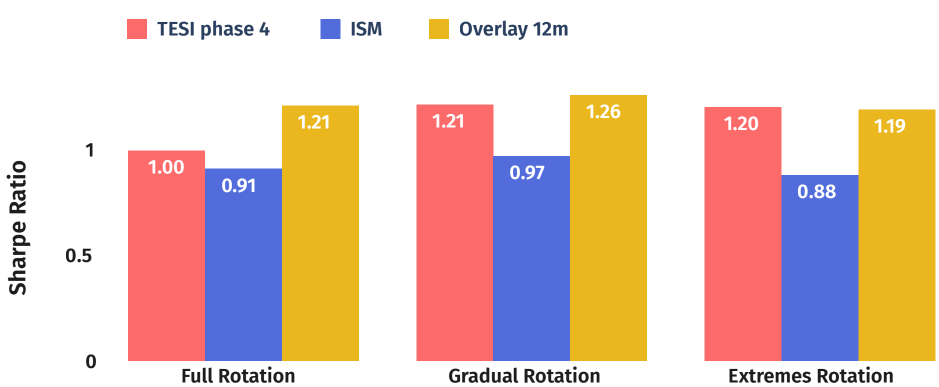
Tracking Economic Activity from Earnings Call Transcripts

Key Takeaways

In this paper, we leverage RavenPack EDGE event detection and sentiment scoring capabilities to analyze company earning call transcripts and create a real-time Transcript Economic Sentiment Indicator (TESI) for the US. We find that:

- **TESI can identify significant inflection points in the U.S. economic activity and detect meaningful changes in the business cycle. The model accurately detects 70% of the U.S. GDP upshifts and 60% of downshifts.**
- **TESI-based stock-bond rotation strategies outperform all common static benchmarks on a risk-adjusted basis, with Sharpe Ratios ranging from 0.74 to 0.90 using daily rebalancing and 0.89 to 1.27 when rebalancing monthly.**
- **An overlay strategy using combined TESI and ISM-based signals further enhances performance, with the Sharpe Ratio improving from 0.91 to 1.21 when fully rotating between the asset classes based on the signal.**



Sharpe Ratio comparison of monthly strategies based on TESI, U.S. ISM Manufacturing PMI, and the combined overlay signal strategies.

Source: RavenPack, February 2022

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QUANTITATIVE RESEARCH

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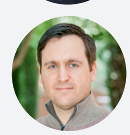

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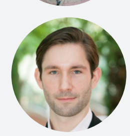

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1. Introduction

In recent papers (HAFEZ ET AL. 2021A, AND HAFEZ ET AL. 2021B), we demonstrated how earnings-related news events can be combined with insider transactions and earnings call transcripts to construct portfolios that outperform the market across different trading horizons ranging from days to months. Earnings call transcripts also contain soft, non-quantitative information such as sentiment (TETLOCK 2007, FELDMAN ET AL. 2009) or readability (Loughran & McDonal 2014), which can be correlated to subsequent market reactions. In addition to providing insights about company performance, earnings calls can offer a window into the financial executives' views about the past, present, and future state of the economy.

In this paper, we leverage the RavenPack Edge event detection and sentiment scoring capabilities to analyze earnings call transcripts and create a real-time Transcript Economic Sentiment Indicator (TESI) for the U.S. The indicator is constructed by aggregating the sentiment scores of individual events detected in the transcripts. We then apply an exponential decay function over time to assign higher weights to more recent transcripts, ensuring a timely, smooth signal which does not decay too quickly. We show that TESI can help detect and anticipate the most significant inflection points in the U.S. economic activity, offering a more accurate assessment of the actual and future states of the economy. Finally, we demonstrate that TESI can be used to create profitable investment strategies by using a simple rules-based stock-bond rotation approach across different rebalancing frequencies. The resulting strategies benefit from higher Sharpe Ratios compared to the standard fixed benchmark and ISM Manufacturing PMI approaches.

Previous literature has demonstrated the impact of Central Bank communications on the business cycle, equity prices, and policy rates (JAROCINSKI ET AL. 2018 AND 2020, AND GARDNER ET AL. 2021). However, we find that earnings call transcripts are another valuable source in timing the business cycle and can be a useful asset in constructing systematic stock-bond rotation strategies. In particular, we find that management teams often provide valuable insights about the economic environment in which they operate, which in turn can be used as inputs to our Transcript Economic Sentiment Indicator *(i.e.: "Ford Motor: we project U.S. GDP growth of around 4%", and "Nestle S.A.: organic U.S. growth accelerated in Q2")*.

The remainder of the paper is organized as follows: **SECTION 2** presents the datasets, their features, and appropriate filtering. In **SECTION 3**, we explain how the events captured from the transcripts data are aggregated to construct TESI. **SECTION 4** shows how TESI can be used to time the U.S. economic activity. **SECTION 5** demonstrates how to use TESI to create profitable investment strategies. In **SECTION 6**, we provide our conclusions, while the Appendix contains further robustness checks.

2. Data Description

RavenPack has developed proprietary natural language processing (NLP) algorithms to identify over 7,000 different event categories and over 12 million entities across 40,000 different sources, such as news articles, transcripts, and company filings. The events are classified within a hierarchical four-layer event taxonomy, starting from five broad topics (Business, Economy, Environment, Politics, and Society) and branching further into the most granular event categories.

To construct the Transcript Economic Sentiment Indicator (TESI), we use analytics from the RavenPack Edge Transcripts dataset[1]. The historical archive spans from January 2003 to the present and consists of more than 500,000 unique conference call transcripts from more than 15,000 companies from all around the world. For the scope of the paper, we focus on the period of January 1st, 2003 to December 15th, 2021. Immediately after a transcript document is made available, typically less than a day after the actual call takes place, RavenPack generates a rich set of scores, tags, and other structured information in real-time. While coverage is global, close to 70% of transcripts originate from U.S. companies. In addition to generally better U.S. coverage of the underlying FactSet transcripts data, there are various inherent reasons for lower volume across other regions – certain countries, for example, do not require the same quarterly reporting frequency as the U.S., or companies may not host earnings calls regularly unless legally mandated[2].

For each document, RavenPack generates several structured records containing the analytics of each transcript as a whole, as well as for all the entities detected within the text. Since our goal is to build a broad U.S. economic activity indicator generated from the discussion about any relevant entities within the U.S., we include records related to non-company detections, such as places or organizations, as well as transcripts from non-U.S. based companies.

We use the following filters to select the most relevant records related to real economic activity:

Topic	Economy
Country code	US
Group	Selected activity groups[3]
Type	Selected activity types[4]
Role	Exclude “rater” events

1 The dataset is retrieved from the FactSet Transcript provider (RP_PROVIDER_ID = “FSTR”) within the RavenPack Edge product.

2 For a more comprehensive description of the FactSet Transcript data see HAFEZ, ET AL. (2021).

3 The Groups selected are in the Appendix A.5.

4 The Types selected are in the Appendix A.5.

The first two criteria ensure that we use records related to macroeconomic activity in the U.S., regardless of the domicile of a company hosting an earnings call. Criteria 3 and 4 aim to narrow down the event selection to comments or sentences that reference specific real macroeconomic events and help filter out any potential noise related to prices or other nominal events. Finally, we exclude all neutral events.

To ensure no look-ahead bias, we consider records over the trailing 24 hours prior to the 15:00 ET daily cutoff and trade the signal at the 16:00 ET market close.

To eliminate any duplicates caused by potential transcript revisions, we retain only the first detected event for each PROVIDER_DOCUMENT_CHAIN_ID. While this reduces the size of our dataset by 50%, we need to avoid using redundant information that may bias or diminish the validity of our results.

FIGURE 1 shows the distribution of detected events in the resulting dataset. Unsurprisingly, economic growth and labor market events dominate the macroeconomic discussion on earnings calls, indicating that the corporate sector is closely monitoring macroeconomic trends.

