AN INVESTIGATION OF THE FORECASTING ABILITY OF ECONOMIC TRACKING PORTFOLIOS

by

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ABSTRACT

An economic tracking portfolio is a set of financial assets whose return is sufficiently correlated with a target economic variable by construction. This paper examines the forecasting performance of economic tracking portfolios for the U.S. economy. Economic tracking portfolios are estimated using monthly stock and bond portfolio returns as base assets for four target macro-variables: industrial production growth, consumption growth, labour income growth, and inflation. The insignificant results from the in-sample estimation and the out-of-sample forecast indicate that the forecasting power of the 12-months ahead economic tracking portfolios are not as strong as what are concluded by some other empirical works.

Keywords: forecasting, tracking portfolio, asset returns, macroeconomic expectations

To my parents, grandparents, and Wing Sum

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

A tracking portfolio is a collection of securities designed to mimic the movement of a target variable. Investment professionals often use tracking portfolios, which are comprised of a relatively small composite of stocks, to manage an index fund at low transaction costs. Some use tracking portfolios to measure risk premia for evaluating asset-pricing models. Others use tracking portfolios to hedge against the fluctuations in oil price, inflation, and exchange rates to reduce risk exposure. In particular, economic tracking portfolios use current asset returns to track the market's changing expectations of economic activities. They directly address the forecasting ability of the current information from the financial market on the future macroeconomy.

Traditionally, the direction of the forecast seems to go from the macroeconomy to the financial market. According to the Intertemporal Capital Asset Pricing Model, macro-variables may serve as state variables that affect investors' preferences over time and influence the expected rate of return of capital as a result (Merton, 1973). Furthermore, economic aggregates are used to construct factors to test the Arbitrage Pricing Theory. As a result, many empirical studies have concentrated on estimating regressions of asset returns on economic variables (Fama, 1981; Chen, Roll, and Ross, 1986; Campell and Ammer, 1993).

Some recent studies in the literature have shifted interest towards using current information from the financial market to explain the expectations on future macroeconomic variables. Schwert (1989) finds that there is weak evidence that macroeconomic volatility can help predict stock and bond return volatility. He finds stronger evidence that financial asset return volatility helps to predict future macroeconomic volatility. Cochrane (1991) finds that a simple implementation of a production-based asset-pricing model can help to explain the forecasting power of stock returns for real variables like investment and output.

Empirical studies do not provide conclusive evidence on the direction of causality between macroeconomy and financial market information. "No satisfactory theory would argue that the relation between financial markets and the macroeconomy is entirely in one direction" (Chen, Roll, and Ross, 1986). "Disentangling cause and effect in the relations between stock returns and real activity is an interesting and formidable challenge" (Fama, 1990). Nevertheless, it is plausible that the macroeconomy and financial market conditions are correlated. Explaining the causal relationship between the macroeconomy and the financial market information is beyond the scope of this paper. Rather, the purpose of this paper is to empirically investigate whether the economic tracking portfolio is useful in forecasting economic indicators, given the existing correlation between the macroeconomy and financial market information. Specifically, this paper is intended to examine whether the remarkable forecast power of economic tracking portfolios claimed by Lamont (2001) can withstand a longer sample period.

This paper proceeds as follows. Section two reviews previous research on the relationship between the financial market and economic aggregates and provides a discussion of the relevant studies on economic tracking portfolios. Since this paper follows closely to the study of Lamont (2001), an in-depth discussion of his paper is included in this section. Section three explains the methodology of economic tracking portfolios. Section four describes the data set. The differences in the data set used in this paper and that used in the study by Lamont is discussed in this section. Section five discusses the results. Section six concludes and provides suggestions for subsequent studies.

2 LITERATURE REVIEW

2.1 Connection between the financial market and the macroeconomy

Lamont (2001) identifies three ways that empirical studies use information from the macroeconomy to explain the financial market: using current economic variables, using future economic variables, and using both current and future economic variables via vector autoregressions (VARs). The first approach involves regressing asset returns on economic variables in the same period. A study testing the Consumption-oriented Capital Asset Pricing Model (CCAPM) by Breeden, Gibbons, and Litzenberger (1989) is an example of this approach. Their study verifies the CCAPM conclusion – the risk premium of a risky security can be explained by the covariance between its return and consumption. Another example is the study by Chan, Roll, and Ross (1986). They test whether the U.S. stock prices reflect the innovations in macroeconomic variables. They conclude that industrial production growth, unexpected inflation, and the spread between the return of long-term and short-term bonds can explain the excess return of risky assets.

Studies using the second approach involve regressing current asset returns on future realization of economic variables. Fama (1981), Geske and Roll (1983), and Kaul (1987) are examples of studies using this approach. Fama (1981) suggests that stock returns are determined by forecasts of economic aggregates including capital expenditures, the average real rate of return on capital, and output. Geske and Roll (1983) find strong evidence of a negative correlation between stock returns and inflation while Kaul (1987) finds less supportive evidence on this connection.

The third approach involves vector autoregression (VAR). A VAR model involves gathering all the variables into a single vector expressed as a linear function of its own lagged values, and an error vector. That is, all the variables are endogenous in the model such that each variable is explained by the lagged values of its own, and the current and lagged values of all other variables. By assuming the direction of influence goes from the macroeconomy to the financial market, studies using VAR analyze the effects of macroeconomic innovations in the pricing equations of risky assets. Campell and Ammer (1993) decompose excess stock and bond returns into changes in expectation of future stock dividends, inflation, short-term real interest rate, and excess stock and bond returns. They find that stock return volatility is largely driven by news about future excess stock returns and inflation while real interest rates have little impact. Campbell (1996) uses forecasts of future labour income growth as one of the factors to explain the postwar U.S. stock and bond returns.

2.2 Relevant studies on economic tracking portfolios

The methodology of economic tracking portfolio is relatively innovative in the literature. It traces back to the study of Breeden, Gibbons, and Litzenberger (1989), in which they construct “maximum correlation portfolios” for current consumption for testing Consumption Capital Asset Pricing Model. Lamont

(1997, 2001) builds on this portfolio constructing method and calls it an "economic tracking portfolio." In his study, Lamont use macroeconomic variables including industrial production growth, real consumption growth, real labor income growth, inflation, excess stock returns, excess bond returns, and T-bill returns. The base assets used to construct the economic tracking portfolios include four bond portfolios (long-term government bonds, intermediate-term government bonds, one-year government bonds, and junk bonds), the market portfolio, and eight industry-sorted stock portfolios. Control variables include T-bills return, term premiums for different types of bonds, dividend yield on CRSP value weighted portfolio, 12-month production growth, CPI inflation, and excess stock return. His data set contains monthly U.S. data from January 1947 to December 1994. The forecasting horizon is 12 months. He uses a 20-year estimation window for the out-of-sample rolling regressions. Lamont (2001) concludes that economic tracking portfolios are useful in forecasting U.S. macroeconomic variables.

Some subsequent studies investigate the economic tracking portfolios using data from different countries. Hayes (2001) looks at the UK equity market from February 1965 to February 2000. The target variables include inflation, industrial production growth and growth in the volume of retail sales. The base assets only consist of stock portfolios sorted by industry. His in-sample results show that the economic tracking portfolios are able to track all three targets. However, Hayes' out-of-sample results are poor. Junttila and Kinnunen (2004) apply the economic tracking portfolio technique to the developing, IT-intensive

Finnish stock market. The data set consists of monthly data from February 1991 to June 1999, which is much smaller than the data set used in Lamont's (2001) study. The target variables include industrial production growth, private consumption growth, inflation, and output growth. Similar to Hayes (2001), Junttila and Kinnunen's (2004) base assets only include industry-sorted stock portfolios. Despite having a small data set, their results confirm the forecasting ability of economic tracking portfolios. Junttila (2002) conducts a more comprehensive study by analyzing the performance of economic tracking portfolios for inflation and industrial production growth in four different countries including the U.S., Italy, France, and Germany. He finds that the overall forecasting ability of economic tracking portfolios is the best for the U.S. economy. Furthermore, he demonstrates that the economic tracking portfolios have stronger forecasting ability than the VAR approach.

