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Macroeconomic momentum and cross-sectional equity market indices

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ABSTRACT

Momentum is a well-known and studied artefact of financial markets. In this paper, we investigate whether momentum in a country's macroeconomic variables is related to the future performance of equities in that country. We find that the past economic trends of a country's fundamentals are positively associated with the equity market index returns. Based on that, an economic momentum portfolio of buying (selling) equity index in countries with relatively strong (weak) economic past trends exhibits an annualised Sharpe ratio of 0.87. The economic momentum portfolio outperforms benchmarks regarding rewards to variability and maximum drawdown and yields an annualised alpha of 3.72%, leaving 95% of the returns unexplained by the benchmarks.

1. Introduction

The past price trends of assets have been demonstrated to influence their future performance, a phenomenon commonly called the "momentum effects". Such effects on asset prices are well documented in the literature.[1] As an extensive work exploring such effects with past trends in assets' fundamentals, Huang et al. (2019) demonstrate that the past trends in stock fundamentals contain information affecting the stock's future prices. Expanding from the firm-level to the country-level fundamentals, Dahlquist and Hasseltoft (2020) (DH) link economic past trends to currency future returns.

Given the established connections between macroeconomic variables and stock markets in prior literature (Merton, 1973; Roll and Ross, 1980; Cox et al., 1985; Chen et al., 1986), our study seeks to investigate whether the past trends of macroeconomic variables can have any cross-sectional impacts on future stock market returns at country level. This investigation aims to shed light on the potential influence of macroeconomic dynamics on country-level stock market performance. Answering this question can give policymakers some insights into how the global stock markets sluggishly react to economic outcomes and their decisions. As for investors, they can gain some insights from this work when allocating their wealth globally by considering the pricing information embedded in past economic trends.

Our findings are threefold. First, we find that the past trends in country fundamentals cross-sectionally and positively predict returns on country indices, which is statistically significant. In detail, we find that one standard deviation increase in the weights, derived from past economic trends, results in an increase of 24 basis points on country index returns. Second, such a pattern is also

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[1] In the context of cross-sectional stock returns, where portfolios that take long positions in relative winners and short positions in relative losers are consistently profitable (Jegadeesh and Titman, 1993; Rouwenhorst, 1998, 1999; Griffin et al., 2003). Beyond equities, existing literature also documents price momentum effects in various other asset classes, including equity indices, commodities, bonds, currencies, options, and cryptocurrencies (Okunev and White, 2003; Miffre and Rallis, 2007; Grobys and Sapkota, 2019; Hsu and Chen, 2021; Li et al., 2021; Heston et al., 2023; Liu et al., 2022). Moreover, Moskowitz et al. (2012) document such momentum effects in the context of time-series asset prices.

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economically significant. To elaborate, we form a portfolio by buying (selling) country indices with relatively strong (weak) past trends in fundamentals. This long-short portfolio earns a Sharpe ratio of 0.87 with a return of 3.60%. It still yields a return of 2.14% after transaction costs. Third, this implementable strategy outperforms benchmarks, such as standard momentum strategies and asset pricing models. Nevertheless, the portfolio yields an annualised alpha of 3.72% after controlling for the benchmarks, leaving 95% of the strategy returns unexplained by the benchmarks.

We construct two indices using macroeconomic variables from the Organisation for Economic Co-operation and Development (OECD) to proxy for countries' fundamentals, representing positive and negative influences on stock market returns. One macro index is calculated as the average log growth of the consumer price index, producer price index, and total manufacturing. In contrast, the other macro index is derived from the average log growth of the OECD leading indicator, hourly earnings, and gross domestic production. Our analysis reveals that the former macro index is positively related to future stock market returns, while the latter is negatively related. Consequently, we refer to the former as the "positive macro effect index" and the latter as the "negative macro effect index".

We follow the process outlined by DH to construct portfolios capturing economic momentum returns. First, we calculate the economic momentum signals as cumulative returns over a specific lookback period on the macro indices at the end of every month for each country in our sample period. Second, we form a dollar-neutral sub-strategy that buys (sells) one country's market index when its relative macro index shows stronger (weaker) momentum signals than its peers. The lookback periods we investigate vary from 1 to 60 months, resulting in 120 sub-strategies (60 lookback periods x 2 macro indices). Third, we group these economic momentum sub-strategies into portfolios. To form a portfolio, we aggregate sub-strategies by weighting them based on their inverse volatilities.[2] Specifically, we create positive and negative macro effect portfolios by aggregating all sub-strategies based on the positive and negative macro effect indices. Additionally, we establish short-term, mid-term, and long-term portfolios by aggregating sub-strategies with respective lookback periods of 1–12, 13–36, and 37–60 months. Finally, a combo portfolio aggregates all 120 sub-strategies.

We assign weights to sub-strategies within each portfolio based on the inverse of the volatility of these sub-strategies. We measure ex-ante volatility at the end of every month for each sub-strategy. For the calculation of ex-ante volatility, we follow the approach outlined in Moskowitz et al. (2012) and DH, employing an exponentially weighted moving average (EWMA) method with a lambda of 0.97. Notably, varying lambda from 0.92 to 0.99 does not affect our main results. Then, we use a scaling factor to ensure that the sum of cross-sectional weights equals one. Generally, the scaled-inverse volatility determines the weights assigned to sub-strategies in a portfolio. For robustness, we also examine it with equally weighting strategies within a portfolio, but this does not impact our main results. Therefore, portfolio returns can be calculated by multiplying the lagged-one-month weights with security returns. We refer to these portfolios as the economic momentum portfolios.

The impact of past macroeconomic trends on stock markets is statistically and economically significant. To study the predictability of economic momentum on market returns, we regress country-level stock market excess returns on one-month-lagged weights derived from economic momentum signals. Empirical results demonstrate that this predictability is statistically significant at the 1% level, resulting in a 24 basis point improvement in future stock market excess returns. For the combo strategy, a portfolio built on this predictability exhibits a Sharpe ratio of 0.87 with an annualised return of 3.60%. Similar improvements of 13, 28, 11, 27, and 20 basis points are observed for the positive macro effects, negative macro effects, short-term, mid-term, and long-term strategies, respectively, with corresponding Sharpe ratios of 0.49, 0.30, 0.40, 0.96, and 0.66.

We then compare our economic momentum portfolios with standard momentum strategies documented in the literature and passive investment strategies over the sample period. The empirical results show that the economic momentum portfolio outperforms the benchmarks regarding Sharpe ratios and exhibits a lower maximum drawdown. Additionally, the portfolio averages an annualised alpha of 3.72% after controlling for standard momentum strategies, while it also captures benchmark returns.

Moreover, we conduct further analysis on the economic momentum combo portfolio. We find that none of the standard asset pricing factor models can fully explain the profitability of the combo portfolio.[3] Furthermore, none of the countries in the portfolio dominates the returns of the combo portfolio. Regarding transaction costs associated with portfolio trading, the portfolio still yields a Sharpe ratio of 0.52 with annualised returns of 2.14% after accounting for transaction costs, represented by bid–ask spreads. Regarding the robustness of country selection, we find that, based on MSCI indices, the economic momentum effects persist in the G10, developed, and emerging markets.

Our contribution to the literature is fourfold. First, we provide extensive work to the momentum-related literature by suggesting the existence of economic momentum effects in global stock markets. Existing literature predominantly explores price momentum effects such as cross-sectional momentum by Jegadeesh and Titman (1993) and time-series momentum by Moskowitz et al. (2012). Extending these elegant studies and the concept of momentum, emerging research links factor momentum (Ehsani and Linnainmaa, 2022; Arnott et al., 2023), and economic momentum (DH) to asset prices. Interestingly, all these works reveal that asset prices do not fully incorporate the past public information related to the assets and challenge market efficiency. We extend the work by DH and bridge the gap between economic momentum and cross-sectional stock market indices. Such findings suggest that global stock markets sluggishly incorporate public information, such as free macroeconomic data from the OECD, giving rise to economic momentum effects.

[2] Aside from volatility-weighted constructions, we also examine that in an equal-weighted way.

[3] The factor models we study include Fama–French Three Factor (FF3) (Fama and French, 1993), Fama–French Five Factor (FF5) (Fama and French, 2015), q-Factor (Hou et al., 2021) and relative factors from Jensen et al. (2023).

Table 1
Data summary statistics.
This table reports summary statistics on each country's 12-month economic momentum signals and equity index futures. Statistics including observations number, mean, standard deviation, 1st quantile (25%), median and 3rd quantile (75%) are reported. Besides, we also report information about the futures, such as their underlying index and contract symbols. Panel A and B report 12-month momentum signals based on positive and negative macro effect indices. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. Panel C reports monthly returns on the combined futures. We composite the continuing series for a market index by rolling the nearest contracts to the second nearest contracts on the last business day of the month, before the previous trading month. The last three letters, XYY, for the futures contract symbols, can be replaced with the maturity month and year of one contract. For example, the ticker for a contract with a maturity of December 2019 based on the S&P 500 index is SPZ19, where SP is the name of the S&P 500 index futures chain, Z represents December and 19 stands for the maturity year 2019. All prices are converted into USD. The sample period is from January 1989 to December 2020.

	Australia	Canada	France	Germany	Italy	Japan	Sweden	Switzerland	United Kingdom	United States
Panel A: 12-Month Log Growth (%) on Positive Macro Effect Index										
Observations	373	373	373	373	373	373	373	373	373	373
Mean	1.85	1.40	0.76	1.27	1.30	−0.06	1.75	1.35	1.47	1.86
Standard Deviation	1.92	2.61	2.53	2.62	3.23	3.10	2.86	2.36	2.08	2.61
25%	0.91	0.14	−0.12	0.07	−0.01	−1.21	0.58	−0.20	0.39	0.98
50%	2.01	1.61	0.97	1.59	1.57	0.60	1.90	1.60	1.74	2.48
75%	2.91	2.98	2.29	2.98	2.97	1.76	3.52	2.98	2.78	3.60
Panel B: 12-Month Log Growth (%) on Negative Macro Effect Index										
Observations	373	373	373	373	373	373	373	373	373	373
Mean	1.16	0.64	0.70	0.81	0.83	0.22	1.02	−0.10	1.03	0.75
Standard Deviation	0.93	1.47	1.40	1.42	1.60	1.73	1.40	1.85	1.67	1.03
25%	0.64	−0.03	0.16	0.13	0.05	−0.44	0.33	−1.27	0.52	0.38
50%	1.17	0.84	0.76	0.89	0.91	0.43	1.14	0.06	1.21	0.84
75%	1.73	1.62	1.57	1.55	1.80	1.20	1.76	1.01	1.93	1.37
Panel C: Monthly Return (%) on Equity Index Futures										
Underlying	S&P ASX 200	S&P TSX 60	CAC 40	DAX	FTSE MIB	TOPIX	OMX STKH30	SWISS MKT	FTSE 100	S&P 500
Symbol	XPXYY	PTXYY	CFXYY	GXXYY	STXYY	TPXYY	QCXYY	SMXYY	Z XYY	SPXYY
Observations	248	256	383	361	202	368	191	320	384	384
Mean	0.50	0.48	0.26	0.37	0.30	−0.01	0.69	0.71	0.08	0.43
Standard Deviation	6.28	5.79	5.95	6.42	7.32	5.72	6.42	4.68	4.92	4.24
25%	−2.55	−2.25	−3.43	−3.24	−3.66	−3.65	−2.82	−1.89	−2.89	−1.88
50%	1.08	0.85	0.45	0.83	0.63	0.14	0.68	1.08	0.19	0.74
75%	3.87	3.93	4.21	4.43	4.50	3.30	4.18	3.58	3.17	2.97

Second, to the best of our knowledge, we are the first to document the cross-sectional predictability of past trends in a country's fundamentals on its future stock market index. This prediction is both statistically and economically significant. We find that stronger past trends in a country's fundamentals are associated with larger returns in that country's stock market. Statistically, a one standard deviation increase in past trends results in 24 basis points higher returns on the equity market index, controlling for country and month fixed effects. A dollar-neutral strategy built on this prediction, buying (selling) the country's index with strong (weak) economic momentum signals, achieves a Sharpe ratio of 0.87 and an annualised return of 3.60%. The mean excess return is statistically significant at the 1% level. This strategy still yields a mean excess return of 2.14% after accounting for transaction costs. The returns of the strategy cannot be explained by popular asset pricing factor models such as FF3 or FF5, and they also cannot be dominated by any of the countries.