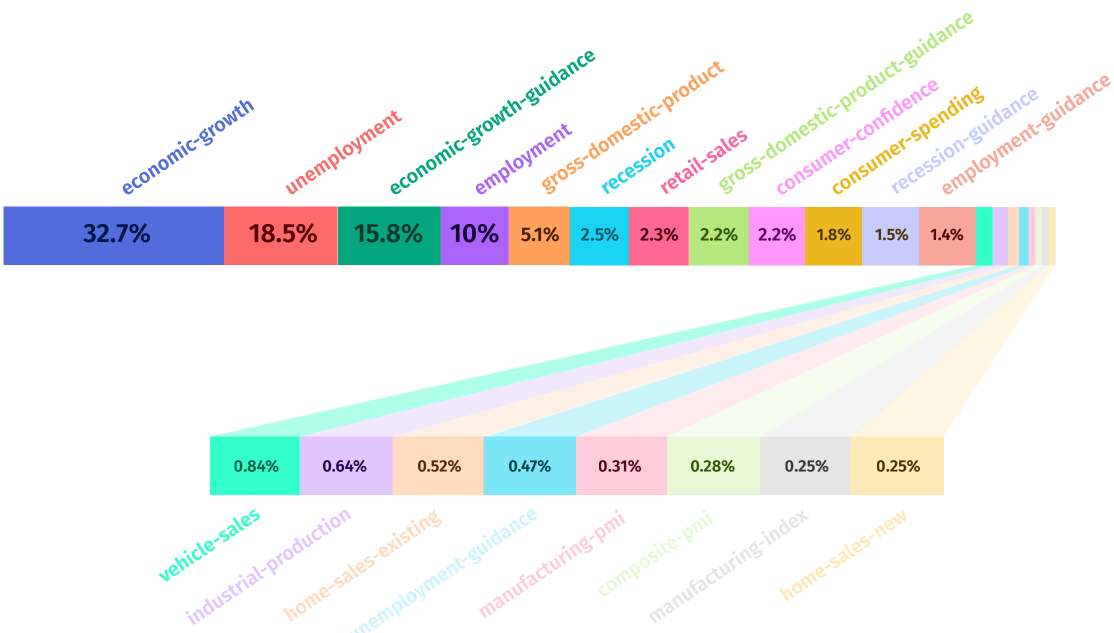


FIGURE 1: Event type distribution from January 2003 through December 2021.
Source: RavenPack, February 2022

The market data used to implement the investment strategies include the S&P 500 index for the stock component, the ICE BofA Current 10-Year U.S. Treasury Index for the bond component, and the ICE BofA 3-Month U.S. Treasury Bill Index for the cash rate.

3. Transcript Economic Sentiment Indicator (TESI)

In this section, we build a bottom-up sentiment indicator that captures the views of corporate executives about the past, present, or future prospects of the U.S. economy. This information is aggregated at the micro level to arrive at a macro view of the economic activity.

We use Event Sentiment (ES), a granular score between -1 and 1 representing entity-specific sentiment for any individual event defined in the RavenPack Taxonomy. The score is determined by systematically matching stories usually categorized by financial experts as having a positive or negative financial or economic impact. The more extreme the value, the more positive or negative the sentiment of an entity is within the context of an event, while a value of zero indicates neutral sentiment.[5].

The daily aggregated signals derived from the Event Sentiment score tend to be highly volatile. Given the slower-moving pace of the business cycle, it is reasonable to apply smoothing to our signal over time. We construct TESI as follows:

- Calculate aggregated daily sentiment of all filtered events over the trailing 24 hours prior to the 15:00 ET daily cutoff.
- Apply an exponential decay function with a one-month half-life, whereby a view expressed one month ago has half the weight relative to a view expressed today.

$$TESI_t = \frac{\sum_{t=\tau-M}^{\tau} ESS_t \ x \ W_t}{\sum_{t=\tau-M}^{\tau} W_t}$$

Where $W_t = exp(-\lambda(t-\tau))$ is the weight for the ESS at time t, $\lambda = log(2)/30$ is the the one-month half-life decay factor, and T is the transcript release day, where $\tau \leq t$.

To generate our final business cycle classification indicator, we apply the four-group classification schema shown in **TABLE 1**, accounting for both the rate of change and the level of TESI values:

Economic Sentiment (TESI)	YoY Change > 0	YoY Change < 0
Level > 0	Expansion	Slowdown
Level < 0	Recovery	Contraction

TABLE 1: Identifying the different business cycle phases based on the rate of change and the level of TESI.

5 For more details, see the guide here.

By focusing on year-on-year (YoY) change, we are able to reduce seasonality resulting from quarterly earnings and general calendar effects.

To minimize the likelihood of frequent phase shifts, we apply robust phase detection – if a new phase is identified, it needs to be sustained for several continuous days to be accepted. This procedure reduces potential noise and volatility, leading to fewer portfolio rebalances **(SECTION 5)**. To determine the optimal number of days that balances this trade-off between noisy phase detection and timeliness, we examine the change in the number of detected phases as we increase the minimum phase length requirement from one to several days.

FIGURE 2 shows that the number of identified phases drops by roughly one-third as we move from no restriction to at least two consecutive days needed to detect a new phase. It further drops by 12.5% as we move from two to three days and by another 12.5% as we move from three to four days. Beyond this point, any further restriction only decreases the number of detected phases by 2. Using a pseudo "elbow rule", the optimal choice appears to be 4 days. While there is scope for further reducing the number of potentially spurious phases, it would be at the cost of compromising timeliness[6].

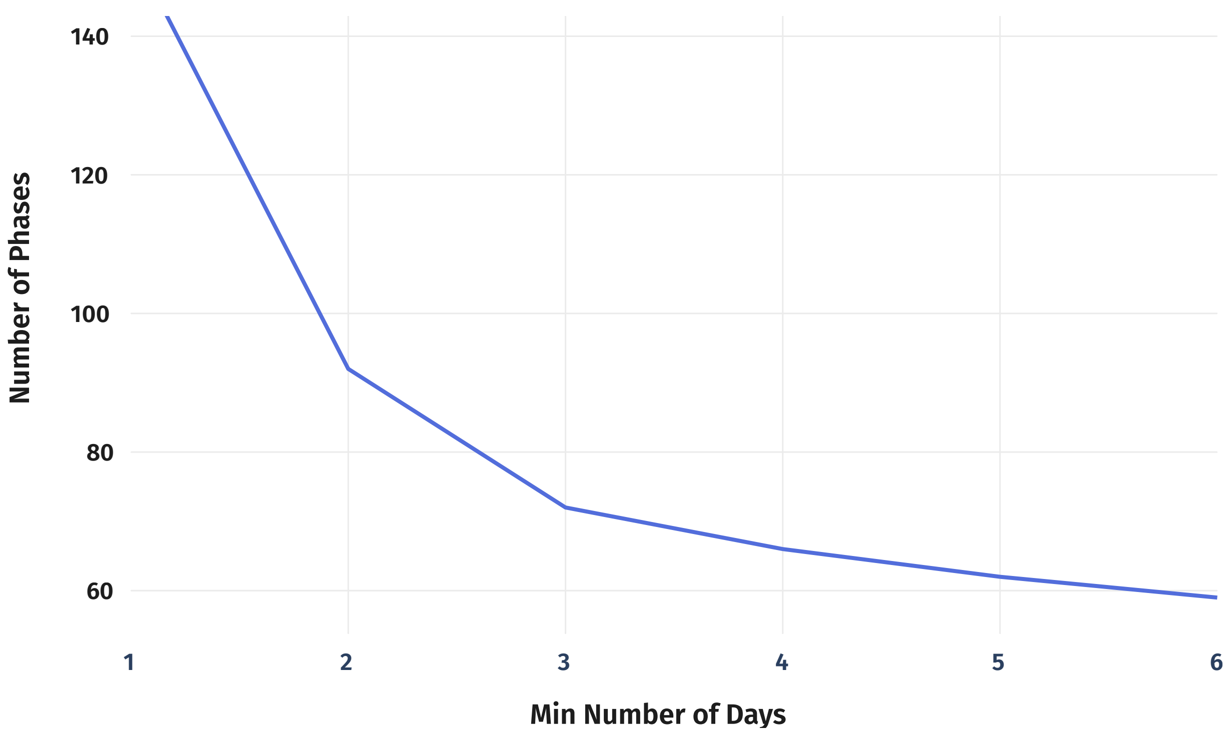


FIGURE 2: Number of business cycle phases identified using from 1 to 6 days as minimal requirement to switch phase. *Source: RavenPack, February 2022*

6 In the Appendix A.3.1 we test model robustness by backtesting a range of 2-6 days for robust phase detection and show that the results still hold.

4. Timing Economic Activity

Policymakers and investors alike must take into account the timing of economic activity in order to devise, update, and modify their monetary policies and investment strategies. The highest degree of uncertainty is around identifying inflection points and the resulting regime shifts. The information available at a point in time carries the risk of being misinterpreted, while the largely backward-looking macroeconomic releases may struggle to reflect the prevailing economic situation. We believe that economic indicators originating from earnings call transcripts can be more timely and forward-looking.

