughout the crypto down cycle. We can study its importance further by segmenting ATLAS claimers that deposit new ships into S.C.O.R.E. into three categories.

Table 5: Accounting for ATLAS Reinvestment

$Reinvestors_t$	ATLAS Claimers By Group	Reinvestment Action
$Claimers_t^{PD}$	Existing residents that made a partial fleet deposit	Existing Fleet Addition
$Claimers_t^{ID}$	Existing residents that made an initial fleet deposit	Fleet Diversification
$Claimers_t^{PD+ID}$	Existing residents that made an initial fleet deposit and a partial fleet deposit	Existing Fleet Addition + Diversification

$Claimers_t^{PD}$  are those that expanded an initial fleet with a partial fleet deposit on the same day they claimed ATLAS.

$Claimers_t^{ID}$  took their ATLAS earnings and diversified their fleets by depositing a fleet of a new ship type.

$Claimers_t^{PD+ID}$  did both.

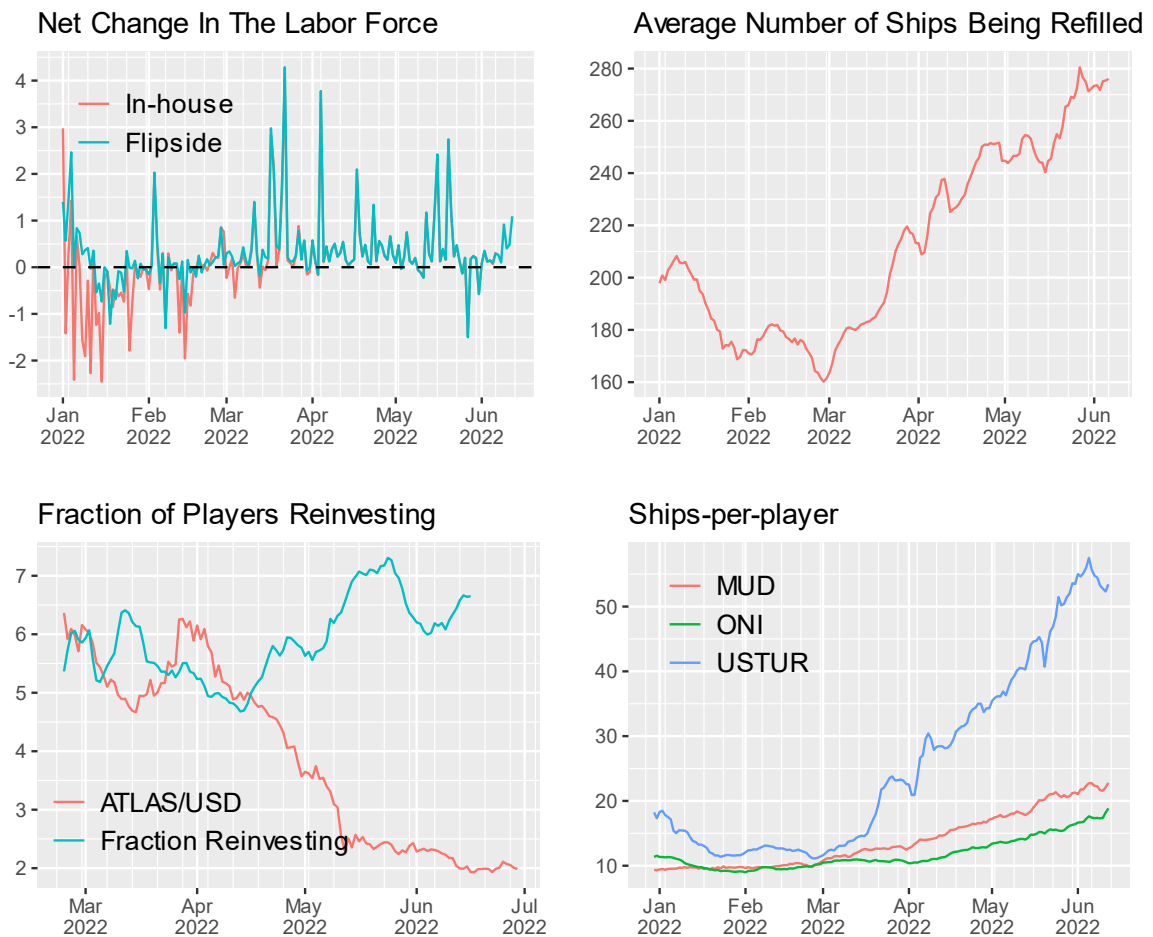
The sum of these three distinct player categories defines  $Reinvestors_t$ . In addition, the ratio of reinvestors to all ATLAS claimants for the day defines the reinvestors' share.

$$Reinvestors_t^{share} = \frac{Reinvestors_t}{Claimers_{Total}} \quad (9)$$

## Labor force re-cap

The story that the labor force conveys is the struggles brought on by the exogenous bear market and the actions existing faction residents take to grow the labor force from within through reinvestment of earnings.