Third, we advance the momentum-related literature by suggesting the outperformance of the economic momentum strategy over benchmarks of momentum strategies such as time-series momentum and value and momentum strategies. Moskowitz et al. (2012) document that past trends in asset returns are positively related to their future performance. Combining cross-sectional momentum and value, Asness et al. (2013) suggest that the effects of half momentum and half value exist across the board. While both studies suggest profitable strategies based on these effects, the economic momentum strategy outperforms them in terms of Sharpe ratios. In comparison, the economic momentum strategy maintains strong persistence, profitability, and stability over time. Especially after the global financial crisis, the benchmarks exhibit higher downside risk and greater volatility. Most importantly, it can explain the benchmarks, while approximately 95% of the returns of it cannot be explained by the benchmarks.

Fourth, we argue the economic and statistical significance of the benchmarks. For the time-series momentum, Moskowitz et al. (2012) find that such effects exist across different asset classes. Doubting that, Huang et al. (2020) reproduce the original work but statistically examine it with time-series and cross-sectional regressions instead of pooled regressions. Consistent with Huang et al. (2020), we find weak evidence of time-series momentum in global stock markets by employing panel regressions with country and month fixed effects. Besides, we also contribute to the literature by providing empirical works questioning the time-varying profitability of the time-series momentum strategy, especially after the financial crisis. As for the value-and-momentum effects, Asness et al. (2013) suggest such effects exist everywhere. However, Hutchinson et al. (2022) argue that the effects diminish over time in the foreign exchange market due to that arbitrageurs learn from the academic and correct the mispricing. Aligning with Hutchinson et al. (2022), we suggest that the value-and-momentum effects are weak in the global stock markets.

Section 2 describes the data. Section 3 discusses methodologies for constructing economic momentum portfolios and benchmarks. Section 4 discusses baseline results and compares them with benchmarks. Section 5 conducts further analysis, including exploring the driving force, transaction costs, and the effectiveness of economic momentum on other types of markets.

2. Data

We retrieve daily settlement prices of futures contracts with different maturities from Bloomberg.[4] We study developed markets, namely Australia (S&P/ASX 200), Canada (S&P/TSX 60), France (CAC 40), Germany (DAX), Italy (FTSE/MIB), Japan (TOPIX), Sweden (OMX STKH30), Switzerland (SWISS MKT), United Kingdom (FTSE 100) and the United States (S&P 500). We screen securities by (i) confirming all developed markets based on the classifications of the MSCI;[5] (ii) removing Israel and Ireland as there are no index futures for these markets; (iii) removing Hong Kong and Singapore markets because the OECD has no relevant macro variables for them; (iv) removing Austria, Denmark and New Zealand as the number of data points for these markets are 1752, 788 and 1632, being dramatically smaller than the other markets which have at least 4000 daily observations; (v) removing the index futures with low daily average open interest since we also concern the liquidity issue. Note that samples are from January 1989 to December 2020 due to their availability.

With contract prices, we composite daily continue-series futures returns for each equity market. Since futures have expired dates, we roll over contracts from the most nearby one to the next nearby one by following Bessembinder (1992), De Roon et al. (2000), Paschke et al. (2020) and Koijen et al. (2018). For example, to generate a continuous series for the S&P 500 index, we compute the daily returns on its relative futures contracts. We then merge the first nearby contract with the second nearby contract on the last business day of the rolling month (the month before the previous trading month.). This way, we can avoid "double costs", including re-balancing and rollover costs. Furthermore, we convert daily returns to monthly returns by summing up daily log returns within a month. Lastly, we calculate the excess returns by taking monthly returns on instruments over one-month Treasury bill rates[6]. All price data in this paper are based on the home currency of the US dollar. Table 1 reports descriptive summary statistics for these composited market indices, including names of underlying, tickers of contracts in Bloomberg.

We obtain macro-variables from the OECD. For those variables lacking monthly data, we follow Dahlquist and Hasseltoft (2020) to convert the quarterly data into monthly data. In detail, the value observed at the end of quarter Q would be repeated monthly in quarter Q+1 to avoid any look-ahead bias. Moreover, this data is one-quarter lagged to ensure our access to economic variables for all countries. Based on the macro-variables, we denote macro index A as the average log growth of the consumer price index (CPI), producer price index (PPI), and total manufacturing. We also denote macro index B as the average log growth of the OECD leading indicator (LOL), gross domestic product (GDP) and hourly earnings (HES). Table 1 summarises the descriptive statistics of 12-month log growth on these macro indices, including mean, standard deviation and number of observations. We regress the equity index futures returns on the 12-month log growth of each macro index with country and month fixed effects. Standard errors are clustered by country. Coefficients with the 12-month momentum signals are 0.27% and −3.88% for macro index A and B, respectively (See Table 12). It suggests that increases in past macro index A (B) trends might have positive (negative) effects on equity index futures returns. Therefore, we denote the macro index A (B) as the positive (negative) macro effect index. We assign a minus sign to the negative macro effect index for constructing portfolios.

3. Methodology

3.1. Baseline portfolios construction

In this section, we construct baseline portfolios based on economic momentum signals in the following steps.

Firstly, we measure economic momentum signals, which are the cumulative returns on macro indices over a lookback period. Since signals are computed from one of the two macro indices j (positive or negative macro effect index) and lookback periods l of 1–60 months, the amount of momentum signal types is 120.

Secondly, we design a sub-strategy trading on an economic momentum signals type, termed $S(j,l)$. A sub-strategy is to long (short) country indices based on their relatively strong (weak) economic momentum signals. There are 120 sub-strategies in total due to 120 signal types. Within each sub-strategy, we assign weights to each country index by following a cash-neutral-rank-based weighting method towards economic momentum signals. In this way, it can make strategies dollar-neutral and avoid outliers of the macro indices (Dahlquist and Hasseltoft, 2020).

In detail, we weight each country index based on their cross-sectional ranking of economic momentum signals by following Asness et al. (2013), Koijen et al. (2018) and Dahlquist and Hasseltoft (2020). Within each sub-strategy, the weight, based on the macro index j and the lookback period l, assigned to country c in month t is

$$\omega_{j,l,c,t} = K_{j,l,t}\left[Rank(Z_{j,l,c,t}) - \sum_{c=1}^{N_{j,l,t}} \frac{Rank(Z_{j,l,c,t})}{N_{j,l,t}}\right] \tag{1}$$

where $Z_{j,l,c,t}$ denotes a momentum signal for country c at time t within a strategy $S(j,l)$. $N_{j,l,t}$ denotes the total amount of available countries at time t within a sub-strategy. $K_{j,l,t}$ is the scale factor that makes the strategy to have one dollar on the long side and one dollar on the short side.

[4] We mainly study index futures rather than the price index since the index is non-tradable. Practically, investors tend to trade index futures for that the futures are cheaper than buying index constituents. For robustness, we also utilise MSCI country indices in Section 5.3.

[5] According to the MSCI, developed markets includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom and the USA.

[6] The risk-free data is from theKen.Frenchlibrary

Thirdly, we aggregate sub-strategies into portfolios in a volatility-weighting method.[7] To avoid look-ahead bias, we estimate ex-ante volatility $\sigma_{j,l,t}$ for each sub-strategy $S(j,l)$ at the end of every month t. $\sigma_{j,l,t}$ is the annualised monthly volatility transformed from daily volatility of $S(j,l)$'s daily log-returns. Specifically, we follow Moskowitz et al. (2012) and Dahlquist and Hasseltoft (2020) to employ the EWMA for calculating the ex-ante volatility with a risk metric λ of 0.97. Note that λ from 0.92 to 0.99 does little difference to the main results. For robustness, we also estimate historical volatility with a rolling window size of three years as an alternative. However, it does not affect our main results. With the weights assigned to sub-strategies, the weights assigned to each country index in portfolio P is

$$\Omega^P_{c,t} = E^P_t \frac{1}{\sigma_{j,l,t}} \omega_{j,l,c,t}, \tag{2}$$

where E^P_t is a scale factor making the sum of weights within the portfolio P equal to one at the end of every month t.

As for portfolio P, we, first, construct a combo portfolio (CM) by aggregating all the 120 sub-strategies. Second, we form a positive macro portfolio (PM) and a negative macro portfolio (NM) by aggregating sub-strategies, which are developed from positive and negative macro effect indices, respectively. We do it to explore the influence of the macro indices on the portfolio performance. Third, we determine short-term (ST), mid-term (MT) and long-term (LT) portfolios by aggregating sub-strategies $S(j,1-12)$, $S(j,13-36)$ and $S(j,37-60)$ for observing effects of lookback periods in the portfolio performance. Therefore, P is one of the six portfolios and returns on the portfolios are computed as,

$$r^P_t = r_{c,t}\Omega^P_{c,t-1}, \tag{3}$$

where $r_{c,t}$ is the excess returns of country index c over one-month-T-bill rates in month t.

3.2. Benchmarks construction

To compare the performance of the economic momentum strategies, we employ standard momentum strategies as benchmarks, including time-series momentum (TSMOM), value(VAL), cross-sectional momentum (MOM), value and momentum (VMOM). Apart from active strategies, we also consider the performance of passive investment, buy-and-holding the MSCI world index over a one-month T-bill.

The constructed TSMOM portfolio mainly obeys the methodology mentioned by Moskowitz et al. (2012). However, the dollar-neutral weighting method would be applied to the TSMOM to be consistent with the portfolios designed above. In particular, weights, $w_{c,t}$ assigned to securities are

$$\Omega^{TSMOM}_{c,t} = K_t Sign(r_{c,t-12,t}) \frac{20\%}{\sigma_{c,t}} \quad , \tag{4}$$

where K_t is the scale factor, making the portfolio have one dollar on the long side and one dollar on the short side. $\sigma_{c,t}$ denotes the annualised EWMA volatility of daily log-returns on security c at time t. Besides, $sign(r_{c,t-12,t})$ is the sign of past-12-month cumulative returns on security c. With weights, the calculation of returns on the TSMOM portfolio is

$$TSMOM_t = \sum_c \Omega^{TSMOM}_{c,t-1} r_{c,t} \quad . \tag{5}$$

Markets covered in the TSMOM are the same as the portfolio created above. Additionally, we also consider the time-series momentum factor data from AQR, denoted as TSMOM_AQR, which has different market selections from this study.