In this section, we explore whether our business cycle classification indicator based on TESI could have helped us foresee the most significant inflection points in U.S. economic activity. If true, it could be an additional tool that practitioners can use to time the business cycle and reduce the uncertainty around these situations. We use GDP to measure the economic activity of a country.

FIGURE 3 shows the real-time value of TESI versus the U.S. GDP expressed in quarterly annualized percentage change (%QoQ Ann.). The U.S. GDP values are plotted on their release dates, approximately one month following each quarter-end. This allows us to accurately reflect the information as it becomes available and offers a fair comparison with TESI, which is fully point-in-time. The shaded areas correspond to the four phases of the business cycle identified by TESI, described in **SECTION 3**.

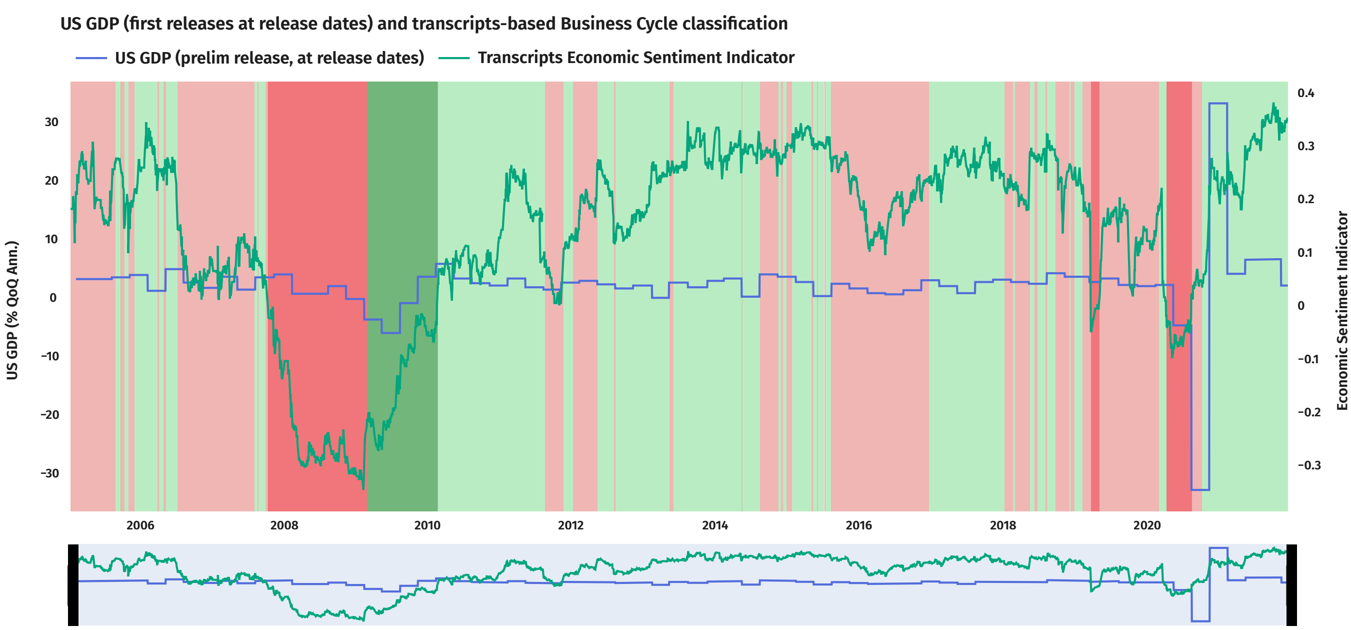


FIGURE 3: Evolution of TESI (black line) and the U.S. GDP (% QoQ Annualized) over time. The shaded areas identify business cycle phases detected by TESI. Contraction in red, slowdown in light red, expansion in light green, and recovery in green. *Source: RavenPack, February 2022*

FIGURE 3 shows that TESI helps anticipate the most significant turning points in the economy. It was not until November 2008 that the NBER announced the Great Recession to have begun in December 2007[7]. TESI had been trending downward from as early as June 2006, signaling a downturn in economic activity by October 1st, 2007, nearly two months before the official start date of the recession. It reached a trough on January 26th, 2009 with a recovery phase beginning on February 13th, 2009, well before the official NBER trough announcement in June 2009[8].

More recently, we observe that TESI began to fall sharply starting on March 1st, 2020, with a contraction phase signaled on March 26th, 2020, well before the first quarter U.S. GDP print was released on April 29th, 2020. Despite the large magnitude of the economic downturn, Covid-19 was the shortest recorded U.S. recession in history, ending in April 2020 according to the NBER. This explains why there was no recovery phase this time, as TESI had moved quickly into the positive sentiment territory by the time its level started improving relative to the previous year.

Finally, the TESI-based business cycle indicator can also help predict the direction of U.S. economic activity before the actual release of the GDP measure. To demonstrate this forecasting ability, we evaluated the relationship between TESI and the U.S. GDP (%QoQ Ann.) on the last day of a given quarter, approximately one month before the release of the actual GDP measure.

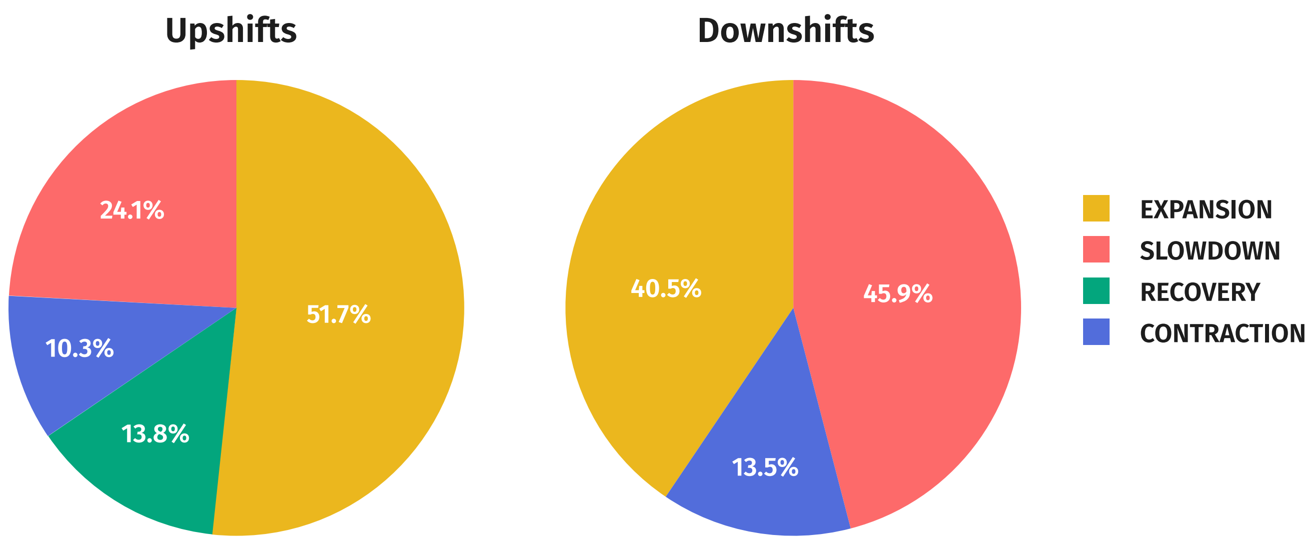


FIGURE 4: Percentage of expansion and recovery phases detected by TESI on the last day of the quarter, approximately one month before an upshift (downshift) of the GDP.
Source: RavenPack, February 2022

7 The NBER official announcement can be found here.

8 All the NBER business cycle phases with dates can be found here.

FIGURE 4 shows that TESI identifies an expansion or a recovery phase (left chart) before a GDP upshift in almost 70% of the cases, while it identifies slowdown or contraction phases (right chart) before GDP downshifts in 60% of the cases. The results suggest that TESI has significant forecasting ability in terms of predicting the direction of economic activity irrespective of its positive or negative level.