3 METHODOLOGY

The key assumption in constructing economic tracking portfolios is that current base asset returns reflect the expectation for future economic states. Unexpected returns of base assets can explain the change in expectation of the target variable. The theoretical model is described in equation (1):

$$\Delta \mathrm{E}_t[y_{t+k}] = \mathbf{b}\widetilde{\mathbf{R}}_{t-1,t} + \eta_t \tag{1}$$

where $\Delta \mathrm{E}_t[y_{t+k}]$ is the change in expectations between period t-1 and t of the target variable k periods ahead. $\widetilde{\mathbf{R}}_{t-1,t}$ is a vector of unexpected returns of the base assets from period t - 1 to period t, and η_t is the component of the change in expectation that is not explained by the base assets. $\widetilde{\mathbf{R}}_{t-1,t}$ and $\Delta \mathrm{E}_t[y_{t+k}]$ cannot be observed directly, but the theoretical model described in (1) can be turned into a regression equation that can be estimated empirically by expressing $\widetilde{\mathbf{R}}_{t-1,t}$ and $\Delta \mathrm{E}_t[y_{t+k}]$ in terms of $\mathbf{Z}_{t-1}$, a vector of control variables with one lag.

Equation (2) defines $\widetilde{\mathbf{R}}_{t-1,t}$, the unexpected return, as the difference between actual and expected returns:

$$\widetilde{\mathbf{R}}_{t-1,t} \equiv \mathbf{R}_{t-1,t} - \mathrm{E}_{t-1}[\mathbf{R}_{t-1,t}] \tag{2}$$

Since $\mathrm{E}_{t-1}[\mathbf{R}_{t-1,t}]$ is an expectation that cannot be observed, one assumes that

$E_{t-1}[\mathbf{R}_{t-1,t}]$ can be expressed as a linear function of the lagged control variables vector $\mathbf{Z}_{t-1}$ as in equation (3):

$$E_{t-1}[\mathbf{R}_{t-1,t}] = \mathbf{m}\mathbf{Z}_{t-1} \tag{3}$$

y_{t+k}, the actual value of the target variable in period t + k, can be expressed as its expectation at period t plus a random error. Furthermore, the expectation at period t can be expressed as the sum of the expectation at period t-1 and the change in expectation from period t-1 to t, as in equation (4):

$$y_{t+k} = E_t[y_{t+k}] + e_{t,t+k} = E_{t-1}[y_{t+k}] + \Delta E_t[y_{t+k}] + e_{t,t+k} \tag{4}$$

Equation (5) shows the projection equation of lagged expectations of y_{t+k} on the lagged control variables:

$$E_{t-1}[y_{t+k}] = \mathbf{n}\mathbf{Z}_{t-1} + \upsilon_{t-1,t} \tag{5}$$

Equation (6) is the resulting OLS regression equation by substituting equation (2), (3), (4) and (5) into equation (1):

$$y_{t+k} = \mathbf{b}\mathbf{R}_{t-1,t} + (\mathbf{n} - \mathbf{b}\mathbf{m})\mathbf{Z}_{t-1} + \varepsilon_{t,t+k} = \mathbf{b}\mathbf{R}_{t-1,t} + \mathbf{c}\mathbf{Z}_{t-1} + \varepsilon_{t,t+k} \tag{6}$$

The estimated coefficient on $\mathbf{R}_{t-1,t}$, $\mathbf{b}$, gives the weights of the base assets in the resulting portfolio that tracks the target variable. $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$ gives the return of the tracking portfolio[1]. An economic tracking portfolio is a particular kind of maximum correlation portfolio (Breeden, Gibbon and Litzenberger, 1989) such that the

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[1] Note that the estimated weights of base assets do not sum to one in general. The corresponding weights should be normalized to one, i.e. $b_i' = \frac{\hat{b}_i}{\sum_{i=1}^{n} \hat{b}_i}$.

portfolio return has unexpected components maximally correlated with the change in expectations of targeted economic variable $\Delta E_t[y_{t+k}]$. In addition, it has the highest correlation with the target variable amongst all portfolios constructed by the same base assets, given the control variables.

The common methodology is first to run an OLS regression based on equation (6) to estimate the weights of base assets, $\hat{\mathbf{b}}$, in the economic tracking portfolio with full sample. The properties of the resulting in-sample portfolios are examined. To investigate the out-of-sample performance of the tracking portfolios, rolling regressions with sub-sample based on an n-years estimation window are performed. That is, for each month t, one estimates $\hat{\mathbf{b}}_t$ and $\hat{\mathbf{c}}_t$ using the monthly data from the past *n* years based on the regression equation described by equation (6). Then one runs a regression based on equation (7):

$$y_{t+k} = \kappa + \lambda \hat{\mathbf{b}}_t \mathbf{R}_{t-1,t} + \pi \hat{\mathbf{c}}_t \mathbf{Z}_{t-1} + \xi_{t,t+k} \qquad (7)$$

where $\hat{\mathbf{b}}_t$ and $\hat{\mathbf{c}}_t$ are the time series of the estimated coefficients from the rolling regressions. The coefficient λ measures the out-of-sample performance of the tracking portfolios. If the tracking portfolio generated by the rolling regressions perfectly tracked the target variable, then the estimated coefficient would be one. If the tracking portfolio generated by the rolling regressions were useless, then the coefficient would be zero. At last, additional robustness tests are performed to compare and examine the economic tracking portfolios constructed from alternative ways.

4 DATA

The data set consists of monthly U.S. data from January 1947 to December 1999[2]. The variables can be categorized into target variables (y_{t+k}), base asset returns ($\mathbf{R}_{t-1,t}$), and control variables ($\mathbf{Z}_{t-1}$). Table 1 reports the descriptive statistics for these variables, expressed in percentages. The choice of variables is similar[3] to that in Lamont's study (2001).

4.1 Target variables

The four target variables y_{t+k} include industrial production growth, real consumption growth, real labour income growth, and inflation. Industrial production growth is the change in the log of the Industrial Production Index from month t to month t + k. The Industrial Production Index (series ID: "INDPRO") is obtained from the Federal Reserve. Real consumption growth is the change in the log of real consumption of services and non-durable goods from month t to month t + k. The real consumption of services and non-durable goods is obtained by subtracting personal consumption expenditure of total durables (series ID: GMCDQ) from total personal consumption expenditure (series ID: GMCQ). These two series are provided by DRI Basic Economics. Inflation is the

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[2] Data on consumption starts from January 1967 and ends on December 1999.

[3] Minor modifications are made due to data availability. Four instead of seven target variables are considered in this paper. French's industry portfolios are used instead of industry portfolios constructed from Sharpe's industry definition. Long-term corporate bonds portfolio is used instead of junk bonds portfolio. One control variable, default premium for commercial paper, is omitted.

Table 1 Descriptive statistics of variables

		Mean	Std. Dev.	Min	Max
y_{t+12}	Production growth	3.58	5.75	-13.26	24.49
	Consumption growth	3.07	1.45	-1.27	7.11
	Labour income growth	3.07	3.19	-5.45	13.24
	Inflation	3.85	3.00	-3.04	13.70
$\mathbf{R}_{t-1,t}$	Mkt	0.70	4.16	-23.13	16.05
	NoDur	0.70	4.21	-21.92	17.46
	Durbl	0.73	5.33	-27.39	21.38
	Manuf	0.66	4.71	-27.68	15.81
	Enrgy	0.77	5.00	-19.01	23.49
	HiTec	0.97	5.88	-27.18	21.46
	Telcm	0.67	3.84	-14.11	13.19
	Shops	0.70	4.86	-28.81	25.48
	Hlth	0.81	5.03	-21.08	28.75
	Utils	0.50	3.67	-13.49	18.81
	Other	0.72	4.81	-24.43	19.43
	LTGB	0.07	2.49	-9.28	13.98
	ITGB	0.09	1.38	-7.30	10.73
	1YGB	0.07	0.43	-2.39	3.96
	LTCB	0.09	2.21	-9.77	12.50
$\mathbf{Z}_{t-1}$	RF	0.40	0.25	0.03	1.35
	PremLTGB	1.39	1.27	-3.65	4.55
	Prem1YGB	5.17	2.93	0.39	16.45
	PremDefault	0.91	0.42	0.32	2.69
	DivYield	3.62	1.24	1.06	7.25
	$XRS_{t-13,t-1}$	2.16	5.91	-21.57	21.14

change in the log of the Consumer Price Index from month t to month t + k. The CPI index is provided by Ibbotson Associates. Real labour income growth is the change in the log of personal income from wage and salaries from month t to month t + k minus the inflation from month t to month t + k. Personal income from wage and salaries (series ID: “GMW”) is also provided by DRI Basic Economics. The changes of the target variables are used to avoid the problem of unit root and trends in time series data.