As for value and momentum strategies, we follow Asness et al. (2013) (AMP) to construct portfolios trading based on value and momentum signals but covering the same selected markets in this paper. We term these portfolios value (VAL), momentum(MOM), value and momentum (VMOM). Considering the influence of market selection, we also obtain respective factors data from AQR and label them with VAL_AQR, MOM_AQR and VMOM_AQR. According to AMP, a metric for measuring the value signal on equity indices is the book-to-market ratio of MSCI indices. Meanwhile, we apply 12-month cumulative returns on indices as the momentum signals. When processing these signals, we also employ the weighting method in formula (1) so that the main portfolios and benchmarks can be comparable. Therefore, weights for country c at time t within VAL and MOM are

$$\boldsymbol{\Omega}^{VAL}_{c,t} = K_t \left[Rank(BM_{c,t}) - \sum_{c=1}^{C_t} \frac{BM_{c,t}}{C_t} \right] \quad \text{and} \tag{6}$$

$$\boldsymbol{\Omega}^{MOM}_{c,t} = K_t \left[Rank(r_{c,t-12,t}) - \sum_{c=1}^{C_t} \frac{r_{c,t-12,t}}{C_t} \right] \quad , \tag{7}$$

where C_t is the total amount of available countries at time t. $BM_{c,t}$ and $r_{c,t-12,t}$ denote the book to market ratio and the past-12-month cumulative returns, respectively. Furthermore, the returns on these portfolios are

$$VAL_t = \sum_c \boldsymbol{\Omega}^{VAL}_{c,t-1} r_{c,t} \quad \text{and} \tag{8}$$

[7] Different sub-strategies may have different volatility. To control the influence of volatility on the portfolio performance, we assign larger (smaller) weights to the sub-strategies with smaller (larger) volatility. For robustness, we also employ an equal-weighting method. Results of that are reported in Table 14 in the appendix, while that does not affect the main results.

$$MOM_t = \sum_c \boldsymbol{\Omega}_{c,t-1}^{MOM} r_{c,t} \quad . \tag{9}$$

Based on that, VMOM, the combination of a half VAL and a half MOM can be calculated as

$$VMOM_t = 0.5 \times VAL_t + 0.5 \times MOM_t \quad . \tag{10}$$

4. Empirical results

This section explores the predictability of a country's past fundamental trends on its equity market index futures returns. We construct economic momentum portfolios, measure their performance, and compare them to benchmark portfolios.

4.1. Baseline: Country-level regression analysis

We create 120 sub-strategies using two macro indices (positive and negative effect macro indices) and 60 lookback periods for measuring momentum signals based on a country's fundamentals. These sub-strategies consist of a combo portfolio (CM), which includes all 120 sub-strategies. Additionally, there are two specialised portfolios: the positive macro effect portfolio (PM), which aggregates 60 sub-strategies developed on the positive macro effect index, and the negative macro effect portfolio (NM), constructed similarly but on the negative macro effect index. Furthermore, we have short-term (ST), mid-term (MT), and long-term (LT) portfolios that combine sub-strategies based on lookback periods of 1–12, 13–36, and 37–60, respectively.

We conduct a panel regression in which we regress the excess returns of equity index futures on lagged-one-month weights, derived from the formula (2). We use these weights as the independent variable instead of the momentum signals to mitigate any issues related to outliers in the signals. The panel regression model is represented as follows:

$$r_{c,t} = \beta_0 + \beta_1 \Omega_{c,t-1}^{P} + \epsilon_{c,t}. \tag{11}$$

In this equation, $r_{c,t}$ is the excess return of the security for country c in month t, and $\Omega_{c,t-1}^{P}$ represents the lagged-one-period-standardised weights, which are the weights of assets within the portfolio P. It is important to note that this regression model accounts for both country and month fixed effects, and the standard errors are clustered by country and month to ensure the validity of the results.[8]

The empirical results in Table 2 indicate that historical trends in one country's fundamentals have statistically significant predictive power for future equity market returns. To be specific, the coefficient associated with the weight derived from the combo portfolio is 0.24%. This suggests that a one standard deviation increase in the weights derived from the combo portfolio can predict a positive gain of 0.24% on equity market index returns. It is noteworthy that these weights are derived from the momentum signals. Consequently, we can conclude that the historical trends in a country's fundamentals can positively predict that country's equity index returns. This phenomenon is referred to as economic momentum effects.

The portfolios that aggregate sub-strategies developed exclusively based on one of the macro indexes demonstrate economic momentum effects. More specifically, see columns 1 to 4, when examining the coefficients associated with the lagged-one-period weights for the positive macro effect portfolio (PM) and the negative macro effect portfolio (NM), we find them to be 0.13% and 0.28%, respectively. These coefficients are statistically significant. Furthermore, when conducting regressions of excess returns on both the weights of PM and NM simultaneously, we observe coefficients of 0.15% and 0.29%, respectively. This implies that the responses of excess returns to the negative macro effect index are approximately 93.33% (calculated as 0.29/0.15-1) more significant than those to the positive macro effect index. In essence, this suggests a stronger impact of the negative macro effect on excess returns than the positive macro effect.

The term-based portfolios also display momentum effects, see columns 5 to 7. Specifically, when examining the coefficients associated with the weights derived from the short-term (ST), mid-term (MT), and long-term portfolios (LT), we find values of 0.11%, 0.27%, and 0.20%, respectively. This suggests that a one standard deviation increase in weights derived from short-term, mid-term, and long-term momentum signals can positively predict gains of 0.11%, 0.27%, and 0.20%, respectively, in stock market index futures returns.

Column 8 of the analysis indicates that economic momentum returns are primarily attributed to mid-term momentum among the term-based portfolios. More specifically, when regressing the excess returns on the lagged weights derived from all three terms (ST, MT, and LT) simultaneously, only the coefficient related to the MT weights is statistically significant, measuring at 0.37%. This magnitude is the largest coefficient among the Panel, indicating that mid-term momentum significantly impacts economic momentum returns among the different terms considered.

To address potential doubts about the robustness of the economic momentum effects, we conduct further analysis by introducing controlling variables that have the potential to affect equity market returns. These control variables are sourced from the Kellydatalibrary and encompass various factors, including accruals, debt issuance, investment, low leverage, low risk, momentum, profit growth, profitability, quality, seasonality, short-term reversal, size, and value, as outlined in the work by Jensen et al. (2023).

[8] We also employ a Fama–MacBeth regression which does not affect our findings, please see Table 13 in the appendix.

Table 2
Economic momentum: Country-level analysis.
This table reports the results of regressing futures returns on weights derived from strategies with country and month fixed effects. The regression model is $r_{c,t} = \beta_0 + \beta_1 \Omega^P_{c,t-1} + \epsilon_{c,t}$, where $r_{c,t}$ denotes excess return on country index futures c in month t. $\Omega^P_{c,t-1}$ is the lagged-one-period weights within portfolio P for futures c. The weights are cross-sectionally standardised each month. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. Standard errors are clustered by country and month, and T-statistics are reported within parentheses. Intercepts are not reported for brevity. The reported coefficients are in percentage. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. The sample period is from January 1989 to December 2020.

Dep. = Returns	1	2	3	4	5	6	7	8
Ω^{CM}	0.24**							
	(3.21)							
Ω^{LM}		0.13**		0.15**				
		(2.28)		(2.36)				
Ω^{SM}			0.28**	0.29**				
			(2.62)	(2.63)				
Ω^{ST}					0.11			−0.08
					(1.71)			(−0.80)
Ω^{MT}						0.27***		0.37**
						(3.46)		(2.60)
Ω^{LT}							0.20**	−0.07
							(2.73)	(−0.76)
Observations	2,944	2,944	2,944	2,944	2,944	2,944	2,944	2,944
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Month Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Within R^2(%)	0.53	0.14	0.49	0.67	0.13	0.72	0.35	0.78
Adj. Within R^2(%)	0.49	0.10	0.45	0.59	0.09	0.69	0.31	0.66

Table 3 presents the results of our analysis, revealing that the economic momentum effects remain statistically significant even after controlling for various relevant variables. However, the magnitudes of these effects are somewhat reduced, and the predictive model's fitness improves. Specifically, the coefficient associated with the weight derived from the combo portfolio is 19%, which is slightly smaller (by 5%) compared to the coefficient of the same term (24%) in the model without control variables. This suggests that while the effect slightly diminishes, it still holds substantial predictive power.

Additionally, the introduction of control variables leads to a significant increase in the model's explanatory power, as indicated by the rise in the adjusted within R^2 value from 0.49% to 20.48%. This increase implies that economic momentum provides valuable predictive information about equity market returns, and it accounts for a substantial portion of the variance in these returns, even after controlling for other relevant factors. Notably, the control variables related to low risk, probability, quality, and size retain their explanatory power, indicating that these factors contribute to explaining equity market returns alongside economic momentum.

4.2. Baseline: Portfolio analysis

We confirm the predictability of economic momentum on equity index futures returns, but it is worth noting that the profitability of these effects remains unexplored. In this subsection, we examine the performance of the economic momentum portfolios.

To compute returns for each portfolio, we utilise the formula (3). The results of this analysis are presented in Table 4, which provides a descriptive summary of the portfolios. This summary includes key metrics such as annualised means (in percentage), annualised standard deviation (in percentage), skewness, excess kurtosis, first-order autocorrelation, maximum drawdown (in percentage), and Sharpe ratios. Panel A of the table provides a detailed overview of the performance of these portfolios, while Panel B reports on the correlations between the portfolios.

In Panel A of Table 4, it is evident that all economic momentum portfolios demonstrate positive mean returns and Sharpe ratios, underscoring their profitability. Specifically, the annualised mean returns for the economic combo (CM), positive macro effect (PM), negative macro effect (NM), short-term (ST), mid-term (MT), and long-term (LT) portfolios are 3.60%, 3.68%, 3.03%, 2.18%, 4.64%, and 3.16%, respectively, with corresponding Sharpe ratios of 0.87, 0.49, 0.40, 0.40, 0.96, and 0.66. These metrics suggest that these portfolios generate positive returns relative to their risk. It is worth noting that there is not a strong auto-correlation observed among portfolio returns, indicating that their performance is not simply driven by recent past performance.

Comparing CM with portfolios based solely on macro indexes (PM or NM), it becomes evident that there are advantages to combining PM and NM. PM exhibits higher mean returns than CM, but CM has a lower standard deviation (4.13%) compared to 7.52% for PM and 7.53% for NM. Moreover, CM offers portfolio diversification and boasts the highest Sharpe ratio (0.87) among them. Additionally, CM shows higher skewness and excess kurtosis but the lowest drawdown.

Table 3
Economic momentum: Country-level analysis with control variables.
This table reports the results of regressing futures returns on weights derived from strategies and control variables with country and month fixed effects. The regression model is $r_{c,t} = \beta_0 + \beta_1 \Omega^P_{c,t-1} + \lambda X' + \epsilon_{c,t}$, where $r_{c,t}$ denotes excess return on country index futures c in month t. $\Omega^P_{c,t-1}$ is the lagged-one-period weights within portfolio P for futures c. The weights are cross-sectionally standardised each month. X' is the control variables, the global factors obtained from Kelly data library. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. Standard errors are clustered by country and month, and T-statistics are reported within parentheses. Intercepts are not reported for brevity. The reported coefficients are in percentage. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. The sample period is from January 1989 to December 2020.