### Change In The Labor Force and the Effects of Reinvestment



Source: ATMTA, Inc. Economics Department  
 Notes: Net Change in The Labor Force is defined in terms of Ships and is equal to Initial Deposits + Partial Deposits - Closed Fleet Accounts. Two alternative measures for fleet closed accounts are used to derive the net-change in the labor force. The first is an in-house measure which counts the withdrawal of AMMO and the second is a measure derived from Flipside. ATLAS/USD is scaled to fit the figure. Fraction of players reinvesting is as defined in the text. Numbers are associated with food re-fill actions. Ships in thousands. 7 day moving averages.

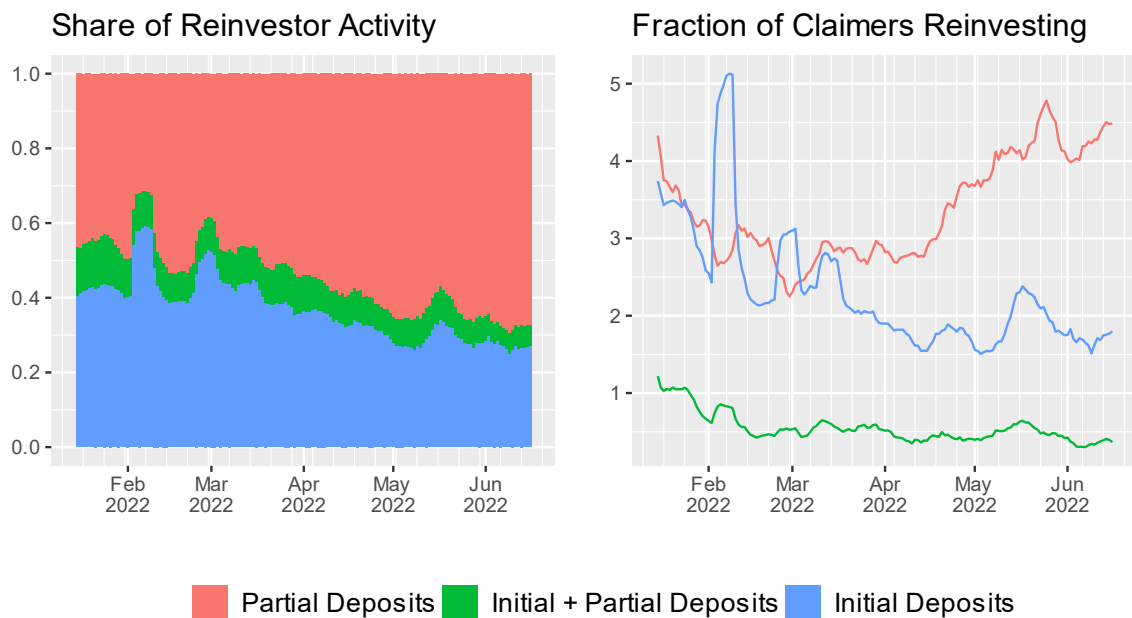
The bear market halted new immigration. The appetite for crypto subsided, and so did new users. Google searches for BTC, or any asset, increase when prices rise and decline when they fall. S.C.O.R.E.

is no different (see Figure 2). The decline in faction immigration coincided with falling asset prices and declining Google search interest.

The daily average number of players has fallen from 15,710 to 10,070.<sup>12</sup> Early data on account closures is missing data which causes our preferred estimate of the total number of ships in S.C.O.R.E. to be biased upward. An alternative labor force estimate is the 7-day moving average of the total ships associated with daily food refill actions. The daily average number of ships refilled increased from 197,858 to 272,439. As a result, the number of ships per player has more than doubled from 13 to 27. This increase in ships per player has coincided with Ustur acquisitions of the Fimbul Airbike.