4.2 Base assets

The fifteen base assets $\mathbf{R}_{t-1,t}$ consist of the stock market portfolio, ten industry-sorted stock portfolios, and four bond portfolios. All portfolio returns are monthly return in excess of monthly T-bill return. The stock market portfolio (Mkt) is the CRSP value-weighted portfolio of all NYSE, AMEX, and NASDAQ stocks. The ten industry portfolios consists of all stocks in CRSP sorted by SIC code: consumer non-durables (NoDur), consumer durables (Durbl), manufacturing (Manuf), energy (Enrgy), business equipment (HiTec), telecommunication (Telcm), wholesale and retail (Shops), health (Hlth), utilities (Utils), and other (Other). Appendix I shows the industry definitions with the associated SIC codes. The returns of the stock market portfolio and the ten industry portfolios are obtained from Kenneth French[4]. The four bond portfolios are portfolios of long-term government bonds (LTGB), intermediate-term government bonds (ITGB), one-year government bonds (1YGB), and long-term corporate bonds (LTCB). The returns of these bond portfolios are provided by Ibbotson Associates.

4.3 Control variables

Eight control variables $\mathbf{Z}_{t-1}$ are used in this paper. Two of them are the constant term (Cons) from rolling regressions based on equation (6) and the monthly T-bill return (RF). The monthly T-bill returns are provided by Ibbotson Associates. The rest of the control variables are lagged by one period. The term premium for long-term government bond (PremLTGB) is the yield to maturity on

[4] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

a portfolio of long-term government bonds minus the T-bill yield. The term premium for one-year government bond (Prem1YGB) is the yield to maturity on an one-year government bond minus the T-bill yield. The yield-to-maturity on long-term government bonds, one-year government bonds, and T-bills are provided by Ibbotson Associates. The default premium for corporate bonds (PremDefault) is the yield on BAA-rated bonds minus the yield on AAA-rated bonds. BAA and AAA yields are obtained from DRI Basic Economics, series "FYBAAC" and "FYAAAC". The dividend yield (DivYield) is constructed from total and dividend-excluded returns on the CRSP value-weighted portfolio using the method in Fama and French (1988). The total and dividend-excluded returns are provided by Ibbotson Associates. The excess stock return (XSR) is the k-months compounded returns of the CRSP value weighted portfolio minus the k-months compounded returns on the T-bill[5]. The lagged production growth and inflation are also included as control variables.

4.4 Comparison with variables used in Lamont's study

This paper is intended to examine whether the remarkable forecast power of economic tracking portfolios claimed by Lamont (2001) can withstand a longer sample period. Lamont's (2001) data set starts from January 1947 and ends in December 1994. The data set used in this paper starts from January 1947 and ends in December 1999. Although it is ideal to use the same variables as in the study of Lamont (2001), minor modifications are made due to data availability.

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[5] $\mathrm{XSR}_{t-k-1,t-1} = \exp(\sum_{i=t-k-1}^{n=t-1} \mathrm{Mkt}_{t-1,t}) - \exp(\sum_{i=t-k-1}^{n=t-1} \mathrm{RF}_{t-1,t})$

Four instead of seven target variables are considered in this paper. The three target variables that are used in Lamont's study but not used in this paper are excess stock returns, excess bond returns, and nominal T-bill returns. French's industry portfolios are used instead of industry portfolios constructed from Sharpe's industry definition which are used in Lamont's (2001) study. These industries include basic industries, capital goods, construction, consumer goods, energy, finance, transportation, and utilities. Long-term corporate bonds portfolio is used instead of junk bonds portfolio. One control variable, default premium for commercial paper, is omitted.

5 RESULTS

5.1 In-sample estimation

Table 2 reports the coefficients, standard errors, and R-squared values obtained from running the OLS regressions based on equation (6) with k = 12. These results define the economic tracking portfolios for the "12-months ahead" target variables. The standard errors are calculated using the Newey-West estimator with 24-month lags to correct for the overlapping dependent observations. The results are not easy to interpret because the base assets are highly correlated (Lamont, 2001). It is more meaningful to look at the properties of the resulting tracking portfolios, shown in Table 3.

Panel A of Table 3 shows whether the base assets in the economic tracking portfolios are able to forecast the 12-months ahead target variables. The first row of Panel A reports the p-values of testing whether all base asset returns jointly have no forecasting ability. The p-values reject the null hypotheses of no forecasting abilities for the tracking portfolios of production growth, consumption growth and labour income growth. On the other hand, the p-value from testing the inflation-tracking portfolio implies it has no forecasting ability. The other rows report the p-values of testing whether four subsets of base asset returns jointly have no forecasting ability: all but the stock market portfolio, the stock market portfolio, the ten industry portfolios, and the four bond portfolios. These results imply that the bond portfolios weakly contribute tracking

Table 2 Results of OLS regressions: $y_{t+12} = \mathbf{bR}_{t-1,t} + \mathbf{cZ}_{t-1} + \varepsilon_{t,t+12}$

		$Y_{t,\,t+12}$			
		Production growth	Consumption growth	Labor income growth	Inflation
$R_{t-1,t}$	Mkt	0.27	-0.04	0.23	0.17
		(0.39)	(0.14)	(0.23)	(0.16)
	NoDur	0.08	0.04	0.02	-0.03
		(0.11)	(0.04)	(0.07)	(0.04)
	Durbl	0.11	0.02	0.04	0.01
		(0.05)	(0.02)	(0.04)	(0.02)
	Manuf	-0.01	-0.04	-0.05	0.07
		(0.11)	(0.04)	(0.07)	(0.06)
	Enrgy	-0.03	-0.02	-0.05	0.01
		(0.05)	(0.02)	(0.04)	(0.03)
	HiTec	-0.06	0.04	-0.04	-0.04
		(0.07)	(0.02)	(0.04)	(0.03)
	Telcm	-0.09	0.01	-0.02	-0.03
		(0.07)	(0.03)	(0.04)	(0.02)
	Shops	-0.09	0.01	-0.02	-0.06
		(0.07)	(0.02)	(0.05)	(0.04)
	Hlth	-0.08	-0.02	-0.04	-0.02
		(0.07)	(0.02)	(0.04)	(0.03)
	Utils	0.01	0.02	0.01	-0.07
		(0.06)	(0.01)	(0.04)	(0.03)
	Other	-0.03	0.00	-0.01	-0.05
		(0.13)	(0.06)	(0.08)	(0.05)
	LTGB	0.03	0.03	0.01	0.02
		(0.09)	(0.03)	(0.06)	(0.04)
	ITGB	0.06	-0.13	0.00	0.14
		(0.14)	(0.07)	(0.08)	(0.07)
	1YGB	0.85	0.74	0.61	-0.29
		(0.49)	(0.16)	(0.33)	(0.32)
	LTCB	-0.01	0.01	-0.03	-0.06
		(0.12)	(0.05)	(0.07)	(0.06)
Z_{t-1}	Cons	9.10	4.36	6.09	-0.92
		(1.72)	(0.77)	(1.31)	(1.11)
	RF	-10.16	-3.78	-3.77	-0.25
		(3.50)	(1.62)	(2.52)	(1.41)
	PremLTGB	0.49	0.08	0.10	-0.24
		(0.35)	(0.19)	(0.29)	(0.17)
	Prem1YGB	1.23	0.13	0.33	0.52
		(0.26)	(0.11)	(0.18)	(0.12)
	PremDefault	-7.32	0.79	-2.70	0.13
		(1.85)	(0.65)	(1.24)	(0.69)
	DivYield	0.15	0.03	0.14	0.27
		(0.57)	(0.27)	(0.31)	(0.32)
	$XSR_{t-13,\,t-1}$	0.09	0.01	0.05	-0.02
		(0.02)	(0.01)	(0.02)	(0.01)
	Production growth $_{t-13,\,t-1}$	-0.39	-0.07	-0.11	0.07
		(0.08)	(0.05)	(0.04)	(0.02)
	Inflation $_{t-13,\,t-1}$	-0.30	-0.20	-0.29	0.31
		(0.29)	(0.10)	(0.12)	(0.13)
R^2		0.53	0.34	0.42	0.62

abilities and the forecasting abilities of the stock market and industry portfolios are insignificant at 5% significant level. A possible explanation is that monthly returns are more useful in predicting the target variables over different forecasting horizons. For example, the p-values of exclusion tests for the inflation-tracking portfolios constructed with k=3 and k=6 reject the null of no forecasting ability. Appendix II reports the properties of tracking portfolios constructed with different k values.