Dep. = Returns	1	2	3	4	5	6	7	8
Ω^{CM}	**0.19***** **(3.98)**							
Ω^{LM}		0.12** (2.68)		0.14** (2.90)				
Ω^{SM}			0.19** (2.67)	0.21** (2.73)				
Ω^{ST}					0.08 (1.36)			−0.06 (−0.78)
Ω^{MT}						0.21*** (4.59)		0.29** (2.79)
Ω^{LT}							0.16*** (3.33)	−0.04 (−0.49)
accruals	−5.17 (−0.55)	−5.16 (−0.55)	−5.05 (−0.54)	−5.05 (−0.54)	−5.18 (−0.56)	−5.16 (−0.55)	−5.18 (−0.55)	−5.14 (−0.55)
debt_issuance	−2.42 (−0.24)	−2.56 (−0.25)	−2.13 (−0.21)	−2.40 (−0.24)	−2.48 (−0.25)	−2.20 (−0.22)	−2.35 (−0.23)	−2.01 (−0.20)
investment	−5.60 (−0.54)	−5.34 (−0.51)	−5.78 (−0.55)	−5.74 (−0.55)	−5.24 (−0.50)	−5.69 (−0.55)	−5.74 (−0.55)	−5.83 (−0.57)
low_leverage	−16.96 (−0.94)	−16.82 (−0.93)	−16.65 (−0.92)	−16.92 (−0.93)	−16.87 (−0.92)	−17.04 (−0.95)	−16.74 (−0.92)	−16.92 (−0.95)
low_risk	−57.52*** (−5.00)	−57.88*** (−4.99)	−57.24*** (−4.97)	−57.39*** (−4.99)	−57.65*** (−4.99)	−57.48*** (−5.02)	−57.64*** (−4.99)	−57.47*** (−5.02)
momentum	1.37 (0.34)	1.53 (0.38)	1.41 (0.36)	1.39 (0.35)	1.44 (0.35)	1.42 (0.35)	1.43 (0.35)	1.48 (0.37)
profit_growth	−10.56 (−1.41)	−10.60 (−1.45)	−10.55 (−1.41)	−10.74 (−1.44)	−10.44 (−1.41)	−10.66 (−1.42)	−10.54 (−1.42)	−10.70 (−1.43)
profitability	25.54* (2.03)	26.09* (2.07)	25.33* (1.99)	25.33* (2.00)	25.68* (2.03)	25.71* (2.05)	25.70* (2.05)	25.97* (2.10)
quality	−50.85*** (−5.86)	−51.30*** (−5.89)	−51.18*** (−5.90)	−50.70*** (−5.85)	−51.30*** (−5.89)	−50.76*** (−5.88)	−51.16*** (−5.88)	−50.89*** (−5.93)
seasonality	−0.42 (−0.03)	−0.37 (−0.03)	−0.16 (−0.01)	−0.32 (−0.03)	−0.38 (−0.03)	−0.76 (−0.06)	−0.12 (−0.01)	−0.84 (−0.07)
short_term_reversal	5.48 (1.08)	5.80 (1.14)	5.43 (1.08)	5.36 (1.06)	5.51 (1.10)	5.32 (1.05)	5.79 (1.14)	5.41 (1.07)
size	−10.59 (−1.65)	−10.27 (−1.60)	−10.85 (−1.69)	−10.75 (−1.68)	−10.38 (−1.61)	−10.60 (−1.66)	−10.59 (−1.64)	−10.62 (−1.68)
value	8.55 (0.74)	8.80 (0.77)	8.69 (0.76)	8.59 (0.75)	8.75 (0.76)	8.58 (0.75)	8.66 (0.76)	8.63 (0.76)
Observations	2,944	2,944	2,944	2,944	2,944	2,944	2,944	2,944
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Month Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Within R^2(%)	20.91	20.69	20.82	20.96	20.65	21.02	20.81	21.06
Adj. Within R^2(%)	20.48	20.26	20.39	20.50	20.22	20.59	20.38	20.56

Interestingly, the analysis suggests that mid-term momentum (MT) plays a crucial role in driving the performance of economic momentum strategies. When comparing CM with term-based portfolios, CM stands out for its lower standard deviation. In contrast, MT demonstrates the highest mean returns (4.64%) and the highest Sharpe ratio (0.96) among all portfolios, along with the lowest maximum drawdown (−5.43%).

Turning to Panel B of Table 4, it is clear that CM has a high correlation (0.95) with MT, suggesting a strong relationship between the combo portfolio and mid-term momentum. Correlations between CM and the term-based portfolios (ST, MT, and LT) are also noteworthy, indicating their interconnectedness. On the other hand, correlations between CM and solely macro-index-based portfolios (PM and NM) are lower, highlighting the benefits of aggregating PM and NM into CM. Indeed, the correlations between the portfolios make sense, given that they are constructed from similar sub-strategies or share underlying components.

Table 4
Economic momentum: Portfolio analysis.
This table reports the results of analysing portfolios constructed on economic momentum signals. Panel A reports portfolio returns' statistics, including mean, standard deviation, skewness, excess kurtosis, one-order autocorrelation, maximum drawdown and Sharpe ratio. Panel B reports correlations between these portfolios. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. We aggregate substrategies based on their inverse volatility in this table while we also consider the equal-weighted methodology, see Table 14 in the appendix. The sample period is selected from February 1992 to December 2020 for the consistency of the economic momentum portfolio periods.

	CM	PM	NM	ST	MT	LT
Panel A: Portfolio Performance						
Mean(%)	3.60	3.68	3.03	2.18	4.64	3.16
Std(%)	4.13	7.52	7.53	5.50	4.83	4.80
Skew	0.58	0.10	−0.03	−0.20	0.91	0.35
Excess Kurtosis	1.02	−1.39	−1.47	3.43	2.71	−0.16
AR(1)	0.07	0.19	0.06	0.02	0.08	0.00
Max. Drawdown(%)	−6.53	−24.72	−20.86	−19.08	−5.43	−9.36
Sharpe Ratio	0.87	0.49	0.40	0.40	0.96	0.66
Panel B: Correlation						
CM	1.00					
PM	0.57	1.00				
NM	0.54	−0.37	1.00			
ST	0.65	0.41	0.31	1.00		
MT	0.95	0.55	0.50	0.56	1.00	
LT	0.88	0.47	0.50	0.29	0.76	1.00

Furthermore, the analysis explores the time-varying persistence of economic momentum effects. Fig. 1 illustrates that all economic momentum portfolios exhibit trending behaviour over time and show resilience during recession periods. In Panel A, PM and NM follow opposite routes, emphasising the value of combining them into CM, which appears to be the most promising strategy in terms of growth. Panel B highlights that MT outperforms ST and LT in terms of cumulative returns over the sample period and has a similar pattern to CM but with better volatility-adjusted cumulative returns. This suggests that mid-term momentum signals are likely to drive the profitability and predictability of the economic momentum portfolio.

4.3. Benchmarks

In this section, we conduct a comparative analysis of economic momentum portfolios against standard momentum strategies and other benchmarks. We consider a range of benchmarks widely recognised in the literature to ensure a comprehensive evaluation. These benchmarks include time-series momentum (TSMOM_AQR), value (VAL_AQR), momentum (MOM_AQR), and value and momentum (VMOM_AQR) factors obtained from AQR. Additionally, to align with the markets selected in this paper, we construct equivalent factor data (TSMOM, VAL, MOM, and VMOM) tailored to the specific markets covered in this research. For passive investment comparison, we create a portfolio that involves buying and holding the MSCI world index's excess returns over one-month treasury returns, referred to as Mkt-Rf. This comprehensive set of benchmarks allows us to assess the performance of economic momentum portfolios compared to established strategies and market indices.

4.3.1. Benchmarks: Portfolio analysis

Panel A of Table 5 provides a comprehensive summary of portfolio performance, including risk-adjusted returns, return distribution characteristics, first-order autocorrelation, maximum drawdown, and Sharpe ratios. The analysis indicates that economic momentum portfolios outperform the selected benchmarks regarding risk-adjusted performance.

Among the benchmark strategies, TSMOM_AQR exhibits the highest annualised returns at 12.10%. However, when considering the volatility of its returns, characterised by a standard deviation of 27.18%, its Sharpe ratio is relatively low at 0.45. In contrast, the economic momentum combo portfolio (CM) achieves a much higher Sharpe ratio of 0.93, while the economic mid-term momentum portfolio (MT) boasts an even more impressive Sharpe ratio of 1.01.

Moreover, when examining the maximum drawdown, which represents the peak-to-trough decline in portfolio value, it is notably lower for the economic momentum portfolios (6.53% for CM and 5.43% for MT) compared to the benchmarks, which generally have maximum drawdowns above 20% (except 16.67% for MOM_AQR). This indicates that economic momentum portfolios tend to be more stable and have the potential for lower maximum losses compared to benchmark strategies.

Table 5
Benchmarks: Portfolio analysis.
This table reports the results of comparing economic momentum portfolios and benchmarks. Panel A reports portfolio returns' statistics, including mean, standard deviation, skewness, excess kurtosis, one-order autocorrelation, maximum drawdown and Sharpe ratio. Panel B reports correlations between these portfolios. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. We construct benchmarks to compare our findings. The passive investment (Mkt-Rf) is to buy and hold the MSCI world index over a one-month treasury bill. The time-series momentum portfolio (TSMOM) trades securities according to the macro indices 12-month cumulative returns (Moskowitz et al., 2012). Likewise, value (VAL) and momentum (MOM) buy-sell assets towards relative book values and relative 12-month cumulative returns. Value and momentum (VMOM) is the sum of a half VAL and a half MOM (Asness et al., 2013). TSMOM_ARQ, VAL_ARQ, MOM_ARQ and VMOM_ARQ are similar portfolios as above but employ the original factor data from the AQR. See 3.2 for details of benchmarks construction. The sample period is from February 1995 to December 2020 due to data points availability of benchmarks.

	CM	PM	NM	ST	MT	LT	Mkt-Rf	TSMOM	MOM	VAL	VMOM	VAL_AQR	MOM_AQR	VMOM_AQR	TSMOM_AQR
Panel A: Portfolio Performance															
Sharpe Ratio	**0.93**	0.63	0.37	0.48	**1.01**	0.76	0.24	0.05	−0.02	0.21	0.13	−0.10	0.34	0.34	**0.45**
Mean(%)	**3.95**	4.64	2.78	2.34	**4.93**	3.66	3.59	1.37	−0.19	1.66	0.94	−0.81	3.37	1.58	**12.10**
Std(%)	**4.24**	7.32	7.49	4.87	**4.89**	4.82	15.19	28.40	11.49	7.79	7.41	8.49	9.81	4.66	**27.18**
Maximum Drawdown(%)	**−6.53**	−22.64	−20.86	−19.08	**−5.43**	−9.36	−59.78	−73.70	−59.96	−26.23	−25.76	−49.92	−16.67	−20.53	−71.91
Skew	0.68	0.45	−0.16	−0.40	1.09	0.42	−0.68	0.38	−0.01	0.04	0.00	0.09	−0.29	0.24	−0.24
Excess Kurtosis	1.14	−2.35	−1.76	1.05	3.19	0.09	−1.33	0.57	−1.81	−2.61	−2.11	−1.37	−0.36	−0.72	−2.03
AR(1)	0.11	0.17	0.02	0.12	0.12	0.02	0.09	−0.15	0.09	−0.04	−0.01	0.12	0.05	0.01	0.11
Panel B: Correlation Between Portfolios															
CM	1.00														
PM	0.59	1.00													
NM	0.57	−0.31	1.00												
ST	0.64	0.42	0.33	1.00											
MT	0.95	0.57	0.53	0.56	1.00										
LT	0.91	0.50	0.55	0.35	0.79	1.00									
Mkt-Rf	−0.19	0.08	−0.34	−0.11	−0.15	−0.21	1.00								
TSMOM	0.10	−0.08	0.21	−0.01	0.12	0.11	−0.24	1.00							
MOM	0.26	0.16	0.14	0.00	0.26	0.30	−0.21	0.25	1.00						
VAL	0.18	0.31	−0.05	−0.02	0.13	0.27	−0.14	0.11	0.15	1.00					
VMOM	0.29	0.29	0.08	−0.01	0.27	0.37	−0.23	0.25	0.85	0.64	1.00				
VAL_AQR	−0.23	−0.19	−0.11	−0.04	−0.19	−0.29	0.33	−0.16	−0.31	−0.48	−0.49	1.00			
MOM_AQR	0.18	0.13	0.08	−0.02	0.14	0.27	−0.23	0.18	0.53	0.22	0.53	−0.49	1.00		
VMOM_AQR	−0.02	−0.04	−0.01	−0.05	−0.03	0.02	0.06	0.04	0.28	−0.21	0.11	0.40	0.61	1.00	
TSMOM_AQR	0.13	0.08	0.07	0.05	0.14	0.14	0.10	0.34	0.33	0.05	0.28	−0.01	0.35	0.36	1.00

The return distribution characteristics further highlight the superior performance of the economic momentum portfolios. The positive excess kurtosis observed in CM and MT (1.14 and 3.19, respectively) signifies that these portfolios achieve returns that are more "fat-tailed" or exhibit more extreme values than the benchmarks. In contrast, the benchmarks tend to have negative excess kurtosis, indicating that their returns are more "thin-tailed" and cluster closer to the mean. Additionally, the skewness of CM and MT (0.68 and 1.09, respectively) is larger than the skewness of the benchmarks. Positive skewness suggests that these portfolios produce positively skewed returns, indicating the potential for higher returns during favourable market conditions.