The figure above plots the net changes in the labor force. Even though the first three months saw large outflows of fleets, the labor force has since recovered. The recovery is attributed to the actions taken by the remaining players actively reinvesting ATLAS earnings into growing their fleets. Most of this reinvestment activity took the form of growing existing fleets rather than diversifying. Since March 1st, 2022<sup>13</sup> the fraction of ATLAS claimants that made a partial fleet deposit on the same day has increased from around 2.3% to 4.5%. The fraction of claimants that diversified their fleets by adding a new type of ship fell from 3.1% to 1.8%. The share of ATLAS daily claimants that took action to both grow and diversify their existing fleets fell from .53% to .36%. In mid-January, 2022, 47% of all reinvestors focused exclusively on fleet expansion; that share has since increased to 67%.

**The cost of capital is a causal determinant of fleet expansion. In particular, the fall in the price of ATLAS has resulted in substantial re-pricing across all previously minted ships below origination values. This explains the growth in the share of reinvested ATLAS earnings attributed to repeat deposits. Ships that are being sold on the market from previously held inventory (at substantial discounts to origination prices) represent a better opportunity than diversifying into newly produced ships.**



Source: ATMTA, Inc. Economics Department; Notes: Fraction of players reinvesting is defined in the text. 7 day moving averages.

<sup>12</sup> From Jan 1, 2022, through May 31, 2022, using seven-day moving average data

<sup>13</sup> Through June 16th, 2022 using 7-day moving averages



## Labor Flows Between Unemployment and Employment<sup>14</sup>

Once a new economy matures past the initial immigration phase, population growth subsides, and new capital investment slows, the within-labor-force flows become the predominant drivers of aggregate wage growth. As previously mentioned, the ships within S.C.O.R.E. offer fixed daily wage rates. When no new ships enter the labor force, changes in aggregate wages are determined entirely by the labor market transitions between unemployment and employment.

There are three flows within the labor force. First, the E-to-E gross flow consists of ships that are employed today and remain employed tomorrow. It is the largest labor-force transition. The U-to-E gross flow accounts for the fleets moving from unemployment to employment. It is a hiring flow. The last flow tracks the movement of fleets from employment to unemployment. E-to-U flows are known as labor market separations. Gross flows expressed as rates are transition probabilities.

The job-finding rate is  $h_t$ . The gross flow from U-to-E is divided by the previous day's unemployed ships.

$$h_t = \frac{UE_t}{U_{t-1}} \quad (10)$$

The separation rate is  $s_t$ . The gross flow from E-to-U is divided by the previous day's employed ships. It is the probability of a ship running out of R4 before the next refill date.

$$s_t = \frac{EU_t}{E_{t-1}} \quad (11)$$

The labor market summary plots in the appendix feature these probabilities. These transition rates are essential in explaining aggregate wage variation in the absence of fleet deposits and account closures.

Combining the two flows into one creates a series that tracks ATLAS wage growth from within labor force transitions. The net job-finding rate is the difference between the flow into employment and the flow out of work divided by the previous day's labor force. The rate is equivalent to the daily change in the employment rate.

$$h_t^{net} = \frac{UE_t - EU_t}{LF_{t-1}} \quad (12)$$

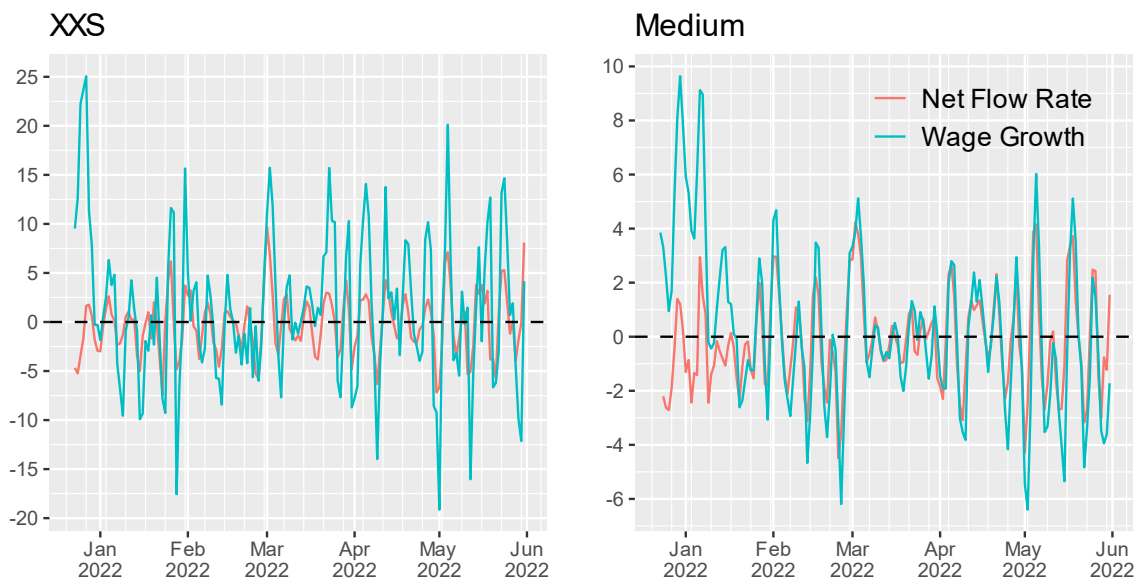
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<sup>14</sup> Labor market transitions between unemployment and employment are within the labor force. Therefore, these flows do not consider flows into and out of the labor force

