On monetary policy and stock market anomalies

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Abstract

This study utilizes a macro-based VAR framework to investigate whether stock portfolios formed on the basis of their value, size and past performance characteristics are affected in a differential manner by unexpected US monetary policy actions during the period 1967-2007. Full sample results show that value, small capitalization and past loser stocks are more exposed to monetary policy shocks in comparison to growth, big capitalization and past winner stocks. Subsample analysis, motivated by variation in the realized premia and parameter instability, reveals that monetary policy shocks' impact on these portfolios is significant and pronounced only during the pre-1983 period.

1. Introduction

Market participants and the financial press assign a large weight to the role of monetary policy decisions for explaining movements in stock prices. Financial analysts and economists closely follow the statements of central banks' board members, while the minutes of monetary policy committees' meetings are scrutinized for signs indicating future monetary policy stance. Reflecting the importance of this issue, there is a well established empirical literature documenting the negative impact of monetary tightening on stock market returns. The seminal studies of Jensen and Johnson (1995), Thorbecke (1997), Patelis (1997), Lobo (2002) and Bernanke and Kuttner (2005) provide characteristic examples. Conover, Jensen and Johnson (1999) confirm this pattern in an international setting, while Lobo (2002) shows that monetary policy shocks have an effect on stock market volatility too. Using a dividend discount model for equity valuation, most researchers mainly focus on two ways through which monetary policy affects stock prices (see Smirlock and Yawitz, 1985). Monetary policy can affect the rates that market participants use to discount future cash flows as well as expected cash flows themselves (Patelis, 1997).

There is an extensive theoretical literature discussing the transmission channels through which monetary policy affects companies' operations (Fazzari, Hubbard and Petersen, 1988, Bernanke and Gertler, 1989, Bernanke and Gertler, 1995). In particular, there are two well-recognized channels: the balance sheet channel and the bank lending channel. Both these mechanisms are part of the credit channel of the monetary policy transmission process (see Walsh, 2003) that affects the external finance premium, i.e. the difference in cost between funds raised externally (e.g. new equity and debt) and funds generated internally (e.g. retained earnings).

According to the balance sheet channel, a monetary tightening can reduce the company's revenues due to lower consumer spending and increase its floating-rate interest payments, leading

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to a significant reduction in its net cash flows. Moreover, it can reduce the value of its assets and hence the value of the collaterals posted for its loans. This process deteriorates the company's interest coverage ratio and other indicators of its financial health, pulling the trigger of financial accelerator that amplifies the initial negative shock and magnifies the external finance premium due to an increase in the agency cost of debt. The bank lending channel has a more immediate effect. In a restrictive monetary environment, the total supply of intermediated credit is significantly reduced. Therefore, companies face more onerous credit terms or even a dramatic reduction in the level of funds they can borrow either from credit markets or from financial intermediaries. Consequently, net cash flows get considerably reduced and profitable projects are abandoned due to lack of funding.

Bernanke and Kuttner (2005) offer two more potential effects of monetary policy on stock prices: its impact on the required risk premium and the potential excess sensitivity or overreaction of market participants to monetary policy shocks. As Bernanke and Kuttner (2005, p. 1205) mention: "A more tightly structured analysis that encompasses a wider class of assets may help to differentiate these interpretations. In any case further exploration of the link between monetary policy and the excess return on equities is an intriguing topic for future research". Nevertheless, no sufficient evidence has been provided to confirm these conjectures.

Despite the sound theoretical foundation of the previous arguments, few studies have attempted to directly link monetary policy shocks to the well documented stock market anomalies (e.g. size, value and momentum anomalies). Apart from broad stock market indices, most of the existing studies have focused on the behaviour of industry returns in an attempt to examine the cross-sectional variation in the impact of monetary policy shocks (Thorbecke, 1997, Jensen and Mercer, 2002 and Bernanke and Kuttner, 2005). But as Cochrane (2008, p. 314) notes: "The challenge is straightforward: We need to understand what macroeconomic risks underlie the "factor risk premia", the average returns on special portfolios that finance research uses to

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crystallize the cross section of assets. A current list might include […] the value and size premiums, the momentum premium. […] Having said "macroeconomics", "risk" and "asset prices", the reader will quickly spot a missing ingredient: money".

Our study utilizes a VAR framework in the spirit of Thorbecke (1997) and examines whether there is a differential contemporaneous impact of monetary policy shocks, as measured by innovations to the change in Federal funds' rate, on stock portfolios formed on the basis of their size, value and past performance characteristics during the period 1967-2007. We argue that these widely used portfolios actually provide a more appropriate setting to examine the validity of the well established transmission channels as well as to test the conjecture regarding the existence of other possible channels. Moreover, we further contribute to the literature by also examining the portfolio returns' impulse responses to monetary policy shocks beyond the first period.