The auto-correlations and inter-portfolio correlations for the economic momentum portfolios are low, as shown in Panel A and Panel B of Table 5. This indicates that economic momentum portfolios are relatively independent of each other and from the benchmark strategies, further supporting their diversification benefits and potential for risk reduction.

Interestingly, the summary data of the benchmarks we construct and the benchmark factor data obtained from AQR are dramatically different. The main reason for this difference is the market selection. To maintain consistency with our primary studies in this paper, we chose the same country markets when constructing the benchmarks, which differ from those used in the AQR factor data.

Additionally, according to Asness et al. (2013), the value portfolio achieves a mean return of 5.70% and a Sharpe ratio of 0.60 in the sample period from 1978 to 2011. We argue that we find a negative mean return on VAL_AQR when considering the sample period from 1995 to 2020. Therefore, we suggest that the performance of the value factor cannot be sustained over time.

In terms of the time persistence of portfolios, we plot line charts, shown in Fig. 2, to visualise cumulative returns on both the economic momentum and the benchmarks, exploring the performance of these strategies over time. The drawdown of these portfolios over time is also plotted in Fig. 3. The NBER recession periods are included in the figures. All portfolio returns are scaled to the same annualised volatility of 6%, which is the average volatility across portfolios. We scale them to control for volatility, allowing for a more meaningful comparison in the visualised line charts.

Panel A of Fig. 2 compares the cumulative returns of the economic momentum combo portfolio (CM) and passive investment, represented by buying-and-holding the MSCI world index over one-month Treasury T-bills (Mkt-Rf). The figure illustrates that CM consistently outperforms in terms of cumulative returns. Additionally, during recession periods, passive investment performs worse than active investment, CM.

Panel B, which compares the performance of CM with time-series momentum (TSMOM and TSMOM_AQR), indicates that CM performs better than these benchmarks in terms of cumulative returns. Notably, TSMOM_AQR briefly matches CM's cumulative

Table 6
Benchmarks: Country-level regression analysis.
This table reports the results of regressing excess futures returns on weights derived from strategies with country and month fixed effects. The regression model is $r_{c,t} = \beta_0 + \beta_1 \Omega^P_{c,t-1} + \lambda X' + \epsilon_{c,t}$, where $r_{c,t}$ denotes excess return on country index futures c in month t. $\Omega^P_{c,t-1}$ is the lagged-one-period weights within portfolio P for futures c. The weights are cross-sectionally standardised each month. X' is the control variables, the global factors obtained from Kelly data library. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. We construct benchmarks to compare our findings. The time-series momentum portfolio (TSMOM) trades securities according to the macro indices 12-month cumulative returns (Moskowitz et al., 2012). Likewise, value (VAL) and momentum (MOM) buy-sell assets towards relative book values and relative 12-month cumulative returns. Value and momentum (VMOM) is the sum of a half VAL and a half MOM (Asness et al., 2013). See 3.2 for details of benchmarks construction. The reported coefficients are in percentage. Intercepts are not reported for brevity. Standard errors are clustered by country and month, and T-statistics are reported within parentheses. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. The sample period is from February 1995 to December 2020 due to data points availability of benchmarks.

Dep = Returns	1	2	3	4	5	6	7	8	9	10
Ω^{CM}	0.24***	0.18***								
	(3.01)	(3.73)								
Ω^{VAL}			−1.68**	−1.21*						
			(−2.11)	(−1.86)						
Ω^{MOM}					−0.05	0.10				
					(−0.19)	(0.37)				
Ω^{VMOM}							−0.44	−0.09		
							(−0.96)	(−0.19)		
Ω^{TSMOM}									−0.01	0.01
									(−0.13)	(0.27)
Observations	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564	2,564
Adj. R^2(%)	0.56	22.30	0.35	22.15	0.00	21.98	0.06	21.98	0.00	21.98
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Month Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Control X	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

returns around 2008 but fails to maintain its trend afterwards. Particularly after 2018, both TSMOM and TSMOM_AQR experience significant declines in their long-term cumulative returns, raising questions about the persistence of time-series momentum strategies over time.

Panel C reports comparisons between CM and individual cross-sectional momentum strategy (MOM) and value strategy (VAL), as well as their AQR benchmarks (MOM_AQR and VAL_AQR). The benchmarks show slight increases over the sample periods, while CM exhibits significant growth.

Panel D compares CM with the value and momentum strategy (VMOM and VMOM_AQR). CM consistently outperforms the benchmarks. Notably, VMOM_AQR experiences substantial growth before 2008 but a decline in cumulative returns after 2008, suggesting doubts about the time persistence of VMOM.

In conclusion, comparing CM with various benchmarks consistently demonstrates that CM's time-varying cumulative returns outperform the benchmarks, even during recession periods. It is important to note that while time-series momentum and value and momentum strategies perform well in their original paper's sample periods, their profits decline during the extended periods in this paper, casting doubt on their long-term persistence.

From Fig. 3, it is evident that CM consistently maintains a drawdown of approximately under 4% over time, unlike the other strategies. The drawdown in the passive investment returns widens around recession periods. Additionally, both TSMOM_AQR and VMOM_AQR experience worsening drawdowns after the global financial crisis.

4.3.2. Benchmarks: Regression analysis

We establish portfolios for both economic momentum and benchmarks and conduct a comparative analysis. Both visually and statistically, our findings lead us to conclude that economic momentum outperforms benchmarks in terms of risk-adjusted returns and risk management. In this section, we delve into a statistical examination of the predictive capabilities of economic momentum and benchmarks on future equity index returns.

From a statistical standpoint, we find strong evidence supporting the superiority of CM over the benchmarks. Utilising the same sample period of 199502:202012 for all portfolios, we conduct panel regression analyses, regressing country index futures' excess returns on lagged one-month portfolio weights.[9] Table 6 presents the results of these panel regressions, accounting for both country

[9] We select this sample period due to the data availability of all portfolios.

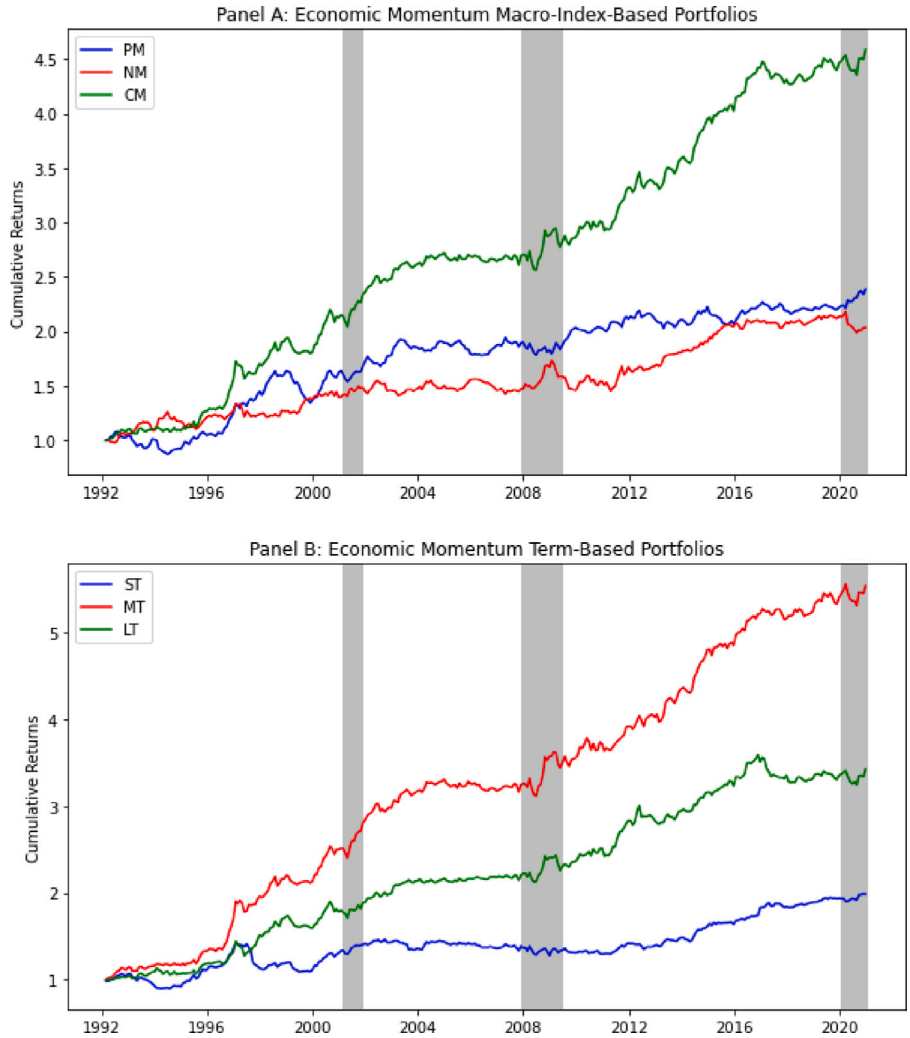

Fig. 1. Cumulative Returns of Economic Momentum Portfolios.
The figure plots the cumulative returns of economic momentum portfolios. Note that all portfolio returns are scaled to the same annualised volatility of 6%, the average volatility across portfolios. We scale them to make their returns comparable. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. Shaded bars indicate the NBER recession periods. The sample period is selected from February 1992 to December 2020 for the consistency of the economic momentum portfolio periods.

and month fixed effects, with standard errors clustered by country. Additionally, we incorporate the control variables employed in Section 4.1 into these regressions.

Table 6 demonstrates that the predictive power of weights derived from CM is the most robust compared to the benchmarks. Specifically, during the sample period 199502:202012, CM maintains its statistically significant predictive power concerning future equity index returns. Even after controlling for relevant variables, the coefficient associated with CM only slightly decreases from 0.24% to 0.18%. Although the magnitude of the coefficient decreases somewhat, it remains solid and significant. The 0.18% coefficient implies that a one standard deviation increase in weights derived from momentum signals corresponds to a 0.18% increase in equity index returns. Conversely, only the VAL strategy exhibits significant coefficients for the benchmarks but bears negative signs, indicating adverse predictive power. The coefficients for the other benchmarks are largely insignificant. Across all columns, it is noteworthy that including control variables in the regressions significantly enhances the model's goodness of fit. For instance, for CM, the R-squared value increases substantially from 0.56% to 22.30% after controlling for variables in the regressions.