5. Timing Stock Bond Rotation

To evaluate whether the transcripts-based economic indicator can be used to create profitable investment strategies, we backtest simple rules-based stock-bond rotation strategies from August 2005 to December 2021. We implement three long-only systematic strategies, which allocate capital based on the TESI business cycle signal:

- The **Full Rotation** strategy goes 100% long the stock market (S&P 500) if the phase identified by TESI is either Recovery or Expansion, and 100% long treasuries (ICE BofA Current US Treasury 10y) for the other phases.
- The **Extremes Rotation** strategy is less aggressive and allocates 100% to stocks if TESI signals a recovery phase, 50% stocks and 50% bonds if the phase detected is either expansion or slowdown, and 100% bonds if TESI classifies the business cycle phase as contraction.
- The **Gradual Rotation** strategy, as suggested by the name, is the least aggressive. It invests 100% in the stock market if the phase identified is Recovery, 100% in the bond market if we are in a Contraction period, 60% in the stock market and 40% in the bond market during an Expansion phase, and 40% in stocks and 60% in bonds when TESI identifies a Slowdown period.

We test our strategies against four standard benchmarks: 100% long only stocks, 100% long only bonds, 60% stocks and 40% bonds, and 50% stocks and 50% bonds. We use two rebalancing frequencies: daily, whereby the portfolio is reallocated on the day following the start of a new phase, and monthly, based on the cycle phase detected on the last business day of a calendar month[9].

To compare the resulting performance of the TESI business cycle allocation strategies and the benchmarks, we use Sharpe Ratios and cumulative returns[10]. We first study the performance of our three stock-bond rotation strategies based on the stand-alone TESI signals. As alternative benchmarks, we create equivalent strategies based on the U.S. ISM Manufacturing PMI[11], a monthly indicator published within the first four days after the end of the reference period, following the same methodology outlined in **SECTION 3**[12]. This soft, macroeconomic indicator describes current economic conditions and is used by practitioners to identify a business cycle when no high-frequency indicators are available. Finally, we explore how to combine these two different signals to overcome periods of high uncertainty.

9 In the monthly rebalancing, the reallocation trades are made at the close price on the last working day of the month, when the phase is observed.

10 We use the ICE BofA US treasury Bill index for cash.

11 The US ISM PMI Manufacturing is downloaded from FactSet, but easily accessible from other data providers.

12 For example, the value US ISM PMI Manufacturing value for April 2021 is published between the 1st and the 4th of May 2021.

5.1 Stand-alone signals: TESI and US ISM PMI Manufacturing to time the asset rotation

FIGURE 5 shows the Sharpe Ratios of the stock-bond rotation strategies based on the three TESI signals relative to the benchmarks using daily rebalancing. By applying the least aggressive Gradual and Extremes rotation strategies, Sharpe Ratios improve relative to the benchmarks in the range of 0.16 to 0.52 points. The results suggest that a robust business cycle phase-detection system with dynamic portfolio rebalancing can enhance strategy performance relative to more static allocations.

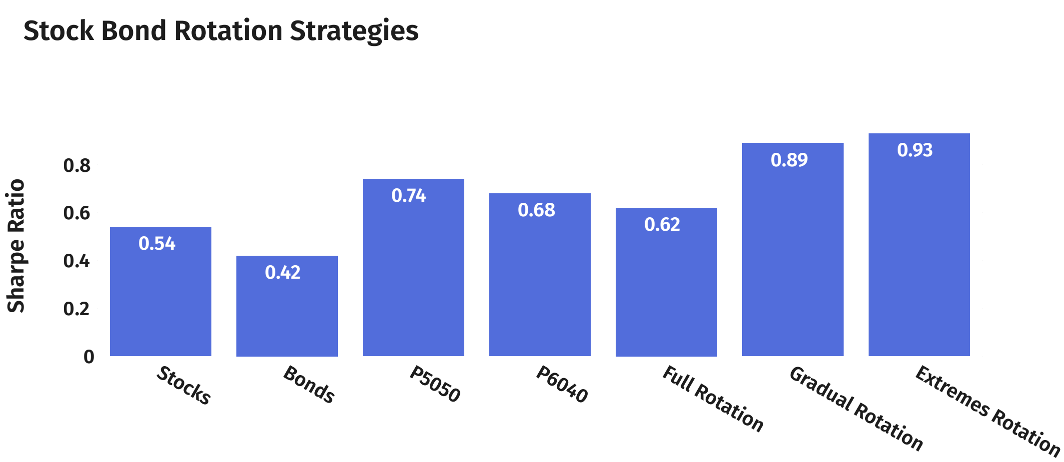


FIGURE 5: Sharpe Ratios of the stock-bond rotation strategies, rebalanced daily
Source: RavenPack, February 2022

Moreover, the cumulative returns in **FIGURE 6** show that TESI-based strategies have outperformed the static benchmarks since early 2007. The positive returns realized during the Great Recession (2007-2009) strongly support the TESI signals' ability to anticipate the phases of the business cycle. However, performance is meaningfully penalized by the sudden onset of the Covid-driven recession. As noted in **SECTION 4**, while TESI exhibited a sharp drop at the beginning of March 2020, it did not enter a negative level or YoY change until the end of March.

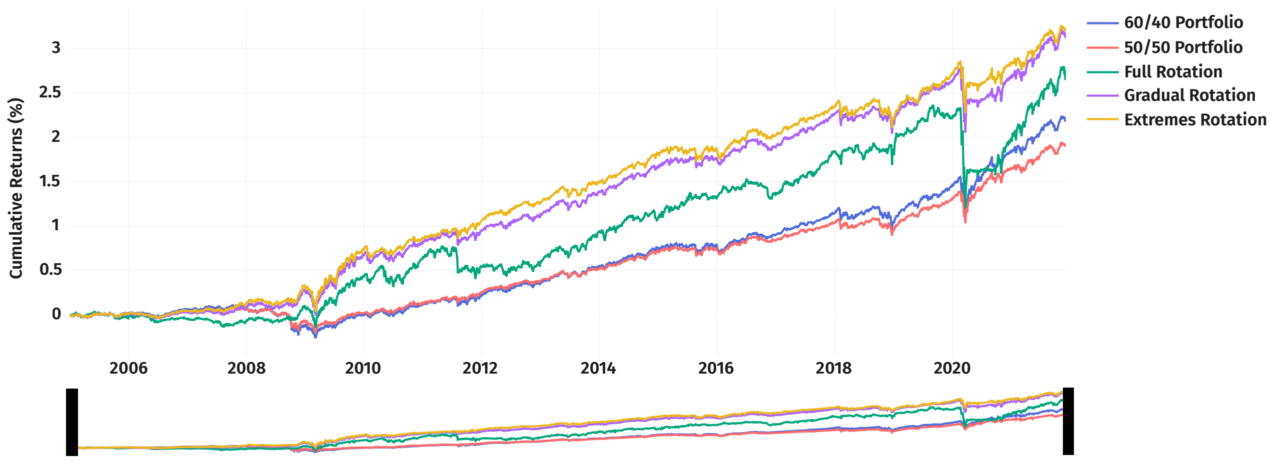


FIGURE 6: Cumulative returns of the daily-rebalanced strategies from 01/08/2005 to 15/12/2021.
Source: RavenPack, February 2022

To validate the robustness of our transcripts-based indicator, we tested the same strategies with monthly rebalancing. **FIGURE 7** shows that all of the TESI-based strategies outperform the benchmarks, with Sharpe Ratio improvements ranging from 0.25 to 0.83.

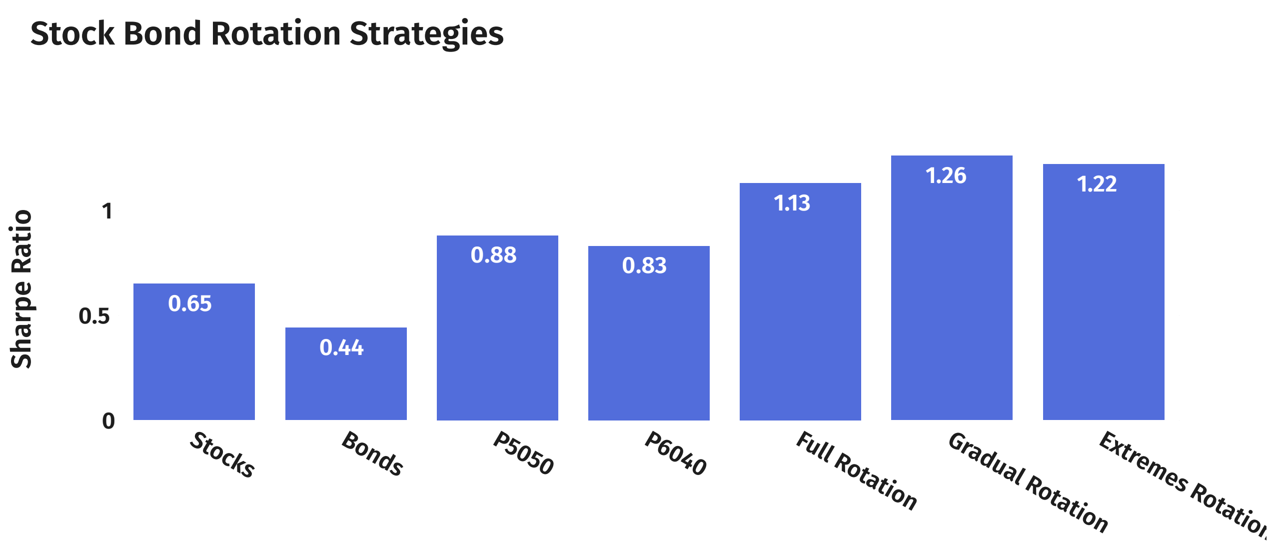


FIGURE 7: Sharpe Ratio of the stock-bond rotation strategies rebalanced monthly.
Source: RavenPack, February 2022