To examine how well the economic tracking portfolios track the target variables, one would like to obtain the R-squared values of the regressions based on equation (1). However, $\Delta E_t[y_{t+k}]$ is unobservable. Alternatively, the partial R-squared value[6] is calculated to give a lower bound on the fraction of variance in news that is captured by tracking portfolio returns. Panel B of Table 3 shows the partial R-squared values for the tracking portfolios, range from 0.03 to 0.09.

Panel C of Table 3 shows the means, standard deviations, minima, maxima, and Sharpe ratios of the excess returns of the tracking portfolios based on the normalized portfolio weights. The magnitude of the mean excess returns shows the risk premium - the price of one unit of exposure to $\Delta E_t[y_{t+k}]$. The production, consumption, and labour income tracking portfolios have positive risk premia while the inflation-tracking portfolio has negative risk premia. This result is identical to the result of the study of Lamont (2001).

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[6] Partial R-squared is obtained by regressing $y_{t+12} - E[y_{t+12} \mid \mathbf{Z}_{t-1}]$ on $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} - E[\hat{\mathbf{b}}\mathbf{R}_{t-1,t} \mid \mathbf{Z}_{t-1}]$.

Table 3 Forecasting ability and descriptive statistics for tracking portfolios

	Production growth	Consumption growth	Labour income growth	Inflation
Panel A - P-values from exclusion tests on **b**				
All returns	0.00	0.00	0.03	0.13
All but Mkt	0.05	0.00	0.37	0.14
Mkt only	0.44	0.29	0.23	0.24
10 industries	0.27	0.29	0.68	0.11
4 bonds	0.07	0.00	0.24	0.69
Panel B - Partial R^2 from regressing $y_{t+12} - \mathrm{E}[y_{t+12} \mid \mathbf{Z}_{t-1}]$ on $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} - \mathrm{E}[\hat{\mathbf{b}}\mathbf{R}_{t-1,t} \mid \mathbf{Z}_{t-1}]$				
	0.04	0.09	0.04	0.03
Panel C - Summary Statistics for tracking portfolio returns $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$				
Mean	0.10	0.09	0.11	0.16
Std. Dev.	0.83	0.60	0.73	1.59
Min	-3.19	-2.65	-2.89	-6.04
Max	4.09	3.08	3.67	8.92
Sharpe ratio	0.12	0.15	0.43	0.10
Panel D – Market model regression: $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} = \alpha + \beta(Market_{t-1,t}) + \xi_{t-1,t}$				
α	-0.03	0.01	-0.02	0.14
	(0.02)	(0.02)	(0.02)	(0.06)
β	0.07	0.00	0.10	0.03
	(0.01)	(0.00)	(0.00)	(0.05)
R^2	0.22	0.00	0.48	0.01
Panel E - Correlation between tracking portfolio returns and base assets returns				
Mkt	0.54	0.08	0.65	-0.09
NoDur	0.56	0.24	0.70	-0.32
Durbl	0.71	0.18	0.75	-0.01
Manuf	0.54	0.02	0.61	0.02
Enrgy	0.38	-0.27	0.29	0.29
HiTec	0.30	0.15	0.40	-0.10
Telcm	0.35	0.25	0.57	-0.36
Shops	0.49	0.24	0.68	-0.33
Hlth	0.24	-0.01	0.40	-0.20
Utils	0.58	0.28	0.63	-0.43
Other	0.55	0.11	0.67	-0.16
LTGB	0.54	0.56	0.52	-0.33
ITGB	0.55	0.58	0.53	-0.28
1YGB	0.61	0.77	0.62	-0.38
LTCB	0.58	0.59	0.56	-0.41

The market model regressions in Panel D of Table 3 evaluate the ability of the CAPM to explain the risk premia on the tracking portfolios. Similar to Lamont's (2001) result, only the consumption-tracking portfolio has an intercept that is significantly different from zero. Lamont (2001) points out that "the CAPM can only misprice the tracking portfolio if it also misprices one or more of the base assets." He removes the one-year government bond portfolio from the base assets and results in an insignificant intercept for the market model regression. Panel E of Table 3 shows the correlations between the returns of the tracking portfolios and the base assets. The correlations range from –0.02 to 0.77.

Figures 1 to 4 shows the time series of the 12-month forward cumulative innovations in returns on the tracking portfolios and the realized target variables y_{t+k}. The cumulative innovations are the sums of residuals from regressing $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$ on $\mathbf{Z}_{t-1}$. Lamont argues that cumulating these residuals can approximately display the market expectation of the target variable of $E_t[y_{t+k}]$. If tracking portfolios do track their targets, forecasting patterns should be spotted in these figures. That is, the increasing and decreasing patterns of the cumulative residuals should match the realized value of the target variable. However, these patterns cannot be spotted in these figures.

Table 4 shows the in-sample results of the estimation of tracking portfolios using data up to 1994 instead of 1999. The purpose of including this table is to investigate whether the differences between the current results and the results of Lamont is due to the difference in sample period or the modification of the data set. The results reported in Table 4 are similar to the results reported in Table 3. Extending the sample period from 1994 to 1999 does not drastically alter the resulting tracking portfolios. Therefore, the different results between Lamont

Figure 1 **Realized values of production growth and the cumulative unexpected returns of its tracking portfolios**

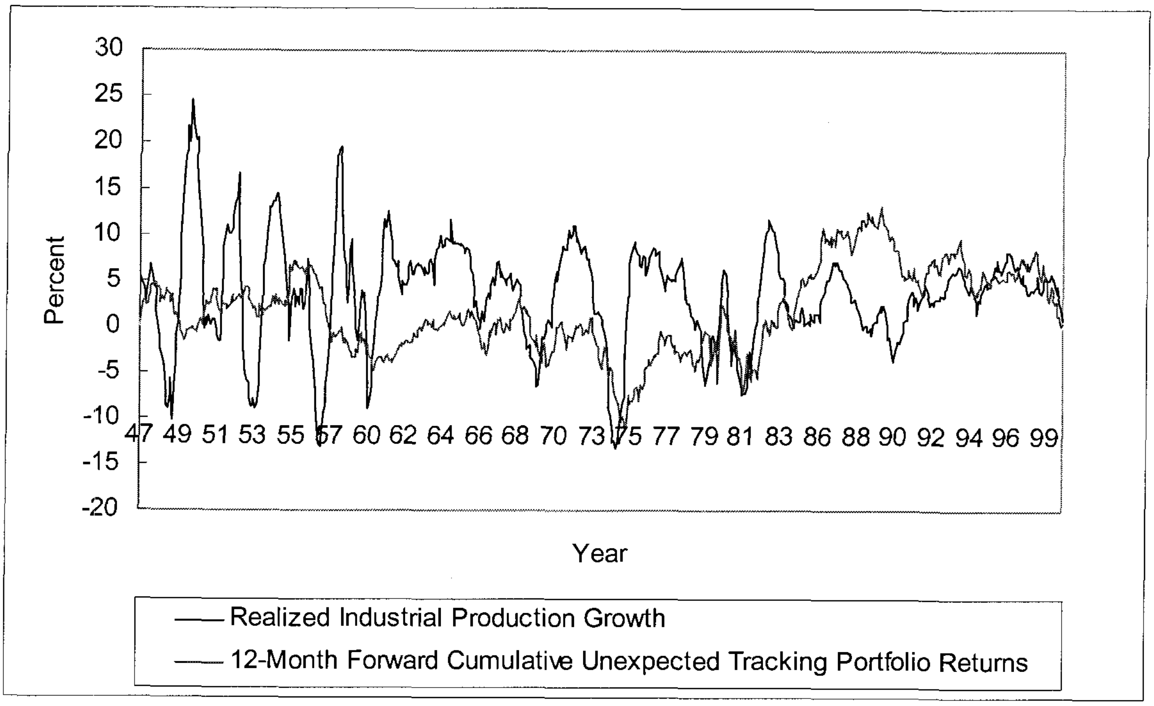

Figure 2 **Realized values of consumption growth and the cumulative unexpected returns of its tracking portfolios**