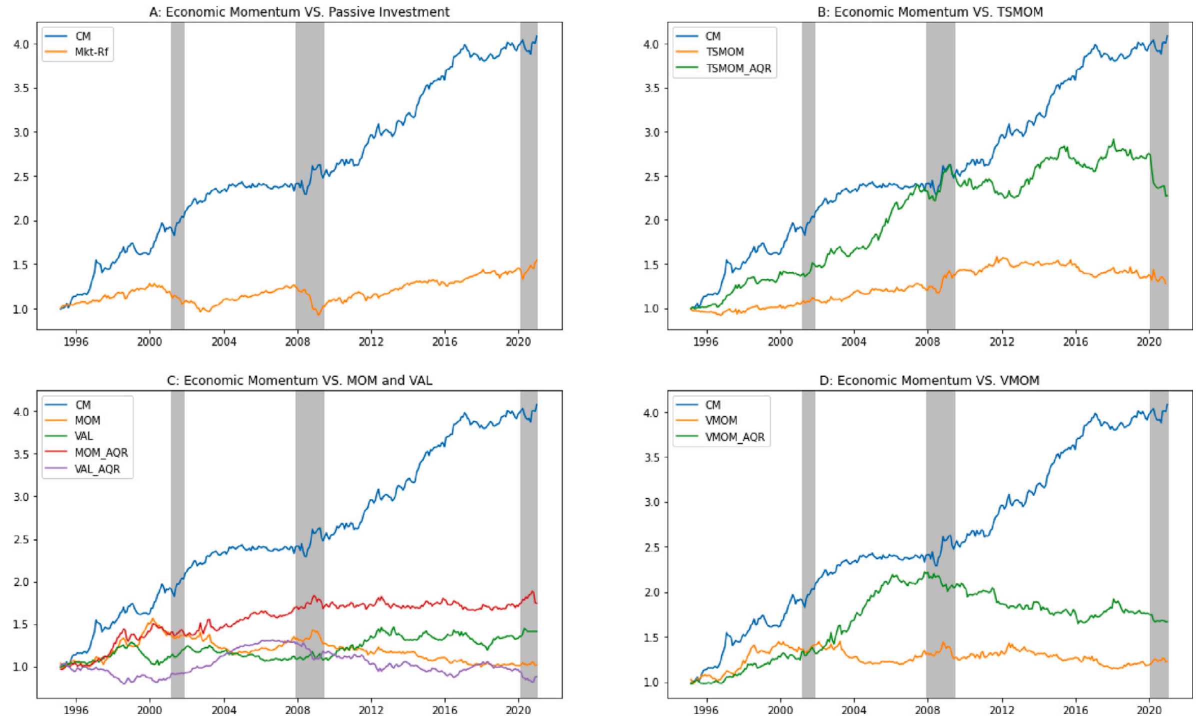

Fig. 2. Economic Momentum Vs. Benchmarks: Cumulative Returns.
The figure plots the cumulative returns of economic momentum combo and benchmark portfolios. Note that all portfolio returns are scaled to the same annualised volatility of 6%, the average volatility across portfolios. We scale them to make their returns comparable. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. We construct benchmarks to compare our findings. The passive investment (Mkt-Rf) is to buy and hold the MSCI world index over a one-month treasury bill. The time-series momentum portfolio (TSMOM) trades securities according to the macro indices 12-month cumulative returns (Moskowitz et al., 2012). Likewise, value (VAL) and momentum (MOM) buy-sell assets towards relative book values and relative 12-month cumulative returns. Value and momentum (VMOM) is the sum of a half VAL and a half MOM (Asness et al., 2013). TSMOM_ARQ, VAL_ARQ, MOM_ARQ and VMOM_ARQ are similar portfolios as above but employ the original factor data from the AQR. See 3.2 for details of benchmarks construction. Shaded bars indicate the NBER recession periods. The sample period is from February 1995 to December 2020 due to data points availability of benchmarks.

4.3.3. Explanations between economic momentum and benchmarks

By empirically evaluating the performance of economic momentum portfolios and benchmarks, we establish that the economic momentum portfolios consistently outperform the benchmarks in terms of risk-adjusted returns and downside risk. However, it is interesting to confirm whether the superior performance of the economic momentum portfolios can be attributed to the benchmarks, or, conversely, if the economic momentum portfolios influence the benchmarks.

We conduct a regression analysis to examine the relationship between the returns of the economic momentum combo portfolio (CM) and the returns of various benchmarks, including the passive investment strategy (Mkt-Rf), time-series momentum (TSMOM), momentum (MOM), value (VAL), and value and momentum (VMOM), as well as their respective factor data (TSMOM_AQR, MOM_AQR, VAL_AQR, and VMOM_AQR) obtained from AQR. The regression model is specified as follows:

$$ret_t^{CM} = \alpha + \beta \cdot ret_t^P + \epsilon_t, \tag{12}$$

where ret_t^{CM} represents the returns on CM. ret_t^P represents the returns on one of the benchmarks P.

Table 7 reveals that none of the benchmarks can fully account for CM's performance. The coefficient associated with Mkt-Rf is −5.22%, indicating a negative relationship between CM and the passive investment strategy. Similarly, CM negatively associates with VAL_AQR, with a coefficient of −11.71%. Except for Mkt-Rf, VAL_AQR, and the insignificant coefficients for TSMOM and VMOM_AQR, all other benchmarks exhibit a positive and statistically significant relationship with CM. Nevertheless, these benchmarks do not entirely explain CM's returns. The average intercept of the model is 0.32, which is statistically significant for all models related to individual benchmarks. Column 10 presents the results of regressing CM returns on all benchmarks. The

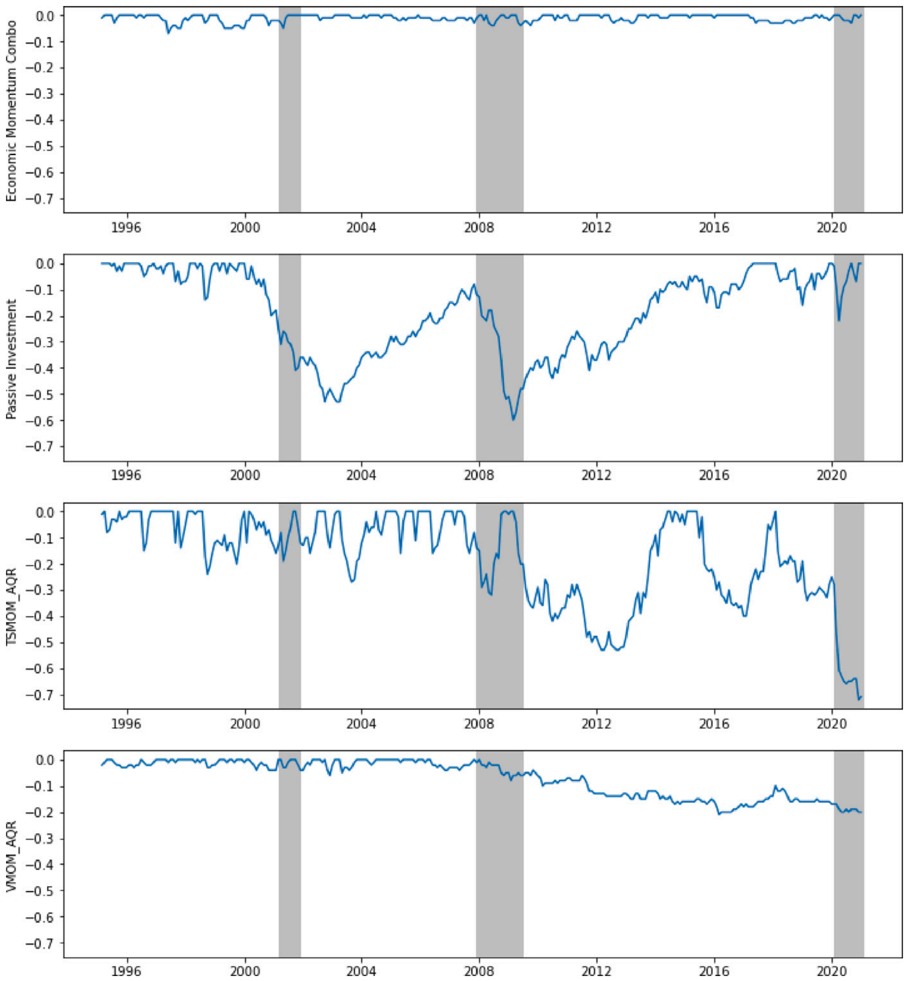

Fig. 3. Economic Momentum Vs. Benchmarks: Drawdown.
The figure plots the time-varying economic combo and benchmark portfolios drawdown. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. We construct benchmarks to compare our findings. The passive investment (Mkt-Rf) is to buy and hold the MSCI world index over a one-month treasury bill. The time-series momentum portfolio (TSMOM) trades securities according to the macro indices 12-month cumulative returns (Moskowitz et al., 2012). Likewise, value (VAL) and momentum (MOM) buy-sell assets towards relative book values and relative 12-month cumulative returns. Value and momentum (VMOM) is the sum of a half VAL and a half MOM (Asness et al., 2013). TSMOM_ARQ, VAL_ARQ, MOM_ARQ and VMOM_ARQ are similar portfolios as above but employ the original factor data from the AQR. See 3.2 for details of benchmarks construction. Shaded bars indicate the NBER recession periods. The sample period is from February 1995 to December 2020 due to data points availability of benchmarks.

annualised alpha of the model is 3.72% (0.31%×12). Considering that the annualised return of CM is 3.95%, we can infer that 94.18% (3.72/3.95) of CM's returns remain unexplained even after accounting for the benchmarks.

On the contrary, we perform regressions of benchmark returns on CM. Specifically, the regression model is defined as follows:

$$ret_t^P = \alpha + \beta \cdot ret_t^{CM} + \epsilon_t, \tag{13}$$

where the notations are the same as those in formula (12).

Table 8 shows that CM significantly incorporates returns on the benchmarks, except for Mkt-Rf, VMOM_AQR, and TSMOM_AQR. Intercepts of models related to Mkt-Rf, VMOM_AQR, and TSMOM_AQR are 0.54%, 0.15%, and 1.07%, respectively, all statistically significant. Regarding the coefficients on the term CM, they suggest that MOM, VAL, VMOM, and MOM_AQR have a positive comovement with CM. In addition, we observe no significant relationship between CM and TSMOM and VMOM_AQR.

Table 7
Benchmarks: Explaining economic momentum.
This table reports the results of regressing economic momentum portfolio returns on benchmark returns. The regression model is $ret_t^{CM} = \alpha + \beta \cdot ret_t^P + \epsilon_t$. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. We construct benchmarks to compare our findings. The passive investment (Mkt-Rf) is to buy and hold the MSCI world index over a one-month treasury bill. The time-series momentum portfolio (TSMOM) trades securities according to the macro indices 12-month cumulative returns (Moskowitz et al., 2012). Likewise, value (VAL) and momentum (MOM) buy-sell assets towards relative book values and relative 12-month cumulative returns. Value and momentum (VMOM) is the sum of a half VAL and a half MOM (Asness et al., 2013). TSMOM_ARQ, VAL_ARQ, MOM_ARQ and VMOM_ARQ are similar portfolios as above but employ the original factor data from the AQR. See 3.2 for details of benchmarks construction. To adjust for serial correlation, the t-statistics, reported in parentheses, are based on Newey and West (1987) standard errors with the six lags. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. The sample period is from February 1995 to December 2020 due to data points availability of benchmarks.