The cumulative returns shown in **FIGURE 8** indicate that Full Rotation is the most attractive strategy when rebalancing monthly. However, as the most aggressive strategy, it has experienced a higher degree of volatility during the Covid-19 crisis. While the remaining TESI-based strategies beat the benchmarks due to their outperformance over the Great Recession, they struggled during the Covid period. The poor March 2020 performance aligns with the expansion phase detected by TESI at the end of February 2020, tilting the strategies toward the stock market.

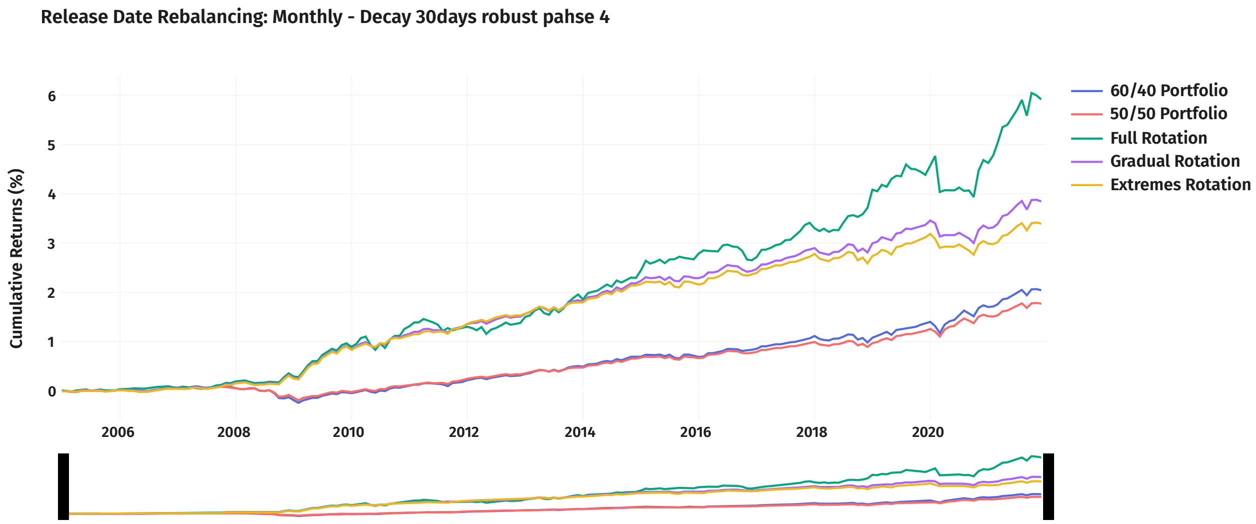


FIGURE 8: Cumulative returns of monthly-rebalanced strategies from 01/08/2005 to 15/12/2021.
Source: RavenPack, February 2022

Finally, we compare the TESI-based strategies to those constructed using the U.S. ISM Manufacturing PMI. To establish a fair comparison, we rebalance the portfolios monthly at the time the U.S. ISM Manufacturing PMI is released.

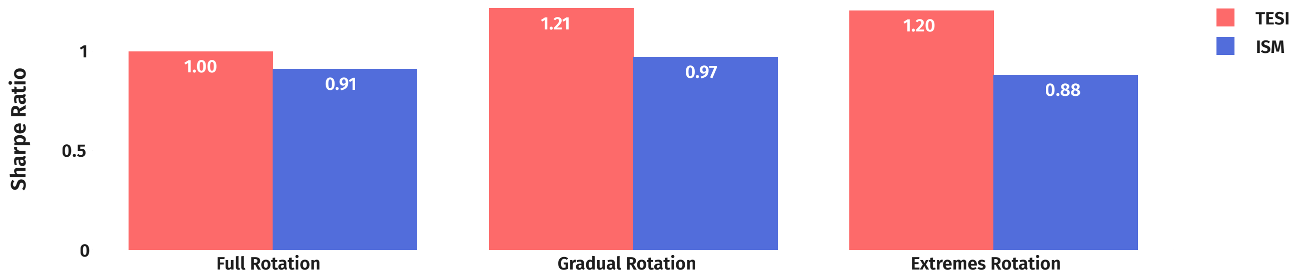


FIGURE 9: Sharpe Ratio comparison between the monthly strategies based on stand-alone TESI and U.S. ISM Manufacturing PMI signals. *RavenPack, February 2022*

FIGURE 9 shows that TESI-based strategies generate superior risk-adjusted performance relative to those based on the ISM, regardless of the rotation methodology. Since TESI incorporates the information about the U.S. economy in real-time, it is more likely to overcome the typical backward-looking issues of classical macroeconomic variables and surveys [13].While the ISM-based strategies perform slightly better than the benchmarks, the highest Sharpe Ratio achieved is below 1 (Gradual Rotation:0.97) [14]. Despite their struggle to beat the benchmark, they generally outperform and generate positive returns over the entire Covid-driven recession from October 2019 to August 2020[15]. Given the performance differentials over this period, which indicate that TESI and ISM-based signals are not perfectly correlated, it is reasonable to examine whether a combined strategy can realize better results.

13 Rebalancing on the ISM release dates marginally deteriorate the TESI-based strategy results (i.e. Gradual Rotation Sharpe Ratio moves from 1.27 to 1.21.

14 Appendix A.3.1 shows that TESI-based strategy results still hold when using different values for the exponential decay factor and for the day-length requirement in robust phase detection.

15 Figure N in the Appendix A.1 shows the cumulative returns of the U.S. ISM Manufacturing PMI-based strategies.

5.2 Combining the TESI and the US ISM Manufacturing PMI signals

The empirical analysis in the previous section demonstrates that each signal has its advantages and disadvantages. The performance divergence is most pronounced around the inflection points in the U.S. economic growth, indicating that TESI and ISM-based signals are distinct from each other and react differently when there is an increase in uncertainty due to how they aggregate information[16]. This view is supported by a modest correlation of 61% between the signals, both in absolute level and YoY change. Therefore, we combine the two signals using a weighted average of the corresponding strategy returns.

Signal weights are computed using a 12-month rolling hit-ratio of TESI strategy monthly returns relative to ISM-based returns[17]. The resulting overlay return at time can be expressed as follows:

$$Ret_t = W_t \text{ x } Ret_t^{TESI} + (1 - W_t) \text{ x } Ret_t^{ISM}$$

where:

$$W_t = 1/12 \sum_{i=t-12}^{t} 1_{(Ret_t^{TESI} > Ret_t^{ISM})}$$

and is the indicator function which equals one when the condition is satisfied and zero otherwise.

FIGURE 10 shows that combining the two signals results in superior risk-adjusted performance across all strategies. Full Rotation benefits the most due to lower volatility, as signal weighting mitigates uneven performance around the Covid-induced downturn.