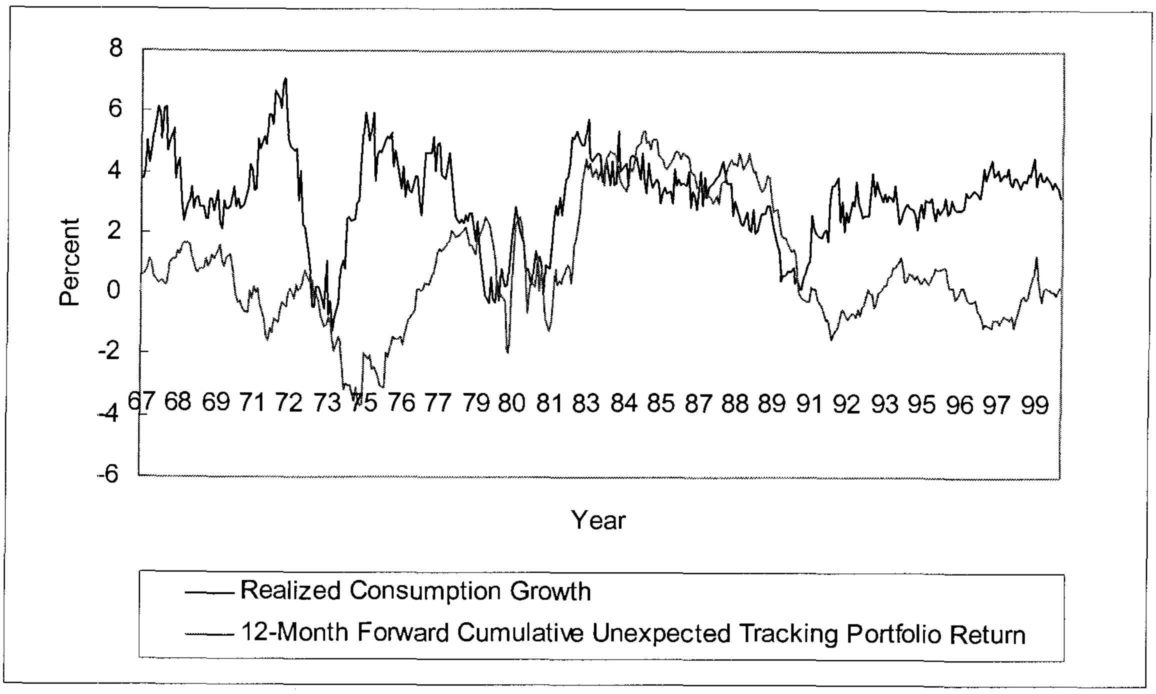

Figure 3 **Realized values of labour income growth and the cumulative unexpected returns of its tracking portfolios**

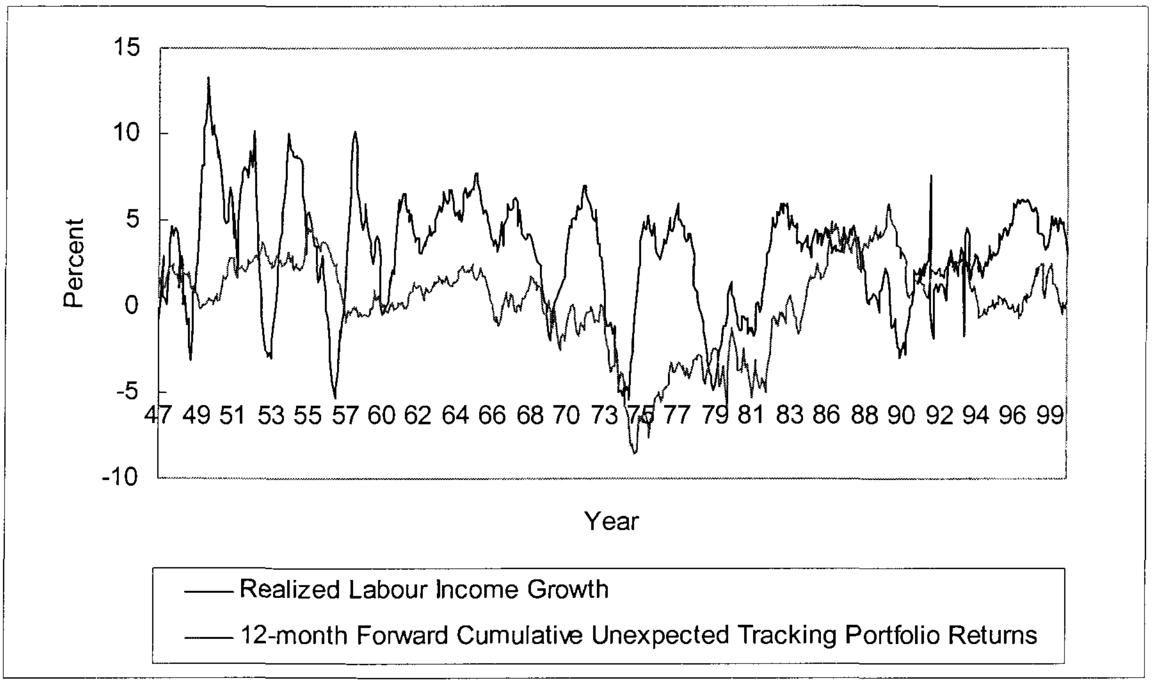

Figure 4 **Realized values of inflation and the cumulative unexpected returns of its tracking portfolios**

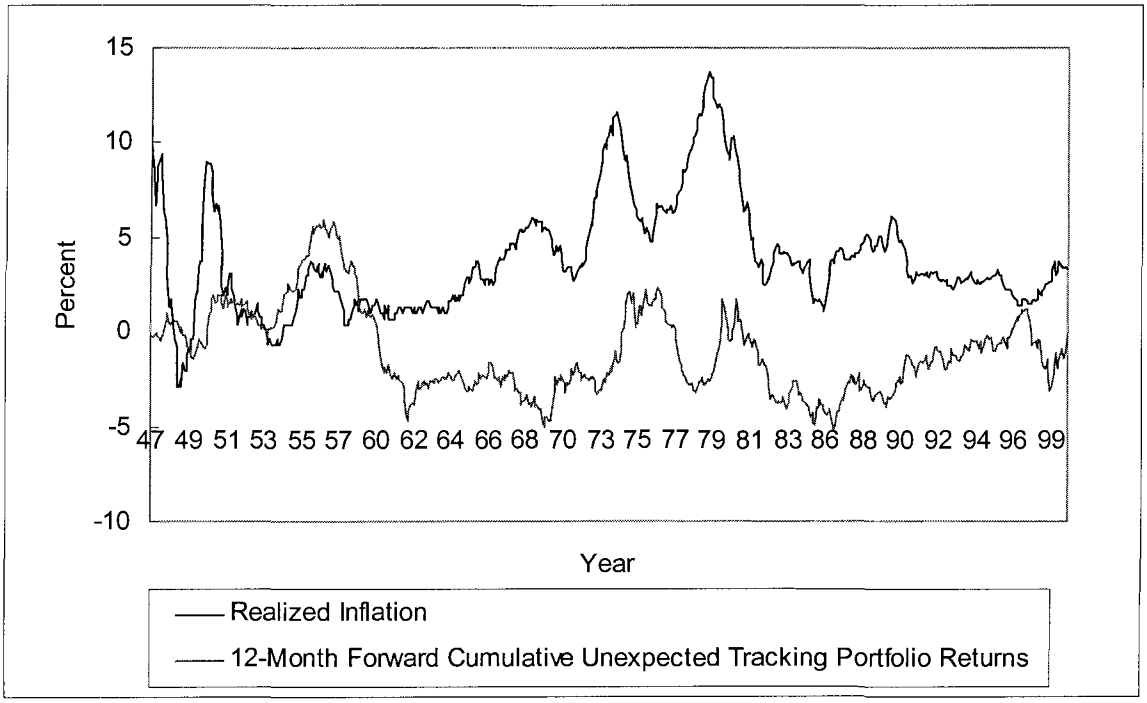

Table 4 **Forecasting ability and descriptive statistics for tracking portfolios with estimation period up to 1994**