Dep = CM	1	2	3	4	5	6	7	8	9	10
Intercept	0.34***	0.32***	0.32***	0.31***	0.31***	0.32***	0.30***	0.33***	0.30***	**0.31*** **
	(4.52)	(4.14)	(4.22)	(4.13)	(4.29)	(4.30)	(3.96)	(4.31)	(4.08)	**(4.36)**
Mkt-Rf	−5.22**									−3.81**
	(−2.50)									(−2.26)
TSMOM		1.56								−0.45
		(1.52)								(−0.61)
MOM			9.25**							4.42
			(2.47)							(1.35)
VAL				9.81**						2.65
				(2.42)						(0.74)
VMOM					16.50***					3.53
					(3.27)					(1.62)
VAL_AQR						−11.71***				−5.10
						(−3.38)				(−1.44)
MOM_AQR							7.95***			−0.63
							(3.23)			(−0.28)
VMOM_AQR								−1.55		−2.87*
								(−0.27)		(−1.67)
TSMOM_AQR									2.10*	1.95**
									(1.69)	(2.13)
Adj R^2 (%)	3.08	0.75	5.91	2.97	8.00	4.89	2.91	−0.30	1.45	9.44
Observations	305	305	305	305	305	305	305	305	305	305

5. Further analysis

5.1. Driving force investigation

To explore the driving force of the economic momentum portfolio returns, we employ standard asset pricing factors models to examine if such economic momentum profitability can be explained. The first model, including the Market, Size and Value factors, is termed the FF3 (Fama and French, 1993). The second model is termed the FF5, which requires the Market (Mkt-Rf), Size (SMB), Value (HML), Profitability (RMW) and Investment (CMA) factors (Fama and French, 2015). The third model is the q5 factor model with the Market (Mkt-Rf), Size (R_ME), Investment (R_IA), Return on equity(R_ROE) and Expected growth (R_EG) (Hou et al., 2021). The fourth model is from Jensen et al. (2023), which classifies factors into themes (see their appendix for details).

Empirical results in Table 9 indicate that none of these standard asset pricing factor models can explain the returns on CM. The alpha (intercept) of factor model FF3, FF5, q-5 and world factors are 0.36%, 0.39%, 0.32% and 0.34%, respectively, statistically significant at the 1% level. These significant alphas imply that none of these factor models can fully explain the returns on CM. However, we note that the market risk premium of FF3 and FF5 can partially explain CM returns but in a negative relationship. Moreover, in the model of world factors, factors of investment, low_leverage, profitability and size have positive explanations on CM returns, while accruals and quality have negative relationships with the CM returns.

Apart from the pricing models, we also decompose the economic momentum combo portfolio returns towards the country for studying if any country domain the combo portfolio returns. In detail, we extract weights for each country index within the combo portfolio. Then, we multiply the weights with the country index futures returns but do not aggregate them, leaving a time-series return for each country.

Table 10 shows that no country dominates the combo portfolio returns. In the table, the maximum mean return, 0.85%, is gained by Switzerland, while the minimum mean return is −0.18%, earned by Sweden. Compared with the mean return of 3.95% of CM,

Table 8

Benchmarks: Explaining them with economic momentum.

This table reports the results of regressing benchmark returns on economic momentum portfolio returns. The model is $ret_t^P = \alpha + \beta \cdot ret_t^{CM} + \epsilon_t$. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1-12, 13-36 and 37-60 months, respectively, ignoring the macro index. We construct benchmarks to compare our findings. The passive investment (Mkt-Rf) is to buy and hold the MSCI world index over a one-month treasury bill. The time-series momentum portfolio (TSMOM) trades securities according to the macro indices 12-month cumulative returns (Moskowitz et al., 2012). Likewise, value (VAL) and momentum (MOM) buy-sell assets towards relative book values and relative 12-month cumulative returns. Value and momentum (VMOM) is the sum of a half VAL and a half MOM (Asness et al., 2013). TSMOM_ARQ, VAL_ARQ, MOM_ARQ and VMOM_ARQ are similar portfolios as above but employ the original factor data from the AQR. See 3.2 for details of benchmarks construction. To adjust for serial correlation, the t-statistics, reported in parentheses, are based on Newey and West (1987) standard errors with the six lags. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. The sample period is from February 1995 to December 2020 due to data points availability of benchmarks.

	Mkt-Rf	TSMOM	MOM	VAL	VMOM	VAL_AQR	MOM_AQR	VMOM_AQR	TSMOM_AQR
Intercept	0.54**	0.25	−0.18	0.06	−0.06	0.09	0.21	0.15**	1.07**
	(2.13)	(0.70)	(−0.86)	(0.40)	(−0.54)	(0.60)	(1.39)	(1.97)	(2.06)
CM	−65.09**	69.12	67.16***	33.54**	50.35***	−44.42**	40.63***	−1.90	84.82**
	(−2.07)	(1.48)	(3.18)	(2.08)	(3.40)	(−2.53)	(3.62)	(−0.26)	(2.07)
Adj. R^2 (%)	3.08	0.75	5.91	2.97	8.00	4.89	2.91	0.00	1.45
Observations	305	305	305	305	305	305	305	305	305

country-level portfolio returns are small. Observing the T-statistics of the mean returns, we find that none of the country-level portfolio mean returns are significant. It suggests that none of the countries leads the CM returns. In addition, the Sharpe ratios of these country portfolios are, on average, below 0.30. In contrast, the combination of them, the economic momentum combo portfolio, achieves a Sharpe ratio of 0.93, suggesting the benefits of portfolio diversification.

5.2. Transaction costs

Recent papers discuss the effects of transaction cost on momentum strategy profits. Based on estimation models, Lesmond et al. (2004) and Korajczyk and Sadka (2004) suggest that the profits of momentum strategies are significantly lower than the theoretical world. However, Frazzini et al. (2018) argue their statement using the live data. To examine if the effect of transaction cost on momentum profits is essential, we construct the bid–ask spread ratio as the transaction cost of the trading. We obtain the bid and ask prices of the 1st generic continue series for each country index futures from Bloomberg. Then, we calculate the bid–ask spread ratio (TC) as

$$Spread_{c,t} = 2 * (ASK_{c,t} - BID_{c,t})/(ASK_{c,t} + BID_{c,t}) \quad and \tag{14}$$

$$TC_{c,t} = \Omega_{c,t-1}^{CM} Spread_{c,t}, \tag{15}$$

where $ASK_{c,t}$, $BID_{c,t}$ and $Spread_{c,t}$ denote the ask price, bid price, and spread between them for the country c at the month t. Note that $\Omega_{c,t}^{CM}$ is the weights derived from formula (2) and $TC_{c,t}$ is the transaction cost of economic momentum combo strategy for country c at the month t. We take the mean basis points of bid–ask spread ratios as the monthly re-balance cost for each market index. Based on that, the economic momentum combo portfolio can still yield a Sharpe ratio of 0.52 with annualised returns of 2.14% even after accounting for transaction costs.

5.3. Other market indices

The profitability and predictability of the economic momentum portfolio are confirmed in the main results. For robustness, we also study its effectiveness in other general market groups such as G10, developed markets and emerging markets based on MSCI country indices. G10 contains Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, the United Kingdom and the United States. Developed markets are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. Emerging markets are Brazil, Chile, China, Colombia, Czech Republic, Greece, Hungary, India, Indonesia, Poland, Russia, South Africa, South Korea and Turkey. The descriptive summary statistics of portfolio performance for different market groups are reported in Panel A of Table 11, including annualised mean returns in percentage, annualised standard deviation in percentage (Std.), skewness, excess kurtosis, lagged-one-period auto-correlation (AR(1)), maximum drawdown in percentage and Sharpe ratio. Panel B of Table 11 presents the results of panel regressions of market indices on the economic momentum portfolio returns for different market groups.

Table 9
Further analysis: Standard asset pricing factor models.
The table presents the explanation power of standard pricing factors on the economic momentum combo portfolio. The regression model is $ret_t^{CM} = \alpha + \lambda F'^{X}_t + \epsilon_t$, where *ret* is the returns on the economic momentum portfolio (CM) and F'^{X}_t is the factors F of the factor model X. Standard asset pricing factor models we examine include the Fama–French Three Factor (FF3) (Fama and French, 1993), Fama–French Five Factor (FF5) (Fama and French, 2015), q-factors (q-5) (Hou et al., 2021) and theme factors in the world (World Factors) (Jensen et al., 2023). FF3 contains market risk premium, size and value factors, and FF5 adds profitability and investment to FF3. The q5 model requires market, size, investment, ROE and expected growth factors. World Factors include themes of accruals, debt insurance, investment, low leverage, low risk, momentum, profit growth, profitability, quality, seasonality, short-term reversal, size and value. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. To adjust for serial correlation, the t-statistics, reported in parentheses, are based on Newey and West (1987) standard errors with the six lags. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. The sample period is from February 1995 to December 2020 due to data points availability of benchmarks.

	FF3	FF5	q-5	World factors
Intercept	**0.36*****	**0.39*****	**0.32*****	**0.34*****
	(4.94)	**(5.35)**	**(5.36)**	**(4.13)**
Mkt-Rf	−5.58***	−6.31***	−1.53	
	(−2.75)	(−3.48)	(−0.55)	
SMB	−4.11	−4.98		
	(−1.20)	(−1.36)		
HML	0.24	0.37		
	(0.09)	(0.08)		
RMW		−5.87		
		(−0.90)		
CMA		1.63		
		(0.23)		
R_EG			3.76	
			(0.66)	
R_IA			1.46	
			(0.38)	
R_ME			−0.67	
			(−0.35)	
R_ROE			−0.74	
			(−0.18)	
accruals				−24.23*
				(−1.89)
debt_issuance				−31.67
				(−1.42)
investment				42.40***
				(3.67)
low_leverage				40.23*
				(1.70)
low_risk				15.00*
				(1.91)
momentum				3.50
				(0.53)
profit_growth				2.88
				(0.23)
profitability				57.72***
				(3.57)
quality				−54.41***
				(−2.89)
seasonality				−8.02
				(−0.40)
short_term_reversal				3.90
				(0.63)
size				22.24***
				(2.62)
value				−23.84
				(−1.24)
Adj R^2 (%)	3.80	3.69	0.00	10.34
Observations	310	308	311	311

Table 10
Further analysis: Decomposition.
The table presents the descriptive summary of economic momentum portfolio returns decomposition towards the country, including annualised means in percentage with its T-statistics, annualised standard deviation, skewness, excess kurtosis, the first-order-autocorrelation, the maximum drawdown and Sharpe ratios. Standard errors are adjusted based on Newey and West (1987) with six lags. The economic momentum portfolio combines all the 120 sub-strategies. The sample period is from January 1989 to December 2020.