Our decomposition of aggregate ATLAS wages identified the change in the employment rate as a core determinant of changes in daily aggregate ATLAS earnings. The net hiring rate captures that change directly.

The figure below shows the relationship between high-frequency changes in the employment rate and ATLAS wages for the XXS and Medium class of ships.<sup>15</sup>

For the XXS class of ships,  $h_t^{net}$  accounts for 51% of the variation in aggregate daily wages. This sector has been heavily influenced by partial fleet deposits and other changes to the size of the labor force. The variation attributable to  $h_t^{net}$  for daily changes in aggregate ATLAS earnings for Medium class ships rises to 70%.<sup>16</sup> **In the absence of significant labor force changes, players' efforts to keep their ships employed determine aggregate ATLAS earnings.** Player effort has real implications for aggregate earnings outcomes.<sup>17</sup> Higher levels of effort translate into higher employment rates and more time spent earning ATLAS.



Source: ATMTA, Inc. Economics Department; Notes: The 3 day rolling sum of the net transition rate is compared to the three day percentage change in aggregate wages for XXS ships and Medium class ships.

## DAO Revenue and R4

There are four resource types: Food, Fuel, Toolkits, and Ammunition. Each ship will burn these resources according to some predetermined rate.<sup>18</sup> There are three measures of R4 consumption: R4 sales by the DAO, the R4 deposited to keep a fleet operational, and the R4 burned per day as implied by the aggregate seconds spent in employment. Daily R4 purchased less the R4 burned in ship

<sup>15</sup> Specifically, the three-day net job-finding rate against the three-day log percentage change in aggregate wages

<sup>16</sup>  $R^2$  from a linear regression of the three-day net job-finding rate against the three-day log percentage change in aggregate wages, from Jan. 12, 2022 to May 31, 2022. The date was chosen to exclude the first few weeks of S.C.O.R.E. These weeks were dominated by new fleet deposits

<sup>17</sup> High unemployment rates indicate an economy not operating at its full potential. Fleet transitions from unemployment to employment raise the rate of domestic output and aggregate ATLAS wealth

<sup>18</sup> This rate is adjusted for some ships during the life of S.C.O.R.E. That causes resource consumption measured by DAO revenue to be out of sync with those implied by our definition of employment.

employment is the change in player-held R4 inventories. The cumulative sum of the daily inventory changes defines the stock of privately held R4.

The expense rate on fleet operations is the proportion of daily ATLAS earnings spent on operating the ship for the day. Despite the changes, average expense rates have remained stable at approximately 16.8%. Ammunition is the most significant component at 6.2% of ATLAS earnings, followed by toolkits, 5.6%; fuel, 3.6%; and food, 1.4%.

*Note: DAO Tax Collection is the expense rate + extra R4 purchased. The DAO collection rate is the Total R4 purchased divided by the total ATLAS earned.*

As highlighted throughout this report – a ship’s class matters greatly. The table below takes a cross-sectional look at the fiscal contributions and earnings of ships aggregated by their class. As a ship’s tier increases, so do the profit margins. XXS ships have an effective tax rate of 23.5%; on average, it costs them a full 1.8 times more to operate than the average Capital ship.<sup>19</sup> *However, on a net margin basis when adjusted for volume weighted average price, all ships perform similarly.*

Table 6: Fiscal Contributions By Ship Class (5-31-2022)