With respect to the traditional transmission channels, examining the differential impact of monetary policy shocks on portfolios formed on the basis of a series of value characteristics can help us shed light on the importance of the balance sheet channel. Moreover, to the extent that small companies are less well immunized against adverse monetary policy decisions and are characterized by weaker relationships with financial intermediaries, as compared to big companies, portfolios of stocks formed on the basis of their market value provide a valuable tool to identify the role of the bank lending channel. Both value and size portfolios allow us to examine whether the risk-premium channel mentioned in Bernanke and Kuttner (2005) is active.

It should be mentioned that, starting from Fama and French (1995), there is a growing literature trying to reconcile stock market anomalies within a "hidden risk factor" framework. Interestingly, a lot of these studies use financial or macroeconomic variables, such as term and default spreads and the T-bill rate (Hahn, O' Neill and Reyes, 2004, Petkova, 2006, Hahn and Lee, 2006), news related to GDP growth (Vassalou, 2003) and variation of credit market conditions over the business cycle (Perez-Quiros and Timmermmann, 2000). In the same spirit,

Aretz, Bartram and Pope (2010) utilized combinations of such variables to explain value, size and momentum anomalies within a GMM asset pricing framework. It has been well established that these variables are linked to monetary policy conditions (Stock and Watson, 1989, Gertler, Hubbard and Kashyap, 1991, Kashyap, Lamont, and Stein, 1994). Given this evidence, we argue that it is more intriguing to examine this potential link by considering the primary source of monetary policy shocks.

Most interestingly, portfolios formed on the basis of stocks' past performance at a five-year, one-year and one-month horizon provide an ideal tool to examine the excess sensitivity conjecture. These portfolios are based solely on the companies' past stock market performance, with no reference to their corporate characteristics, and hence explanations relying on the traditional channels are not applicable. Therefore, we are able to examine whether the excess sensitivity mechanism analyzed in studies trying to explain the momentum anomaly (see Jegadeesh and Titman, 2005, for a review) is present and whether this reaction is related to monetary policy shocks. This is not to say that we exclude the potential validity of the excess sensitivity mechanism to explain the value and size anomalies too (see Shleifer, 2000, for a detailed discussion).

Among the notable previous studies that directly examined the differential impact of monetary policy shocks on the returns of portfolios constructed on the basis of stocks' fundamental characteristics, Thorbecke (1997) utilized size portfolios, Jensen, Johnson and Mercer (1997), Guo (2004) and Maio and Tavares (2007) considered both value and size anomalies, while Ehrmann and Fratzscher (2004) and Basistha and Kurov (2007) investigated this issue using portfolios of financially constrained stocks. In comparison to Jensen et al. (1997), Guo (2004), Ehrmann and Fratzscher (2004) and Basistha and Kurov (2007), we employ a more general VAR system instead of relying on single-equation models for returns and we use a much longer sample period. This extended sample period as well as the use of value proxies to examine

the balance sheet channel more appropriately makes our study distinct from Thorbecke (1997). In contrast to Maio and Tavares (2007), we use a macro-based VAR and conduct subsample analysis to reveal the time-varying nature of the relationship. The particularly innovative feature of the present study relative to the existing literature is the use of past performance ordered portfolios to examine the excess sensitivity mechanism conjectured by Bernanke and Kuttner (2005).

Contributing further to the literature, we examine whether the impact of monetary policy shocks differs across monetary policy regimes. Laopodis (2006, 2010) provided extensive evidence for the time-varying relationship between Fed funds rate and the general stock price index. Park and Ratti (2000) also examined this relationship across different monetary policy regimes. If this impact varies through time, then this finding could be a potential explanation for the documented instability of some of these anomalies' premia (see Horowitz, Loughran and Savin, 2000, Schwert, 2003, and Guidolin and Timmerman, 2008). Moreover, the time-variation of this impact can help us evaluate the hypothesis of Bernanke and Gertler (1995) that some channels for the transmission of monetary policy may become inactive. In particular, following Clarida, Gali and Gertler (2000), we split the sample using 1983 as cut-off point since around that time Volcker's disinflation mission was largely accomplished. Volcker's first years of tenure were associated with strict anti-inflationary policies which eventually ushered the "great moderation" period, characterized by low inflation, interest rates and overall macroeconomic volatility. The selection of this time point for splitting the full sample period is strongly supported by the Chow-type break test of Candelon and Lutkepohl (2001).