	Australia	Canada	France	Germany	Italy	Japan	Sweden	Switzerland	United Kingdom	United States
Mean(%)	0.08	−0.15	0.31	0.45	0.42	0.59	−0.18	0.85	0.45	0.56
T-Stat. of Mean	1.34	−0.05	−0.60	1.09	0.93	0.42	−0.54	1.03	0.95	−0.41
Std(%)	1.53	3.07	2.37	2.43	3.13	2.42	2.47	3.11	2.74	2.22
Skew.	0.05	−0.20	0.13	−0.09	0.09	0.78	−0.98	−0.05	0.34	−1.03
Excess Kurtosis	3.85	2.94	2.33	0.71	1.52	17.40	2.09	0.68	1.55	7.86
AR(1)	−0.07	0.16	−0.05	−0.06	0.13	0.14	−0.01	0.11	−0.01	0.02
Max. Drawdown(%)	−4.68	−18.05	−10.02	−10.40	−12.66	−7.65	−14.64	−21.17	−13.49	−10.90
Sharpe Ratio	0.05	−0.05	0.13	0.18	0.13	0.24	−0.07	0.27	0.16	0.25

Table 11
Further analysis: Economic momentum effects in other markets.
Based on MSCI country indices, this table summarises the predictability and profitability of the economic momentum effects, represented by the economic momentum combo portfolio, in the selected markets in this paper, G10, developed, and emerging markets. According to OECD, members of G10 are Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, the United Kingdom and the United States. Developed markets are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. Emerging markets are Brazil, Chile, China, Colombia, Czech Republic, Greece, Hungary, India, Indonesia, Poland, Russia, South Africa, South Korea and Turkey. Panel A presents annualised mean return in percentage, annualised standard deviation, skewness, excess kurtosis, lagged-one-period auto-correlation (AR(1)), maximum drawdown and Sharpe ratio for the economic momentum combo (CM) portfolios in different market groups. Panel B reports the results of regressing equity index returns on the lagged weights derived from the momentum signals within CM. The model is $ret_{c,t} = \alpha + \beta\Omega_{c,t-1} + \epsilon_{c,t}$, where $ret_{c,t}$ is the equity index return for country c in month t. $\Omega_{c,t-1}$ is the weight for country c, developed on the momentum signals of the economic momentum combo portfolio. Both country and month fixed effects are included in the regressions. Standard errors are clustered by country and month, and T-statistics are reported within parentheses. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. This table is based on MSCI market indices obtained from Bloomberg. The sample period is from January 1989 to December 2020.

	Selected markets	G10	Developed	Emerging
Panel A: Portfolio Performance				
Mean(%)	3.27	2.48	1.49	7.35
Std(%)	3.91	3.78	3.57	14.48
Skew.	0.52	0.54	0.23	0.39
Excess Kurtosis	0.01	0.74	−1.11	2.79
AR(1)	−0.01	−0.06	−0.08	−0.07
Max. Drawdown(%)	−6.04	−7.61	−12.30	−34.70
Sharpe Ratio	0.84	0.66	0.42	0.51
Panel B: Regression Analysis				
Ω^{CM}	0.24***	0.18***	0.14**	0.72***
	(3.18)	(2.72)	(2.43)	(4.04)
Observations	2,946	3,402	6,376	3,162
Adj. Within R^2 (%)	0.14	19.34	21.30	18.52
Country Fixed Effect	YES	YES	YES	YES
Month Fixed Effect	YES	YES	YES	YES

Table 11 suggests that economic momentum effects are profitable in different markets. The Sharpe ratios for G10, developed, and emerging markets are 0.66, 0.42, and 0.51, respectively. It is worth noting that the emerging markets portfolio achieves the highest mean return of 7.35%. Still, it lacks stability regarding standard deviation and drawdown, resulting in lower Sharpe ratios compared to the others. All portfolios exhibit low autocorrelation. Furthermore, the predictability of economic momentum in different markets is statistically significant. Therefore, we conclude that economic momentum effects also persist in other markets.

6. Conclusion

This paper reveals the substantial predictive power of past trends in a country's fundamentals on its future stock market index performance. It contributes to the literature by providing cross-sectional works suggesting that economic momentum matters to country-level stock markets. Prior work by Dahlquist and Hasseltoft (2020) demonstrate the economic momentum effects in foreign exchange markets. Inspired by them, we suggest a similar pattern in stock markets. Given that macroeconomic variables are free to access by the public, the existence of past trends in economics predicting future stock markets suggests that financial markets do not fully price the macro-level information.

Moreover, such a predictive pattern is economically and statistically significant. Specifically, one standard deviation increase in the weights derived from a country's economic momentum signals leads to a 24 basis points increase in the excess returns on the country index futures, which we term as economic momentum effects. A strategy, referred to as the economic momentum combo portfolio, built upon this effect generates a Sharpe ratio of 0.87 and an annualised return of 3.60%. The return remains at 2.14% after accounting for transaction costs. Notably, none of the standard asset pricing models, such as FF3, FF5, q-5 and world factors, can explain its profitability. Also, we find none of the countries solely drive the strategy return.

Furthermore, we find that the economic momentum strategy outperforms popular momentum strategies documented in the literature, such as time-series momentum and value-and-momentum strategies. Comparing the economic momentum strategy with these benchmarks, we observe superior risk-adjusted returns in our strategy. Specifically, our strategy gains an average annualised alpha of 3.72% (calculated as the monthly alpha of 0.31% times 12), even after controlling for benchmarks, leaving around 95% (calculated as 3.72/3.95) of the returns unexplained by the benchmarks. The economic momentum strategy also exhibits lower and more stable time-varying drawdowns than the benchmarks. Moreover, the economic momentum portfolio effectively captures returns on strategies of time-series momentum, cross-sectional momentum, value, and value-and-momentum.

In addition, the economic momentum strategy exhibits economic and statistical significance, whereas the benchmarks do not. In terms of the time-series momentum strategy, our findings are consistent with Huang et al. (2020), who argue that the time-series momentum is statistically weak in their time-series and cross-sectional analysis compared to the pooled regressions utilised by Moskowitz et al. (2012). Apart from the statistical evidence, we also contribute to the literature by providing evidence arguing that the profitability of time-series momentum effects in global stock markets over the sample period from 1989 to 2020 is questionable. As for the value-and-momentum strategy documented by Asness et al. (2013), Hutchinson et al. (2022) doubt the persistence of value-and-momentum effects in currency markets and attribute it to the mispricing corrections by arbitrageurs. To this end, we contribute to the literature by providing empirical evidence arguing its time-varying persistence in global stock markets. However, we do not further conduct works to examine if that is due to similar mispricing corrections since it is not the main purpose of this paper. Future studies extending this could be interesting.

Lastly, regarding the market selection, one may doubt the robustness of the economic momentum effects in other markets. We, therefore, examine the same pattern in G10, developed and emerging markets. We find that the predictability of economic momentum in equity market index returns remains statistically and economically significant. However, this paper mainly studies market indices, which capture large-cap stocks, ignoring the influence of small-cap stocks in the stock markets. Future studies on individual stocks could be interesting.

CRediT authorship contribution statement

Yu Zhang: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Konstantina Kappou:** Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Andrew Urquhart:** Conceptualization, Supervision, Writing – original draft, Writing – review & editing.

Data availability

The authors do not have permission to share data.

Appendix

See Tables 12–14.

Table 12
Appendix: 12-month log growth on macro index and equity index futures returns. This table reports the relationship between futures returns and macro index 12-month log growth. Macro Index A is the average log growth of the consumer price index, producer price index and total manufacturing. Macro Index B is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production.

	1	2	3
Macro Index A	0.27		1.20
	(0.05)		(0.21)
Macro Index B		−3.88	−4.61
		(−0.84)	(−1.13)
Observations	3,729	3,729	3,729
R^2(%)	0.00	0.01	0.01
Country Fixed Effects	YES	YES	YES
Month Fixed Effects	YES	YES	YES

Table 13
Appendix: Country-level Fama–MacBeth regression analysis.
This table reports the results of regressing futures returns on weights derived from strategies with Fama–MacBeth regression. The regression model is $r_{c,t} = \beta_0 + \beta_1 \Omega^P_{c,t-1} + \epsilon_{c,t}$, where $r_{c,t}$ denotes excess return on country index futures c in month t. $\Omega^P_{c,t-1}$ is the lagged-one-period weights within portfolio P for futures c. The weights are cross-sectionally standardised each month. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. To adjust for serial correlation, the t-statistics, reported in parentheses, are based on Newey and West (1987) standard errors with the six lags. Intercepts are not reported for brevity. The reported coefficients are in percentage. *, ** and *** indicate the relative parameters are significantly different from zero at the significance level of 10%, 5% and 1%. The sample period is from January 1989 to December 2020.

Dep. = Futures Returns	1	2	3	4	5	6
Ω^{CM}	0.24***					
	(4.68)					
Ω^{LM}		0.15**				
		(2.29)				
Ω^{SM}			0.14**			
			(2.23)			
Ω^{ST}				0.13**		
				(2.05)		
Ω^{MT}					0.27***	
					(5.31)	
Ω^{LT}						0.20***
						(3.87)
Intercept	0.36	0.37	0.37	0.37	0.36	0.37
	(1.32)	(1.33)	(1.32)	(1.33)	(1.32)	(1.32)
Observations	2,944	2,944	2,944	2,944	2,944	2,944
Number of Groups	347	347	347	347	347	347
Avg. R^2(%)	13.25	15.09	15.99	14.62	13.56	13.38

Table 14
Appendix: Economic momentum portfolio analysis (equal-weighted).
This table reports the results of analysing portfolios constructed on economic momentum signals. Panel A reports portfolio returns' statistics, including mean, standard deviation, skewness, excess kurtosis, one-order autocorrelation, maximum drawdown and Sharpe ratio. Panel B reports correlations between these portfolios. The construction of economic momentum portfolios is based on lookback periods of momentum signals and macro indices. We measure the momentum with lookback periods varying from 1 to 60 months. The positive macro effect index is the average log growth of the consumer price index, producer price index and total manufacturing. The negative macro effect index is the average log growth of the OECD leading indicator, hourly earnings and gross domestic production. We then design a sub-strategy that buys (sells) one country index based on its relatively strong (weak) momentum signals. With 60 lookback periods and 2 macro indices, we have 120 sub-strategies. The economic momentum combo portfolio (CM) combines all the sub-strategies above. The positive macro effect portfolio (PM) aggregates sub-strategies trading on momentum signals derived from the positive macro effect index with all lookback periods. Likewise, the negative macro effect portfolio (NM) aggregates sub-strategies constructed on the negative macro effect index. The long-term (LT), mid-term (MT) and short-term (ST) portfolio aggregates sub-strategies built on lookback periods varying between 1–12, 13–36 and 37–60 months, respectively, ignoring the macro index. **We aggregate substrategies in an equal-weighted way.** The sample period is selected from February 1992 to December 2020 for the consistency of the economic momentum portfolio periods.

	CM	PM	NM	ST	MT	LT
Panel A: Portfolio Performance						
Mean(%)	3.37	3.52	2.81	2.78	3.32	3.83
Std(%)	4.21	7.52	7.61	8.84	8.48	7.77
Skew	0.63	0.11	−0.03	−0.17	−0.06	0.41
Excess Kurtosis	0.74	−1.35	−1.43	−0.10	−1.26	−1.85
AR(1)	0.08	0.20	0.06	0.14	0.16	0.18
Max. Drawdown(%)	−6.35	−24.72	−21.58	−36.49	−27.96	−24.07

(*continued on next page*)

Table 14 (*continued*).

	CM	PM	NM	ST	MT	LT
Sharpe Ratio	0.80	0.47	0.37	0.31	0.39	0.49
Panel B: Correlation						
LM	1.00					
PM	0.55	1.00				
NM	0.56	−0.38	1.00			
ST	0.39	0.76	−0.32	1.00		
MT	0.53	0.97	−0.37	0.72	1.00	
LT	0.53	0.91	−0.31	0.47	0.83	1.00

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