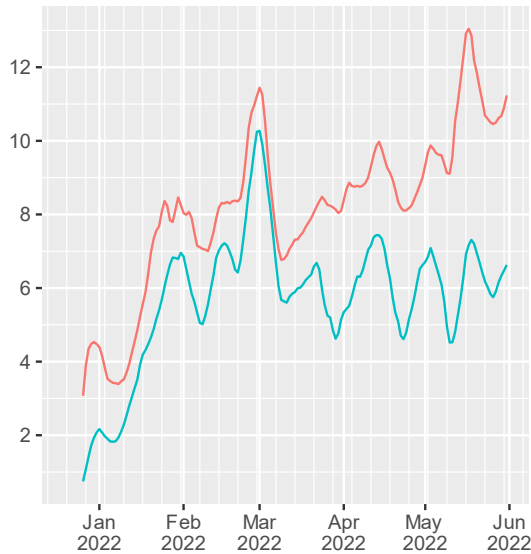
	Effective Tax-Rate	Share of Total			
		Employment Hours	Earnings	R4 Burned	Net ATLAS Rewards
<b>Capital</b>	12.8	0.2	18.0	13.7	18.8
<b>Commander</b>	13.8	0.1	15.7	12.9	16.3
<b>Large</b>	17.6	0.7	17.3	18.2	17.2
<b>Medium</b>	17.7	2.6	18.2	19.2	18.0
<b>Small</b>	18.9	9.5	22.5	25.3	21.9
<b>XS</b>	19.9	8.4	4.4	5.2	4.3
<b>XXS</b>	23.5	78.5	3.9	5.4	3.6

The employment of Small, Medium, and Large ships, account for 62.7% of the R4 burned. Their combined share of total employment hours is 12.8%, and their share of take-home earnings is 57.1%. XXS ships account for 78.5% of total employment and only 3.6% of take-home ATLAS earnings (largely the result of non-normalized data). Capital and Commander ships’ share of aggregate employment hours worked is .3%, yet they account for a fourth of all R4 burned and a whopping 35.1% of all take-home ATLAS emissions.

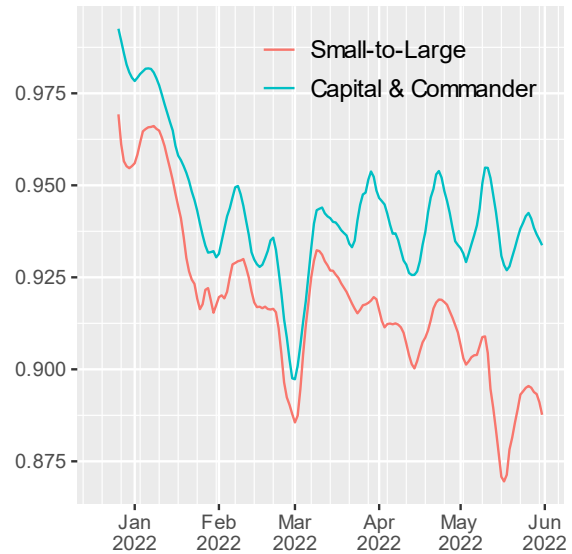
This sheds light on a key issue for the performance of the DAO and that of S.C.O.R.E. more broadly. 90% of the R4 burned and over 92% of the net ATLAS earned daily comes from the employment of Small tier ships and up.

<sup>19</sup> As a share of daily ATLAS earnings

## Unemployment Rates



## Employment Rates



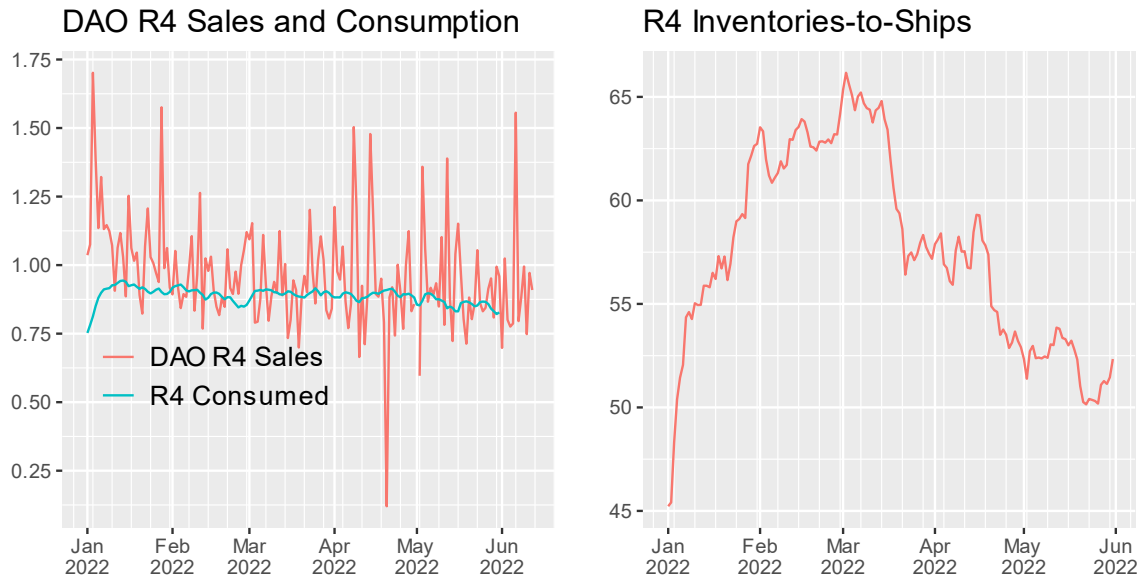
Source: ATMTA, Inc. Economics Department  
Notes: 7-day rolling mean.