Previewing our results, we show that regardless of the employed value proxy, value stocks are considerably more sensitive to monetary policy shocks than growth stocks are in the full sample period, confirming the significance of the balance sheet transmission channel. However, the subperiod analysis shows that this differential impact was more pronounced only during the pre-1983 period. With respect to size ordered portfolios, we are able to offer an explanation for

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the disappearance of the size premium in the post-1983 period. Small cap companies were considerably more sensitive to changes in the Fed funds rate only in the pre-1983 period, when actually the size premium was quite high. On the contrary, during the "great moderation" period, we find no differential impact of monetary policy shocks on the returns of small versus big cap stocks. Moreover, regardless of the frequency used, past losers are also considerably more sensitive to monetary policy shocks than past winners in the full sample period. This finding reinforces the appeal of excess sensitivity explanations for past performance anomalies and shows that monetary policy shocks may well be a source of information to which portfolios of stocks under- or over-react. Nevertheless, results from subperiod analysis indicate that the evidence on the excess sensitivity mechanism is strong only during the pre-1983 period. The differential responses for all these portfolios continue to hold even when we augment the benchmark VAR specification to incorporate a set of commonly used risk factors.

The structure of our study is as follows. Section 2 analyzes the potential channels through which monetary policy shocks can affect stock prices of companies with different characteristics. Section 3 describes the dataset used in this study as well as various methodological issues. Section 4 presents the benchmark full sample empirical results. Section 5 presents the results from a series of sensitivity checks and subsample stability analysis. Finally, Section 6 concludes.

2. Monetary policy transmission channels and stock returns

To illustrate the well established effects of monetary policy on stock prices, we employ the standard dividend discount model. After applying the commonly used transversality condition, the familiar version of this model is (Campbell, Lo and MacKinlay, 1996, p.256):

$$P_{i,t} = E_t \left[\sum_{j=1}^{\infty} \left(\frac{1}{1+R_i} \right)^j D_{i,t+j} \right] \qquad (1)$$

where $P_{i,t}$ is the price of stock i at time t and R_i is the rate used to discount the dividends $D_{i,t+j}$ that company i pays out from time t to $t+j$.

As Smirlock and Yawitz (1985) point out, an increase in the Fed funds rate will cause a reduction in the stock price of company i for two main reasons. Firstly, the discount rate R_i will rise, since an increase in the Fed funds rate is usually associated with an increase in the short-term money market rates that are commonly used as discount rates (Kuttner, 2001). Secondly, expectations of future net cash flows (earnings and hence dividends) will be diminished, to the extent that a monetary contraction associated with an increase in the Fed funds rate hampers real economic activity (Bernanke and Gertler, 1995).

Taking a step further and decomposing the discount rate R_i into the risk-free rate R^f and the risk premium RP_i associated with company i, the dividend discount model can be written as:

$$P_{i,t} = E_t \left[\sum_{j=1}^{\infty} (\frac{1}{1+R^f+RP_i})^j D_{i,t+j} \right] \qquad (2)$$

It should be noted that the risk premium is allowed to be different across stocks with different characteristics. Following the arguments of Bernanke and Kuttner (2005), this version of the model illustrates that the risk premium is an additional potential channel through which monetary policy shocks are transmitted to the stock market. Tight money could directly increase the riskiness of stocks by raising the interest costs or weakening the balance sheets of the firms. Additionally, tight money could reduce the willingness of stock investors to bear risk.

Recognizing that risk premia differ for stock portfolios formed on the basis of different underlying characteristics allows us to argue that monetary policy shocks may have a differential impact on these portfolios' returns. In particular, we examine whether the well documented size and value anomalies can be linked to reactions to monetary policy shocks. If the argument regarding the risk premium channel is valid, then the returns of small size and value stocks should be more sensitive to such shocks as compared to the returns of big capitalization and growth

stocks. Greater sensitivity to adverse monetary policy shocks implies greater exposure to a "hidden risk factor", justifying the higher average returns that small cap and value stocks are typically found to yield.

Moreover, the considerable time-variation that risk premia exhibit (see Lettau, Ludvigson and Wachter, 2007) and the instability in the anomalies' premia (see Horowitz, Loughran and Savin, 2000, Schwert, 2003, and Guidolin and Timmerman, 2008) motivates us to examine whether stock portfolios' returns respond differently to such shocks under different monetary policy regimes. Evidence of a link between the observed risk premia and exposure to monetary policy shocks over time would indicate support for the conjecture that monetary policy risk may be an important factor behind these premia.