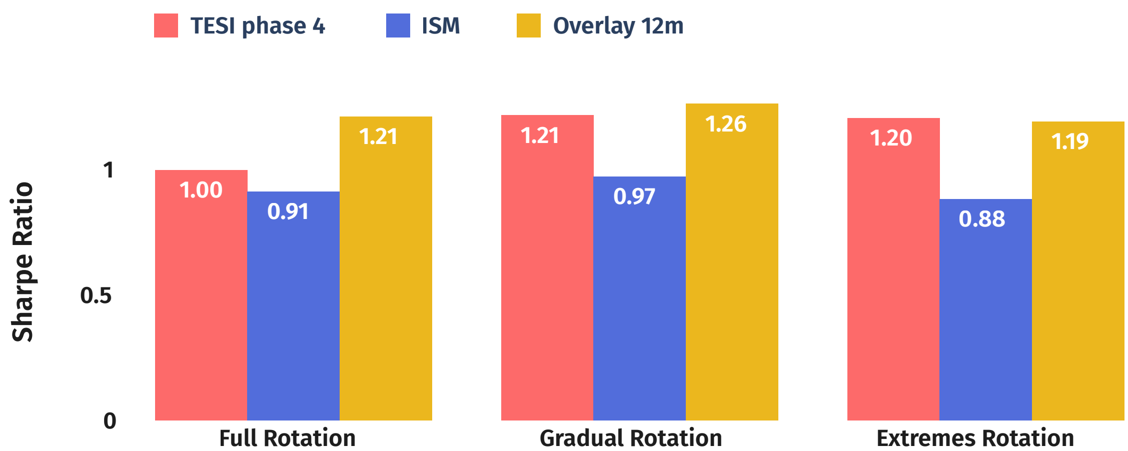


FIGURE 10: Sharpe Ratio comparison of monthly strategies based on TESI, ISM Manufacturing PMI, and the combined overlay signal strategies.
Source: RavenPack, February 2022

16 The ISM shows a higher historical persistence.

17 In the Appendix A.3.2 we try different rolling window sizes: 3, 6, and 24 months to show the robustness of our findings.

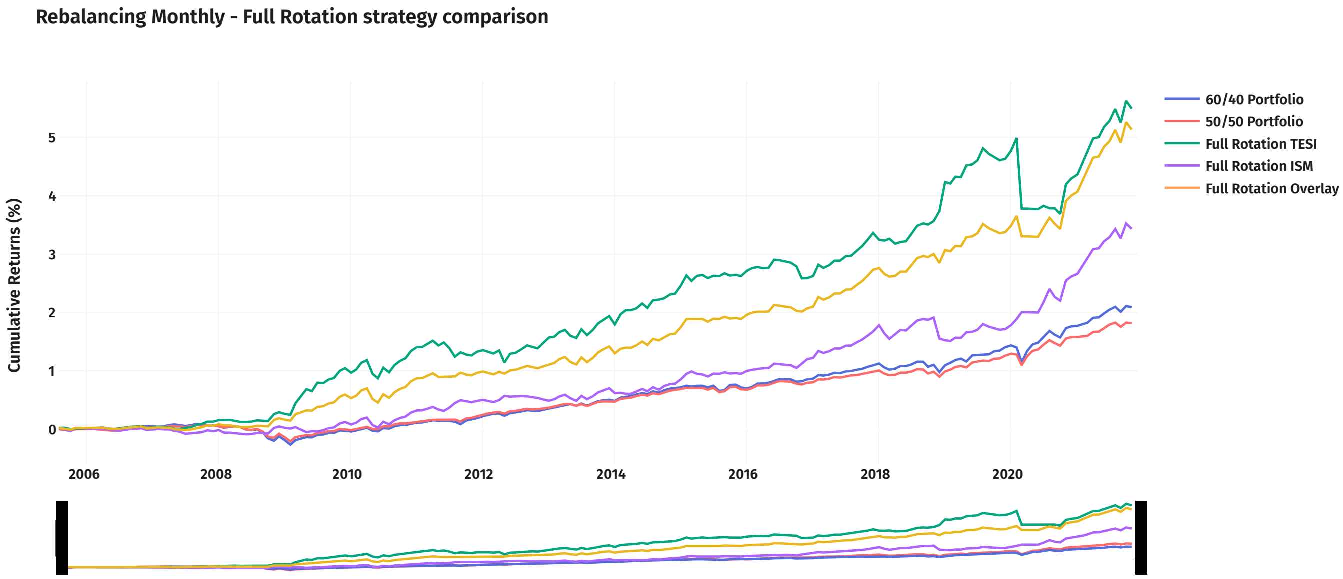


FIGURE 11: Cumulative returns of the Full Rotation Overlay monthly rebalanced strategies from 01/08/2005 to 15/12/2021. *Source: RavenPack, February 2022*

Cumulative returns shown in **FIGURE 11** illustrate the positive effects of using the combined signal to construct the Full Rotation strategy. The dynamic weighting scheme evidently allows for differentiating between the two strategies amid heightened economic uncertainty. Specifically, the TESI-based strategy is more heavily weighted during the Great Recession of 2008-2009 and the 2018-2019 crisis due to better relative performance over the trailing 12-month period, while the inverse is true in favor of the ISM strategy around the Covid-induced downturn[18]. Figure A.2 in the Appendix shows the evolution of weights over time, where the disparate nature of the two strategy signals can be observed during volatile periods. Specifically, the assigned strategy weights diverge the most during the above-mentioned crisis periods. Appendices A.3.1 and A.3.2 show the results using different hit-ratio rolling windows, all of which deliver similar results[19].

18 The Gradual and Extremes Rotation strategies exhibit similar performance with less pronounced moves due to their more defensive nature. Results are available upon request.

19 Additional strategy results obtained by combining raw TESI and ISM signals are available upon request. The results are in line with the main findings of the paper.

	Sharpe	Ret	Vol
Stocks	0.59	10.34%	17.49%
Bonds	0.44	3.10%	7.00%
P5050	0.83	6.72%	8.09%
P6040	0.76	7.44%	9.78%
ISM Full Rotation	0.91	9.77%	10.68%
ISM Gradual Rotation	0.97	6.82%	7.05%
ISM Extremes Rotation	0.88	6.09%	**6.91%**
TESI Robust 4 days			
Full Rotation	1.00	**12.34%**	12.38%
Gradual Rotation	1.21	10.54%	8.69%
Extremes Rotation	1.20	10.10%	8.39%
Overaly rolling 12 months			
Full Rotation	1.21	11.67%	9.62%
Gradual Rotation	**1.26**	9.22%	7.33%
Extremes Rotation	1.19	8.52%	7.16%

TABLE 1: Performance metrics for each strategy. All TESI strategies use a monthly decay factor with a robust phase-detection length of 4 days.

TABLE 1 shows detailed strategy performance metrics. The results indicate that volatility reduction is the primary advantage of using the overlay method. Finally, Appendix A.4 contains the performance summary for different aggregations, hit-ratio rolling windows, and robust phase lengths.

6. Conclusions

This study illustrates how corporate earnings call transcripts from RavenPack Edge can be used to derive valuable insights about the state of the U.S. economic activity. We constructed a robust Transcripts Economic Indicator (TESI), which incorporates the views of financial executives about the past, present, and future of the U.S. economy. Exponential smoothing helps balance the signal speed over time and aligns it with the slower-moving pace of the business cycle without sacrificing timeliness. As a result, TESI is better able to predict the business cycle than traditional methods and is more effective at providing timely insights into the prevailing state of the economy.

Next, we demonstrated through an empirical exercise that TESI can be applied to generate profitable investment strategies based on stock-bond rotation. The TESI-based strategies outperform all common static benchmarks by accurately forecasting an appropriate economic phase and rotating between risky and less risky assets. They also outperform similar strategies based on common macroeconomic monthly indicators, such as the U.S. ISM Manufacturing PMI. Our research has also indicated that lower-frequency rebalancing strategies are likely to prove more effective than rebalancing at higher frequencies.

Finally, we showed that overlaying strategies based on TESI and ISM signals can significantly reduce volatility and improve risk-adjusted performance. The results were robust across varying exponential decay windows, phase detection ranges, and overlay aggregation methods.