As we know from the previous section, labor force rates are fundamental in determining aggregate ATLAS wages. From January 1, 2022 through March 1, 2022 the Small-to-Large unemployment rate rose from 4.4% to 11.4%. Likewise, the Capital and Commander fleets' unemployment rate rose from 2.2% to 10.3%. Capital and Commander fleets' experienced a subsequent 3.6% drop in unemployment rates. Whereas the Small-to-Large unemployment rate now stands at 11.2%.

The Small-to-Large unemployment rate is troublesome because of how important this group is to aggregate wages and DAO revenue. Mirroring the rise in unemployment is the hit to after-tax ATLAS wages, which have fallen by 235,195 ATLAS per day since March 1st, 2022.

The slowdown in economic activity resulted in a significant build-up in privately held R4 stocks. As a result, privately held R4 inventories-to-ships peaked in early March at 66 ATLAS per ship and have seen a significant drop since then to 52 ATLAS per ship. The inventory drawdown of 14 ATLAS per ship coincides with the recovery in employment hours and pick-up in general activity.

As of June 14th, 2022, the DAO has collected 177,192,388 ATLAS in revenue. Since R4 burned is a direct function of the time spent earning ATLAS, DAO revenue is pro-cyclical.



Source: ATMTA, Inc. Economics Department  
 Notes: ATLAS Revenue and R4 burned during employment are in millions of ATLAS. R4 inventories-to-ships is the cumulative sum of R4 purchased in ATLAS less R4 burned in employment divided by the number of ships in Score.

## Concluding Thoughts

The unprecedented bear market in broader crypto markets has negatively impacted S.C.O.R.E. New fleet deposits have come to a halt, and the number of players actively maintaining their fleets has declined. These developments are not in the least bit unusual. What is unusual are the unmistakable signs of resilience that S.C.O.R.E. has exhibited throughout this period. The total number of ships has increased, and ships brought in early on have not seen the withdrawals one would expect after a significant market downturn. S.C.O.R.E. has been sticky. As shown throughout this report, there is every reason to have expected a substantial decline in daily ATLAS earned. The primary driver of this expected decline would have come from a decline in labor force participation and falling employment rates. That did not happen; instead, aggregate labor hours increased. This increase in hours came about with the release of the Fimbul Airbike. This ship has become a favorite target for reinvested ATLAS earnings.

S.C.O.R.E. has proven to be a real economy. An external shock occurred at the outset when the decline in broader crypto markets reduced the net wealth of faction residents.<sup>20</sup>

The high correlation of ATLAS to metaverse gaming tokens meant that this decline transmitted directly into S.C.O.R.E. through the price of ATLAS. That resulted in a dramatic economic slowdown characterized by falling labor-force participation and a decline in capital stock. As the price of ATLAS fell, a natural rebalancing mechanism took place. Ships of all classes denominated in ATLAS fell in price relative to their potential output. This caused a flood of reinvestment in ATLAS earnings, which raised business fixed investment and increased the economy's potential output. This led to a halt in the economic slowdown and the start of economic recovery where we remain today.

<sup>20</sup> The metaverse-gaming token index fell 51% from January 15th, 2022 through the end of February. The metaverse and gaming token space lost 38.8 billion in market capitalization from January 1, 2022 through June 13, 2022

# Data Appendix

## Labor Market Transition Rates and Wage Growth By Ship Class

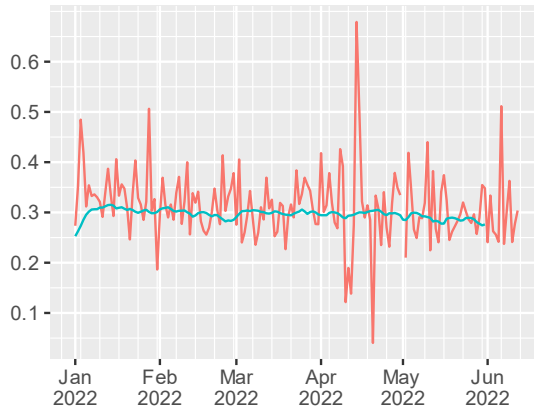


Source: ATMTA, Inc. Economics Department  
 Notes: The 3 day rolling sum of the net transition rate is compared to the three day percentage change in aggregate wages.