	Production growth	Consumption growth	Labour income growth	Inflation
Panel A - P-values from exclusion tests on **b**				
All returns	0.01	0.00	0.02	0.13
All but Mkt	0.06	0.00	0.20	0.13
Mkt only	0.78	0.36	0.47	0.63
10 industries	0.33	0.25	0.66	0.10
4 bonds	0.05	0.00	0.12	0.59
Panel B - Partial R^2 from regressing $y_{t+12} - E[y_{t+12} \mid \mathbf{Z}_{t-1}]$ on $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} - E[\hat{\mathbf{b}}\mathbf{R}_{t-1,t} \mid \mathbf{Z}_{t-1}]$				
	0.05	0.10	0.04	0.04
Panel C - Summary Statistics for tracking portfolio returns $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$				
Mean	0.11	0.07	0.10	0.11
Std. Dev.	0.80	0.63	0.66	1.45
Min	-3.15	-2.36	-2.70	-5.29
Max	4.03	3.05	3.57	7.26
Sharpe ratio	0.14	0.11	0.15	0.08
Panel D – Market model regression: $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} = \alpha + \beta(Market_{t-1,t}) + \xi_{t-1,t}$				
α	0.05	0.06	0.04	0.10
	(0.01)	(0.03)	(0.02)	(0.06)
β	0.05	0.02	0.09	0.02
	(0.03)	(0.01)	(0.01)	(0.01)
R^2	0.26	0.02	0.34	0.00
Panel E - Correlation between tracking portfolio returns and base assets returns				
Mkt	0.51	0.04	0.58	-0.04
NoDur	0.53	0.23	0.68	-0.27
Durbl	0.66	0.15	0.66	0.03
Manuf	0.51	-0.02	0.56	0.05
Enrgy	0.35	-0.29	0.22	0.31
HiTec	0.30	0.10	0.35	-0.06
Telcm	0.32	0.22	0.49	-0.31
Shops	0.46	0.19	0.63	-0.29
Hlth	0.19	-0.07	0.36	-0.17
Utils	0.54	0.24	0.60	-0.39
Other	0.51	0.05	0.60	-0.11
LTGB	0.54	0.52	0.54	-0.32
ITGB	0.55	0.54	0.57	-0.28
1YGB	0.64	0.73	0.69	-0.40
LTCB	0.58	0.54	0.59	-0.39

(2001) and this paper are more likely due to the differences of the data set rather than the differences of sample periods.

5.2 Out-of sample robustness

Table 4 reports the out-of-sample results of regressing equation (7), y_{t+k} on $\hat{\mathbf{b}}_t\mathbf{R}_{t-1,t}$ and $\hat{\mathbf{c}}_t\mathbf{Z}_{t-1}$, where $\hat{\mathbf{b}}_t$ and $\hat{\mathbf{c}}_t$ are estimated from the rolling regressions of equation (6) with a 20-years estimation window. A 20-years estimation window is used in the study of Lamont (2001). The reported standard errors are computed using the Newey-West estimator with 24-month lags. The results indicate that the out-of sample performance of the tracking portfolios is weak. Only the coefficients of $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$ on labour income growth and inflation are significantly different from zero, with values 0.29 and 0.38 respectively. The magnitude of these coefficients is much lower than the magnitude of coefficients in Lamont's out-of sample study (2001). The control variables also suffer forecasting deterioration. Only the coefficients on $\hat{\mathbf{c}}_t\mathbf{Z}_{t-1}$ of production growth, labour income growth, and inflation are significantly different from zero, with values 0.37, 0.48, and 0.57 respectively.

Table 4 also shows mean-squared error for the out-of sample period. The rolling MSE is the average of the squared value of y_{t+k} - $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$ - $\hat{\mathbf{c}}_t\mathbf{Z}_{t-1}$. To account for the expected performance deterioration in this measure, one calculates an R-squared like measure: $1-\frac{\text{Rolling MSE}}{\text{Variance}}$. The variance is obtained from regressing equation (7). This R-squared like measure indicates how the estimated out-of sample tracking portfolio performs. By this measure, it appears that only the inflation forecast is useful out-of-sample. A negative value means the out-of-sample tracking portfolio is worse than the portfolio constructed

Table 5 **Out-of sample results using rolling regressions with a 20-years estimation window**

	Production growth	Consumption growth	Labour income growth	Inflation
$y_{t+12} = \kappa + \lambda \hat{\mathbf{b}}_t \mathbf{R}_{t-1,t} + \pi \hat{\mathbf{c}}_t \mathbf{Z}_{t-1} + \xi_{t,t+12}$				
κ	1.97	3.21	1.63	2.14
	(0.63)	(0.49)	(0.48)	(0.48)
λ	0.03	0.26	0.29	0.38
	(0.12)	(0.18)	(0.14)	(0.11)
π	0.48	-0.09	0.37	0.54
	(0.07)	(0.15)	(0.06)	(0.12)
R^2	0.47	0.03	0.31	0.63
Rolling MSE	24.02	2.63	12.7	6.94
Variance	20.49	0.90	7.69	8.14
$1-\frac{\text{Rolling MSE}}{\text{Variance}}$	-0.17	-1.92	-0.65	0.15
In-sample MSE	8.19	0.41	4.35	1.64
In-sample R^2	0.62	0.61	0.47	0.81

from the sample mean, which is a very poor performance. The in-sample MSE and in-sample R-squared are obtained from regressing equation (6) on the observations between January 1967 and December 1999 (between January 1987 and December 1999 for consumption growth). The in-sample MSE shows the properties of the residual over the out-of sample period. The in-sample R-squared shows the goodness-of-fit of the tracking portfolios over the out-of sample period. Note that the intercept κ is non-zero because the variables are not demeaned. If first differencing were used on the variables, then there would be no intercept in the out-of sample regression.

5.3 Alternative ways in constructing tracking portfolios

Table 5 compares the tracking portfolio constructed previously (the "baseline") with portfolios that are constructed with different variations. The p-

Table 6 Tracking portfolios constructed using alternative methods

	Production growth	Consumption growth	Labour income growth	Inflation
Panel A – Baseline				
P-values from exclusion test	0.00	0.00	0.03	0.13
Partial R^2	0.04	0.09	0.04	0.03
Correlation with baseline portfolio	1.00	1.00	1.00	1.00
Panel B – 60-month ahead target variable (k=60)				
P-values from exclusion test	0.41	0.21	0.69	0.37
Partial R^2	0.00	0.00	0.00	0.00
Correlation with baseline portfolio	0.41	0.15	0.11	0.19
Panel C – Base assets with stocks only				
P-values from exclusion test	0.02	0.08	0.05	0.04
Partial R^2	0.03	0.04	0.03	0.03
Correlation with baseline portfolio	0.87	0.73	0.90	0.96
Panel D – Base assets with bonds only				
P-values from exclusion test	0.00	0.00	0.01	0.15
Partial R^2	0.02	0.06	0.02	0.01
Correlation with baseline portfolio	0.63	0.79	0.64	0.46
Panel E – No control variables				
P-values from exclusion test	0.00	0.00	0.00	0.00
Partial R^2	0.07	0.09	0.06	0.06
Correlation with baseline portfolio	0.70	0.82	0.75	0.71

values from the exclusion test of all base assets, the partial R-squared values, and the correlation with the baseline are reported for each portfolio. The p-value determines whether these alternative portfolios track their target variables. The partial R-squared value describes how well they track the targets.

Panel A of Table 5 copies the relevant statistics of the baseline from Table 3. Panel B shows the results of the tracking portfolios using 60-months ahead target variables (k=60) instead of 12-months ahead (k=12). The large p-values imply that these tracking portfolios have no forecasting ability. This result is probable because current information is unlikely to enclose relevant information about the economy in 60 months. The correlations with the baseline are low except for the production-tracking portfolio.