Appendix A

A.1 US ISM PMI Manufacturing cumulative return

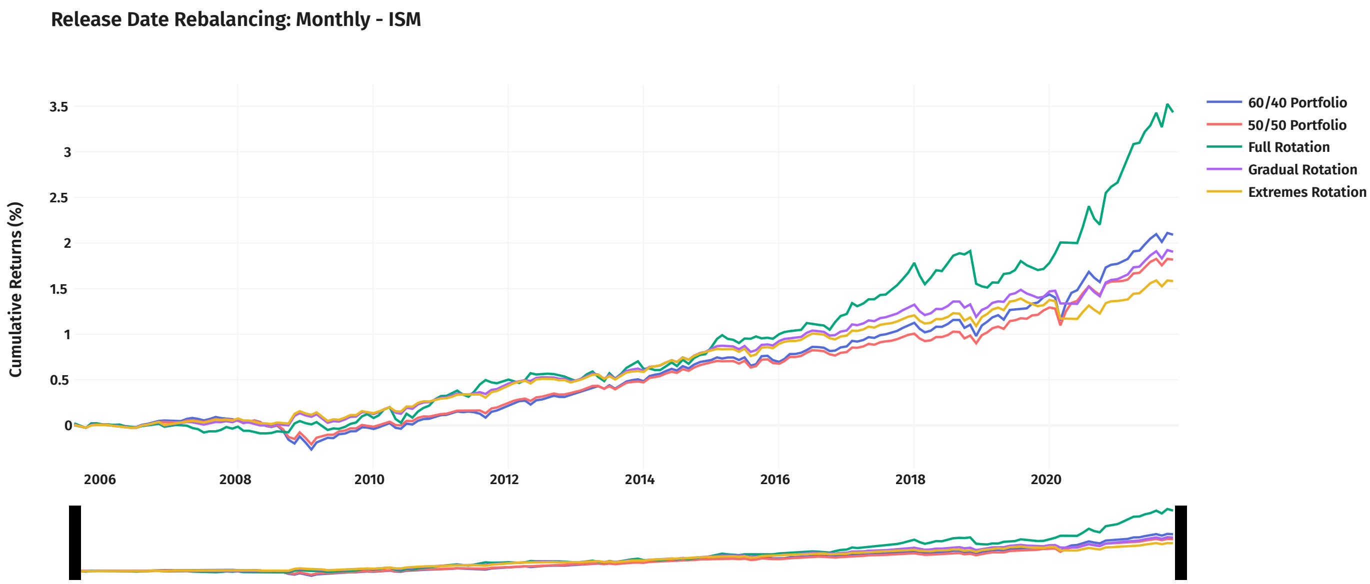
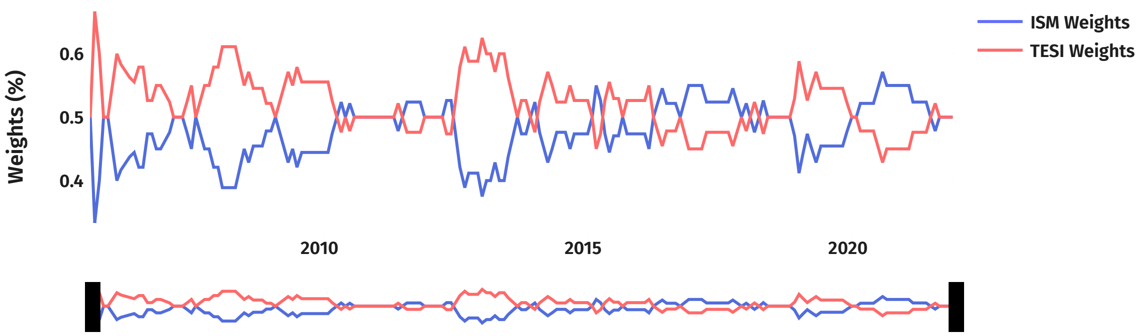


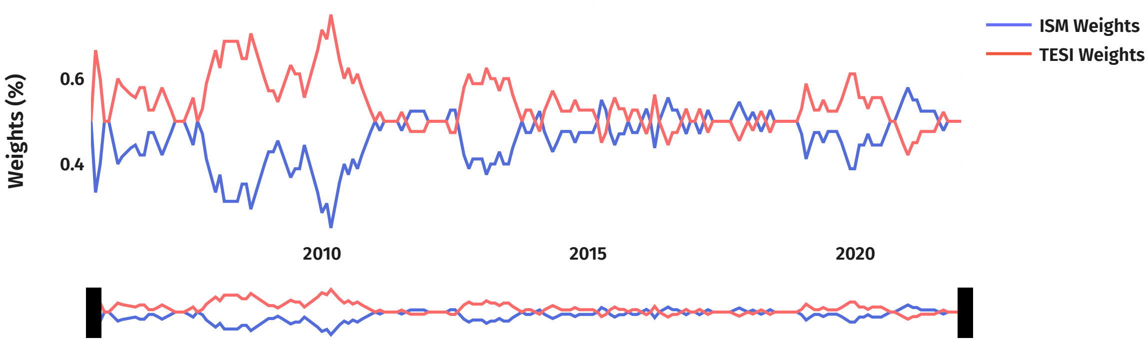
FIGURE A.1: Cumulative returns of monthly-rebalanced strategies based on the U.S. ISM Manufacturing PMI from 01/08/2005 to 15/12/2021.
Source: RavenPack, February 2022

A.2 TESI/ISM Overlay Strategies – Dynamic Weights

Full Rotation Overlay Weights



Gradual Rotation Overlay Weights



Extremes Rotation Overlay Weights

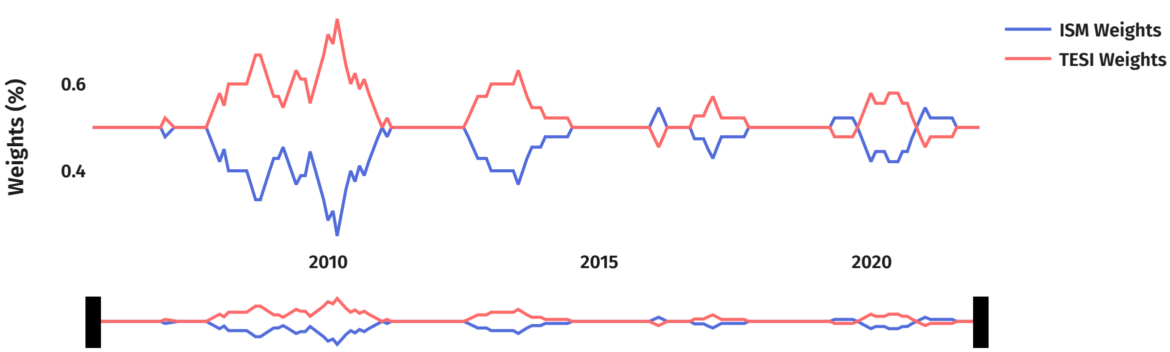


FIGURE A.2: Overlay weights computed using the 12-month rolling hit-ratio for the Full Rotation strategy (top), Gradual Rotation strategy (middle), and Extremes Rotation strategy (bottom).
Source: RavenPack, February 2022

A.3 Robustness checks

This appendix focuses on various robustness checks. A.3.1 shows the results when using a range of 2-6 days for robust phase detection. A.3.2 overlays the TESI and the ISM-based strategies using a simple average[20]. Finally, A.3.3 shows the effects of using a one-quarter half-life decay function[21]. All robustness results focus on stand-alone TESI strategies.

A.3.1 Different days-length for robustness phase detection

FIGURE A.3 shows the risk-adjusted performance comparison of TESI-based strategies when using different lengths for robust phase detection. The Sharpe Ratios resulting from 2, 3, and 6-day values used to detect a new phase remain similar to those of the 4-day value applied in the main paper, with TESI strategies outperforming the ISM across the board.

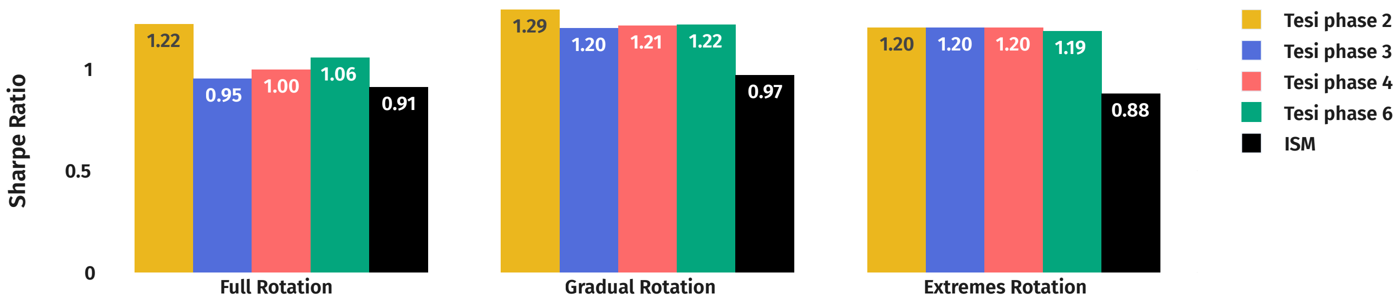


FIGURE A.3: Sharpe Ratio comparison of monthly TESI-based strategies using 2,3,4, and 6 days for robust phase detection, relative to the U.S. ISM Manufacturing PMI-based strategies. *Source: RavenPack, February 2022*

The results remain robust across different phase-detection lengths. We observe similar performance differentials in the TESI/ISM overlay strategies[22].