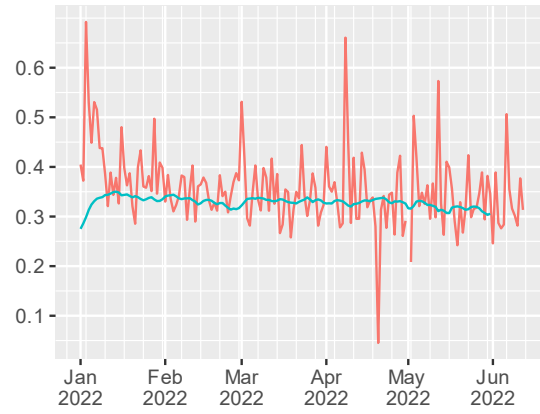
# DAO Revenue and R4 Consumption

## DAO ATLAS Revenue and Resource Consumption

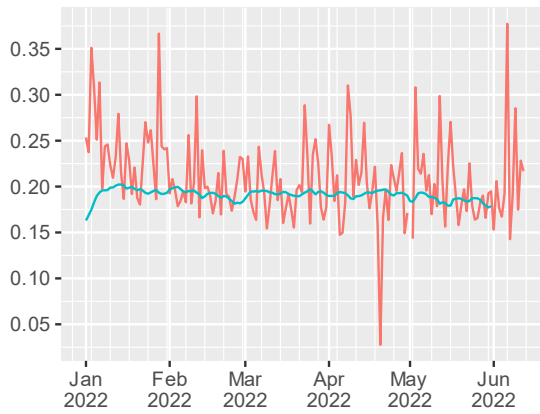
Toolkits



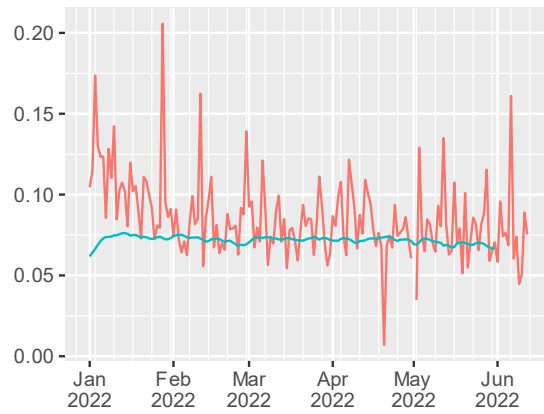
Ammunition



Fuel



Food



— DAO Sales — Burned in Employment

Source: ATMTA, Inc. Economics Department  
 Notes: ATLAS Revenue and R4 burned during employment are in millions of ATLAS.

## Metaverse, Gaming, and Meta-Gaming Token Price Index construction

Tokens used for respective indexes are from <https://coinmarketcap.com/>. Tokens that overlap gaming and metaverse are classified as metaverse gaming and are excluded from the gaming and metaverse categories. Categories and data are sourced from Coinmarketcap.com.

Token Index	Tokens
Gaming	185
Metaverse Gaming	115
Metaverse	85

## Gross Flows Full Decomposition

Table 8: Gross Flows Summary

Gross Flow	Definition
N_to_E	Initial and partial deposits
U_to_E	Refilling R4 after being on empty
E_to_E	Refilling R4 before running out
E_to_N	Closing an fleet and withdrawing ships (with a positive R4 balance at closure)
U_to_N	Closing a fleet and withdrawing ships (with zero R4 balance)
E_to_U	Running out of R4 and entering Unemployment
N_to_U	Initial deposit straight into Unemployment (zero case)
U_to_U	Remaining unfilled

## Which projects are contributing towards crypto adoption?

This model focuses on new Star Atlas users. To begin with we need to explore **where** these players come from. There are two populations in this world, those that are familiar and use crypto today,  $U_t$ , and those that don't use it (yet),  $N_t$ . The total global population is noted by  $P_t$ . So we have that,

$$P_t = U_t + N_t \quad (13)$$

- $U_t$  = total number of crypto users in existence<sup>21</sup>
- $P_t$  = Global population
- $N_t = P_t - U_t$ , the total number of non-crypto users or potential users is the difference between the global population and crypto users.