Panel C and D show the results of the tracking portfolios constructed with subsets of the fifteen base assets. The tracking portfolios in Panel C constructed with the eleven stock portfolios (the market plus ten industry stocks) only. The tracking portfolios in Panel D constructed with the four bond portfolios only. The p-values show that most of these tracking portfolios track the target variables, except stocks-only consumption tracking portfolio and bonds-only inflation tracking portfolio. The values of partial R-squared range from 0.01 to 0.06. The correlations are quite high, range from 0.46 to 0.96.

Panel E reports the results of the tracking portfolios constructed with no control variables. This treatment intends to verify the importance of the control variables. The correlations with the baseline range from 0.70 to 0.82. Unlike the results of Lamont (2001), the p-values show that all of these tracking portfolios have forecasting ability on the target variables. Furthermore, the values of partial R-squared of these portfolios are the same or greater than the values of partial R-squared of the baseline portfolios. These results imply that the control variables are not important. Other studies (Haynes, 2001; Junttila, 2002) bring up the issue of the choice of control variables. Lamont (2001) uses the highest number of control variables amongst all studies on economic tracking portfolios.

6 CONCLUSION AND SUGGESTIONS FOR SUBSEQUENT WORK

The results of this paper suggest that the forecasting power of the 12-months ahead economic tracking portfolios is weaker than what is concluded in Lamont's study (2001). The inflation-tracking portfolio does not withstand the bottom-line exclusion tests of all base assets. Some in-sample partial R-squared values, which represent how well the tracking portfolios track, are low. The production and consumption tracking portfolios generated by the out-of sample rolling regressions have no forecasting power. However, these results cannot completely refute the forecasting power of all tracking portfolios. The labour income-tracking portfolio has adequate performance in both the in-sample and out-of sample estimations. Furthermore, it is possible that the poor performance of the economic tracking portfolios is due to an inappropriate estimating horizon. The forecasting power increases significantly when the inflation-tracking portfolio uses a 3-months ahead estimating horizon. To improve the overall forecasting power, different target variables may require tracking portfolios constructed with different estimating horizons. This hypothesis can be tested in subsequent studies.

Since the economic tracking portfolio is relatively new to the literature, there exists room to investigate and extend this method. It is possible to modify the composition of the economic tracking portfolios. For example, all previous studies on economic tracking portfolios include industry-sorted stock portfolios in their base assets. One can imagine sorting the stocks into portfolios in other ways, such as size, book-to-market value, momentum, mean reversion, and price-to-earning ratio. Liew and Vassalou (2000) use a similar approach and find that returns of portfolios sorted by size and book-to-market value contain information about the future GDP. It is also possible to add other kinds of portfolio, such as commodities, real estate, and international securities, to the base assets (Lamont, 2001). Furthermore, the forecasting power of economic tracking portfolios can be examined on the macroeconomy of countries that have not been considered in earlier studies. Further investigation and extension of the economic tracking portfolios remain a task for future studies.

REFERENCE LIST

Breeden, D. T., M.R. Gibbons, R. Litzenberger (1989) Empirical tests of the consumption-oriented CAPM. *Journal of Finance*, 44, 231-262

Campbell, J.Y. (1996) Understanding risk and return. *Journal of Political Economy*, 104, 267-297.

Campell, J.Y., J. Ammer (1993) What moves the stock and bond markets? A variance decomposition for long-term asset returns. *Journal of Finance*, 48, 3-38.

Chen, N.-F., R. Roll, & S.A. Ross. (1986) Economic forces and the stock market. *Journal of Business*, 59, 383-403.

Cochrane, J.H. (1991) Production-based asset pricing and the link between stock returns and economic fluctuations. *Journal of Finance*, 46, 209-237.

Fama, E.F. (1981) Stock returns, real activity, inflation, and money. *American Economic Review*, 71, 545-565.

Fama, E.F. (1990) Stock returns, expected returns, and real activity. *Journal of Finance*, 45, 1089-1108.

Fama, E.F., K. French. (1988) Dividend yields and expected stock returns. *Journal of Financial Economics*, 47, 315-337.

Geske, R., R. Roll. (1983) The fiscal and monetary linkage between stock returns and inflation. *Journal of Finance*, 38, 1-33

Hayes, S. (2001) Leading indicator information in UK equity prices: an assessment of economic tracking portfolios. *Bank of England Working paper.*

Junttila, J. (2002) Forecasting the macroeconomy with current financial market information: Europe and the United States. *EFMA 2002 London Meetings.*

Junttila, J., H. Kinnunen. (2004) The performance of economic tracking portfolios in an IT-intensive stock market. *Quarterly Review of Economics and Finance*, 44, 601-623.

Kaul, G. (1987) Stock returns and inflation: The role of the monetary sector. *Journal of Financial Economics*, 18, 253-276.

Lamont, O.A. (1997) Economic tracking portfolios. *NBER Working paper* 7055.

Lamont, O.A. (2001) Economic tracking portfolios. *Journal of Econometrics*, 105, 161-184.

Lee, B.-S. (1992) Causal relations among stock returns, interest rates, real activity, and inflation. *Journal of Finance*, 47, 1591-1603.

Liew, J., M. Vassalou (2000) Can book-to-market, size and momentum be risk factors that predict economic growth? *Journal of Financial Economics*, 57, 221-245

Merton, R. (1973) An intertemporal capital asset pricing model. *Econometrica*, 41, 867-887.

Schwert, G..W. (1989) Why does stock market volatility change over time? *Journal of Finance*, 45, 1237-1257.

APPENDICES

Appendix A

Table 7 Classification of Industries by K. French

Variable	Industry	Definition	SIC codes
NoDur	Consumer non-durables	Food, tobacco, textiles, apparel, leather, and toys	0100-0999, 2000-2399, 2700-2749, 2770-2799, 3100-3199, 3940-3989
Durbl	Consumer durables	Cars, Televisions, furniture, and household appliances	2500-2519, 2590-2599, 3630-3659, 3710-3711, 3714, 3716, 3750, 3751, 3792, 3900-3939, 3990-3999
Manuf	Manufacturing	Machinery, trucks, planes, chemicals, office furniture, paper, and commercial printing	2520-2589, 2600-2699, 2750-2769, 2800-2829, 2840-2899, 3000-3099, 3200-3569, 3580-3629, 3700-3709, 3712, 3713, 3715, 3717-3749, 3752-3791, 3793-3799, 3830-3839, 3860-3899
Enrgy	Energy	Oil, gas, and coal extraction and products	1200-1399, 2900-2999
HiTec	Business Equipment	Computers, software, and electronic equipment	3570-3579, 3622, 3660-3692, 3694-3699, 3810-3839, 7370-7379, 7391, 8730-8734
Telcm	Tele -communication	Telephone and television transmission	4800-4899
Hlth	Health	Health care, medical equipment, and drug	2830-2839, 3693, 3840-3859, 8000-8099
Utils	Utilities	Utilities	4900-4949
Other	Other	Mines, construction, building management, transportation, hotels, business service, entertainment, finance	Other SIC codes that are not included in other industries

Appendix B

Table 8 Descriptive statistics for 3-months ahead tracking portfolios

	Production growth	Consumption growth	Labour income growth	Inflation
Panel A-P-values from exclusion tests on **b**				
All returns	0.00	0.00	0.23	0.00
All but Mkt	0.01	0.00	0.30	0.00
10 industries	0.06	0.23	0.13	0.00
4 bonds	0.21	0.00	0.98	0.03
Panel B: Partial R^2 from regressing $y_{t+3} - \mathrm{E}[y_{t+3} \mid \mathbf{Z}_{t-1}]$ on $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} - \mathrm{E}[\hat{\mathbf{b}}\mathbf{R}_{t-1,t} \mid \mathbf{Z}_{t-1}]$				
	0.05	0.10	0.03	0.09
Panel C: Summary Statistics for tracking portfolio returns $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$				
Mean	0.01	-0.02	0.02	-0.02
Std. Dev.	0.49	0.19	0.20	0.21
Min	-2.35	-0.87	-0.71	-0.76
Max	1.84	0.88	1.31	1.18
Sharpe ratio	0.02	-0.11	0.10	-0.10
Panel D: Market model regression: $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} = \alpha + \beta(Market_{t-1,t}) + \xi_{t-1,t}$				
α	-0.02	-0.01	0.01	-0.02
	(0.02)	(0.01)	(0.01)	(0.01)
β	0.05	-0.01	0.02	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.18	0.07	0.10	0.00
Panel E: Correlation between tracking portfolio returns and base assets returns				
Mkt	0.42	-0.22	0.32	0.03
NoDur	0.27	-0.41	0.27	-0.16
Durbl	0.73	-0.26	0.49	-0.02
Manuf	0.50	-0.23	0.28	0.07
Enrgy	0.24	0.21	-0.07	0.44
HiTec	0.44	-0.32	0.48	-0.03
Telcm	0.24	-0.25	0.47	-0.31
Shops	0.42	-0.36	0.39	-0.07
Hlth	0.02	-0.29	-0.04	-0.13
Utils	0.06	-0.28	0.34	-0.32
Other	0.41	-0.18	0.31	-0.03
LTGB	-0.34	-0.63	0.20	-0.47
ITGB	-0.40	-0.64	0.23	-0.48
1YGB	-0.37	-0.72	0.26	-0.55
LTCB	-0.31	-0.58	0.26	-0.56