20 The TESI used is the one from the empirical application in Section 5 with a month half-life exponential decay function and 4 days as robust phase detection.

21 Using an exponential decay function with a quarter half-life and 6 days robust phase length produces similar robust results. They are available upon request.

22 Additional results available upon request.

A.3.2 Different hit-ratio overlay strategy

FIGURE A.4 shows that using different rolling windows to compute hit-ratios delivers similar performance and with the standalone signal improving in all cases. Shorter windows result in higher Sharpe Ratios, implying that a long persistence of winning streaks is not a necessary precondition for improving standalone TESI strategies.

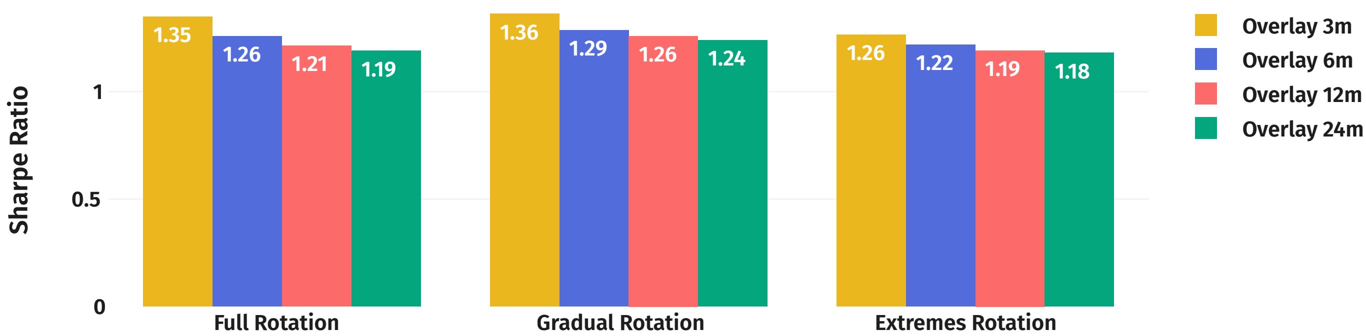


FIGURE A.4: Sharpe Ratio comparison of the overlay strategies using 3, 6, 12, and 24-month rolling hit-ratios to compute signal weights.
Source: RavenPack, February 2022

A.3.3 Using 90-day half-life decay function

The monthly stand-alone TESI signal based on 90-day half-life is more defensive and moderately slower relative to the 30-day signal, helping it circumvent the sharp Covid-related downturn. The 90-day strategies resulted in marginally lower performance during the Great Recession, with similar Sharpe Ratios overall.[23].

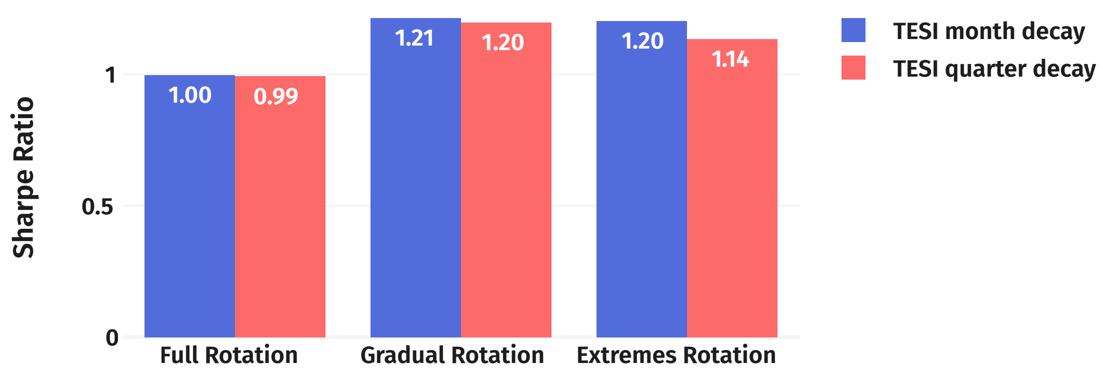


FIGURE A.5: Sharpe Ratio comparison of TESI-based strategies when using 30 vs. 90-day decay factor. *Source: RavenPack, February 2022*

23 The 90-day half-life exponential decay function also improves the performance of daily rebalanced strategies. Results are available upon request.

A.4 Summary Performance Metrics

	Sharpe	Ret	Vol
Stocks	0.53	10.40%	19.49%
Bonds	0.42	3.00%	**7.22%**
P5050	0.74	6.70%	9.07%
P6040	0.68	7.44%	10.97%
TESI Based Strategies			
Decay 30 Days			
Full Rotation	0.62	8.61%	13.85%
Gradual Rotation	0.89	8.87%	10.00%
Extremes Rotation	0.93	8.94%	9.62%
Decay 90 Days			
Full Rotation	0.91	**10.62%**	11.92%
Gradual Rotation	**1.04**	9.16%	8.71%
Extremes Rotation	0.99	8.79%	8.70%

TABLE A.1: Daily rebalancing performance metrics for stand alone signals. The TESI based strategies use a robust phase length of 4 days. Results with different lengths are similar (available upon request).

	Sharpe	Ret	Vol
Stocks	0.66	9.68%	14.69%
Bonds	0.44	2.96%	**6.80%**
P5050	0.89	6.32%	7.09%
P6040	0.83	6.99%	8.39%
Robust 2 days			
Full Rotation	1.03	11.22%	10.91%
Gradual Rotation	1.26	9.64%	7.67%
Extremes Rotation	1.25	9.25%	7.41%
Robust 3 days			
Full Rotation	1.11	11.84%	10.65%
Gradual Rotation	1.29	9.77%	7.60%
Extremes Rotation	1.25	9.26%	7.41%
Robust 4 days			
Full Rotation	1.14	12.11%	10.61%
Gradual Rotation	1.27	9.69%	7.61%
Extremes Rotation	1.22	9.08%	7.42%
Robust 4 days			
Full Rotation	1.25	**13.00%**	10.43%
Gradual Rotation	**1.30**	9.87%	7.56%
Extremes Rotation	1.22	9.08%	7.42%

TABLE A.2: TESI based monthly strategies rebalanced at the end of month. All the strategies use a monthly decay factor.

A.5 Groups and Types selected from RavenPack Taxonomy

GROUPS = [“BUSINESS-ACTIVITY”, “DOMESTIC-PRODUCT”, “ECONOMIC-ACTIVITY”]

TYPES = [“CONSUMER-CONFIDENCE”, “CONSUMER-CONFIDENCE-GUIDANCE”, “CONSUMER-SPENDING”, “CONSUMER-SPENDING-GUIDANCE”, “RETAIL-SALES”, “RETAIL-SALES-GUIDANCE”, “VEHICLE-SALES”, “VEHICLE-SALES-GUIDANCE”, “VEHICLE-SALES-NEW”, “VEHICLE-SALES-NEW-GUIDANCE”, “EMPLOYMENT”, “EMPLOYMENT-GUIDANCE”, “JOBLESS-CLAIMS”, “JOBLESS-CLAIMS-GUIDANCE”, “NON-FARM-PAYROLLS”, “NON-FARM-PAYROLLS-GUIDANCE”, “UNEMPLOYMENT”, “UNEMPLOYMENT-GUIDANCE”, “BUILDER-CONFIDENCE”, “HOME-SALES-EXISTING”, “HOME-SALES-EXISTING-GUIDANCE”, “HOME-SALES-NEW”, “HOME-SALES-NEW-GUIDANCE”, “HOME-SALES-PENDING”, “HOME-SALES-PENDING-GUIDANCE”, “BUILDING-PERMITS”, “COMPOSITE-PMI”, “COMPOSITE-PMI-GUIDANCE”, “CONSTRUCTION-OUTPUT”, “CONSTRUCTION-PMI”, “CONSTRUCTION-PMI-GUIDANCE”, “FACTORY-ORDERS”, “INDUSTRIAL-PRODUCTION”, “MANUFACTURING-INDEX”, “INDUSTRIAL-PRODUCTION-GUIDANCE”, “MANUFACTURING-INDEX-GUIDANCE”, “MANUFACTURING-PMI”, “MANUFACTURING-PMI-GUIDANCE”, “NON-MANUFACTURING-PMI”, “NON-MANUFACTURING-PMI-GUIDANCE”, “SERVICES-PMI”, “SERVICES-PMI-GUIDANCE”]

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