<sup>21</sup> *crypto.com* appears to have started tracking this and put the global crypto population at 295 Million for December 2021, for more info on their methodology see: <https://crypto.com/research/2021-crypto-market-sizing-report-2022-forecast>



The total stock of crypto users is defined by how many users there were last period and the total change in users over the period.

$$U_{t-1} + \Delta U_{t-1,t} = U_t \quad (14)$$

Since  $\Delta U_{t-1,t}$  is the change in total users, and not *new* users, a further decomposition is required. The total change in crypto users is then equal to the number of *new* crypto users,  $NU_{t-1,t}$ , less the number of people leaving crypto over the period,  $UN_{t-1,t}$

$$\Delta U_{t-1,t} = NU_{t-1,t} - UN_{t-1,t} \quad (15)$$

New users have to come from the stock of potential new users. The rate which defines how many new crypto users there are this period, is also fundamentally the crypto adoption rate,  $\delta_t^{N \rightarrow U}$

$$NU_{t-1,t} = \delta_t^{N \rightarrow U} \times N_{t-1} \quad (16)$$

The rate which defines the number of people leaving crypto is the separation rate,  $\delta_t^{U \rightarrow N}$

$$UN_{t-1,t} = \delta_t^{U \rightarrow N} \times U_{t-1} \quad (17)$$

The crypto adoption rate -  $\delta_t^{N \rightarrow U}$  - is a time-varying parameter of interest.

$$\delta_t^{N \rightarrow U} = \frac{NU_{t-1,t}}{N_{t-1}} \quad (18)$$

Total crypto-to-population ratio is defined as  $U_t/P_t$ , this is the fraction of the world's population

that uses crypto. Crypto.com uses the terminology crypto adoption rate - but I call it the cryptoto-population ratio.

The crypto adoption rate can be decomposed in a number of unique ways. One such decomposition helps us answer the question of which projects are driving crypto adoption. For each crypto-project,  $i$ , we can calculate how much they are driving new adoption. Let  $NU_{t-1,t}^i$  equal the number of people participating in crypto for the first time and joining the crypto-project  $i$ .

$$\delta_t^{N \rightarrow U^i} = \frac{NU_{t-1,t}^i}{N_{t-1}} \quad (19)$$

The sum of all  $\delta_t^{N \rightarrow U^i}$  is  $\delta_t^{N \rightarrow U}$

$$\delta_t^{N \rightarrow U} = \sum_{i=1..k}^K \delta_t^{N \rightarrow U^i} \quad (20)$$

A fundamental question that this breakdown can answer is how much each project is contributing to total crypto adoption.

A projects contribution to the crypto-adoption rate is given by  $\lambda_t^i$

$$\lambda_t^i = \frac{\delta_t^{N \rightarrow U^i}}{\delta_t^{N \rightarrow U}} \quad (21)$$

By definition the sum of all  $\lambda_t^i$  is equal to 1.

$$\sum_{i=1..k}^K \lambda_t^i = 1 \quad (22)$$

Given the cost of data collection this project would entail, short-cuts are encouraged. A calculate  $\lambda_t^i$  that doesn't rely on  $N_t$  or  $P_t$  is

$$\lambda_t^i = \frac{NU_{t-1,t}^i}{NU_{t-1,t}}$$

## Estimating The Contribution of Star Atlas to Global Crypto Adoption in December 2021

We do not have the data for computing exactly what we want, but we do have enough data to compute Star Atlas's new player contribution to the total change in crypto user growth. This approach may not always yield meaningful results as  $\Delta U_{t-1,t}$  can technically be negative.

*This example is for illustrative purposes only. 1. We would need an accurate measure of Star Atlas players that are brand new to crypto; and 2. The measure of total crypto users may not be representative of the true number of crypto users. 3. Using the change in total users nets out people leaving crypto, and is therefore not measured as exactly required. All of these factors would cause the estimate to be revised downward.*

1. According to Crypto.com between November 30 and December 31, 2021 the change in total crypto users was  $\Delta U_{t-1,t} \approx 3,000,000$
2. According to internal estimates the growth in new players was  $NU_{t-1,t}^i = 54,188$

The rough estimate suggests Star Atlas contributed 1.8% to the growth in the global crypto user base in December 2021.

$$\lambda_t^{SA} = \frac{54,188}{3,000,000} \times 100 \approx 1.81\% \quad (24)$$

Given the data and measurement issues described above, a safe bet would be to adjust this estimate downwards.

We assume that 60% of new players were first time crypto users,  $54188 * .6 = 32513$  and that 3.5M new users was the actual number. This brings the estimate of Star Atlas' contribution to roughly 1%.