Table 9 Descriptive statistics for 6-months ahead tracking portfolios

	Production growth	Consumption growth	Labour income growth	Inflation
Panel A - P-values from exclusion tests on $\mathbf{b}$				
All returns	0.00	0.00	0.00	0.00
All but Mkt	0.04	0.00	0.01	0.00
10 industries	0.03	0.33	0.01	0.01
4 bonds	0.91	0.00	0.38	0.36
Panel B – Partial R^2 from regressing $y_{t+6} - \mathrm{E}[y_{t+6} \mid \mathbf{Z}_{t-1}]$ on $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} - \mathrm{E}[\hat{\mathbf{b}}\mathbf{R}_{t-1,t} \mid \mathbf{Z}_{t-1}]$				
	0.06	0.10	0.05	0.06
Panel C - Summary Statistics for tracking portfolio returns $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$				
Mean	0.06	0.03	0.05	-0.03
Std. Dev.	0.77	0.27	0.40	0.28
Min	-3.16	-1.25	-1.41	-1.10
Max	4.32	1.42	2.22	1.32
Sharpe ratio	0.08	0.11	0.13	-0.34
Panel D – Market model regression: $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} = \alpha + \beta(Market_{t-1,t}) + \xi_{t-1,t}$				
α	-0.02	0.03	0.02	-0.03
	(0.02)	(0.01)	(0.01)	(0.01)
β	0.11	0.01	0.04	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)
R^2	0.38	0.05	0.19	0.01
Panel E - Correlation between tracking portfolio returns and base assets returns				
Mkt	0.62	0.15	0.44	-0.07
NoDur	0.54	0.30	0.35	-0.24
Durbl	0.88	0.21	0.71	-0.12
Manuf	0.67	0.08	0.40	0.01
Enrgy	0.30	-0.20	0.09	0.36
HiTec	0.48	0.19	0.34	-0.10
Telcm	0.36	0.30	0.45	-0.39
Shops	0.63	0.31	0.44	-0.16
Hlth	0.24	0.10	0.11	-0.16
Utils	0.39	0.42	0.52	-0.44
Other	0.66	0.17	0.48	-0.12
LTGB	0.11	0.66	0.37	-0.52
ITGB	0.06	0.69	0.35	-0.50
1YGB	0.16	0.80	0.45	-0.58
LTCB	0.20	0.71	0.42	-0.57

Table 10 Descriptive statistics for 36-months ahead tracking portfolios

	Production growth	Consumption growth	Labour income growth	Inflation
Panel A - P-values from exclusion tests on **b**				
All returns	0.07	0.51	0.11	0.49
All but Mkt	0.08	0.43	0.25	0.77
10 industries	0.02	0.42	0.10	0.58
4 bonds	0.74	0.51	0.83	0.48
Panel B – Partial R^2: from regressing $y_{t+36} - E[y_{t+36} \mid \mathbf{Z}_{t-1}]$ on $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} - E[\hat{\mathbf{b}}\mathbf{R}_{t-1,t} \mid \mathbf{Z}_{t-1}]$				
	0.04	0.03	0.03	0.02
Panel C - Summary Statistics for tracking portfolio returns $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$				
Mean	0.05	0.07	0.11	-0.10
Std. Dev.	1.20	0.42	0.86	0.79
Min	-6.77	-2.20	-3.74	-5.02
Max	4.97	1.89	5.10	2.76
Sharpe ratio	0.04	0.17	0.13	0.13
Panel D – Market model regression: $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} = \alpha + \beta(Market_{t-1,t}) + \xi_{t-1,t}$				
α	-0.01	0.07	0.04	-0.03
	(0.05)	(0.02)	(0.03)	(0.03)
β	0.09	0.00	0.10	-0.09
	(0.01)	(0.00)	(0.01)	(0.01)
R^2	0.09	0.00	0.23	0.25
Panel E - Correlation between tracking portfolio returns and base assets returns				
Mkt	0.30	-0.01	0.48	-0.50
NoDur	0.47	0.16	0.59	-0.50
Durbl	0.60	0.18	0.72	-0.39
Manuf	0.37	0.00	0.50	-0.36
Enrgy	0.16	-0.21	0.25	-0.18
HiTec	0.14	0.14	0.37	-0.51
Telcm	0.12	-0.03	0.29	-0.48
Shops	0.31	0.15	0.53	-0.62
Hlth	0.11	-0.02	0.26	-0.34
Utils	0.39	0.10	0.48	-0.48
Other	0.41	0.15	0.56	-0.49
LTGB	0.14	0.13	0.08	0.15
ITGB	0.02	0.19	-0.03	0.25
1YGB	0.02	0.41	0.07	0.15
LTCB	0.13	0.20	0.10	0.11

Table 11 Descriptive statistics for 60-months ahead tracking portfolios

	Production growth	Consumption growth	Labour income growth	Inflation
Panel A - P-values from exclusion tests on $\mathbf{b}$				
All returns	0.03	0.21	0.65	0.55
All but Mkt	0.05	0.17	0.74	0.96
10 industries	0.14	0.31	0.82	0.88
4 bonds	0.53	0.42	0.46	0.81
Panel B – Partial R^2 from regressing $y_{t+60} - \mathrm{E}[y_{t+60} \mid \mathbf{Z}_{t-1}]$ on $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} - \mathrm{E}[\hat{\mathbf{b}}\mathbf{R}_{t-1,t} \mid \mathbf{Z}_{t-1}]$				
	0.04	0.05	0.02	0.01
Panel C - Summary Statistics for tracking portfolio returns $\hat{\mathbf{b}}\mathbf{R}_{t-1,t}$				
Mean	0.24	0.08	0.18	-0.19
Std. Dev.	1.49	0.63	0.92	1.34
Min	-8.52	-2.39	-3.29	-6.92
Max	9.58	2.09	6.25	6.06
Sharpe ratio	0.16	0.13	0.20	-0.14
Panel D – Market model regression: $\hat{\mathbf{b}}\mathbf{R}_{t-1,t} = \alpha + \beta(Market_{t-1,t}) + \xi_{t-1,t}$				
α	0.18	0.08	0.12	-0.01
	(0.06)	(0.03)	(0.03)	(0.04)
β	0.08	0.00	0.09	-0.24
	(0.01)	(0.01)	(0.01)	(0.01)
R^2	0.06	0.00	0.15	0.57
Panel E - Correlation between tracking portfolio returns and base assets returns				
Mkt	0.24	0.04	0.39	-0.75
NoDur	0.48	0.12	0.45	-0.64
Durbl	0.40	-0.07	0.51	-0.56
Manuf	0.23	0.14	0.37	-0.60
Enrgy	0.17	-0.01	0.24	-0.42
HiTec	0.07	0.21	0.41	-0.74
Telcm	0.08	-0.19	0.12	-0.66
Shops	0.38	0.11	0.45	-0.70
Hlth	0.16	0.04	0.22	-0.61
Utils	0.54	-0.06	0.42	-0.57
Other	0.29	0.21	0.44	-0.70
LTGB	0.14	-0.08	-0.18	0.03
ITGB	0.21	-0.04	-0.18	0.10
1YGB	0.40	0.20	0.10	0.11
LTCB	0.23	-0.01	-0.11	0.00