With respect to size ordered portfolios, there are a series of arguments why small cap stocks' returns could be more sensitive to changes in the Fed funds rates. Gertler and Gilchrist (1994) extensively argued that a monetary tightening should affect more severely small size companies because these are typically less well immunized against such an adverse economic condition. This is a reasonable hypothesis since optimal risk management procedures are too costly for small companies to bear. Moreover, these companies are less well collateralized and, as a result, they are more likely to be harmed due to the "flight to quality lending" by creditors (Bernanke, Gertler, Gilchrist, 1994).

There are a series of studies examining the impact of capital market imperfections on corporate investment that use size as a proxy for financially constrained companies (see e.g. Fazzari et al., 1988 and Kashyap et al., 1994). This is because small companies are typically younger firms, they have limited ability to issue commercial paper and face higher agency costs of debt, finding it more difficult to raise capital due to their limited ownership base. Moreover, small companies have restricted access to intermediated credit, and hence on the advent of an overall reduced supply of bank loans, these companies are typically the first to be cut off their

credit lines. The previous arguments lead to the conclusion that, in the face of a monetary tightening, the increase in the external cost of finance will be more pronounced for small companies, making them more risky for investors.

Portfolios of value stocks are also expected to be more exposed to monetary policy risk as compared to portfolios of growth stocks. Gertler and Gilchrist (1994) argue that a monetary tightening, by increasing interest rates, can worsen cash flow net of interest and thus firms' balance sheet positions, pulling the trigger of the financial accelerator (see also Bernanke et al. 1994). Value stocks are more heavily exposed to this type of risk since by construction they are characterized by high cash flows (earnings, dividends etc.) in current times and the near future relative to their market prices. On the other hand, since growth stocks have low current earnings-to-price and book-to-market value ratios, investors expect that these companies will realize their cash flows in the distant future. Therefore, a temporary monetary tightening should not greatly affect them.

Along the lines of the previous arguments, since value stocks are more heavily dependent on cash flows than growth stocks, a reduction in the level of their revenues and earnings will oblige them to seek external finance for their current operations, exactly when this becomes more costly. Monetary policy shocks affect mainly the short-end of the term structure (Kuttner, 2001), and hence the short-term cost of financing that is of particular importance for value stocks. To the contrary, growth companies are expected to rely on long-term borrowing due to long-term business plans; therefore, increases in short-term rates should not be as harmful for growth stocks as they are for value stocks.

This line of reasoning is consistent with the "good beta, bad beta" explanation of the value premium proposed by Campbell and Vuolteenaho (2004), where interest rate risk (to which growth stocks are predominantly exposed) is termed "good beta" because an interest rate shock is reversible through time, while cash flow risk (to which value stocks are mainly exposed) is "bad

beta" since negative cash flow shocks are almost irreversible.[1] More generally, default risk increases more for companies with cash flow problems. This argument underlies the explanation for the value premium provided by Fama and French (1995), who argue that value firms are usually firms that have been in distress for a substantial period, they are more likely to be credit-constrained and, hence, more sensitive to monetary policy shocks than growth firms (see Ehrmann and Fratzscher, 2004, and Basistha and Kurov, 2007, for a discussion). Zhang (2005) proposes a mechanism based upon costly reversibility, a technological friction, to provide a rational expectations consistent explanation of the value premium. More specifically, in Zhang's (2005) model, when firms try reduce their capital they face higher costs as opposed to when they try to expand, which in combination with the countercyclical price of risk causes value firms to be riskier than growth firms, especially in bad times when the price of risk is high.

Going beyond the traditional risk-based explanations that relate corporate and economic fundamentals to monetary policy shocks, Bernanke and Kuttner (2005, p. 1254) hinted that market participants may also overreact to policy actions and this could explain the large movements in excess returns following changes in the Fed funds rates. Interestingly, Kurov (2009) documents that monetary policy decisions have a significant effect on investor sentiment, especially during bear markets. This argument actually uncovers another potential transmission channel of monetary policy to the stock market, drawing a crucial link with the well-established behavioral finance literature. A series of studies have documented that investors tend to overreact or underreact to news, driving market prices to levels not easily justified by fundamentals (see the seminal studies of Lakonishok, Shleifer and Vishny, 1994 and Daniel and Titman, 1997). A strand of the literature documents long-term reversals in stock prices (De Bondt and Thaler, 1985) and

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[1] Supporting this explanation, Bernanke and Gertler (1995) report that after a positive shock to the Fed funds rate, corporate income is considerably reduced and it takes more than eight quarters till it starts recovering. On the other hand, the Fed funds rates itself absorbs this shock in less than eight months.

the outperformance of momentum strategies (Jegadeesh and Titman, 1993). The excess sensitivity of market participants to good and bad news is the core mechanism that rationalizes these findings (see Shleifer, 2000, for an extensive analysis).

Using portfolios formed solely on the basis of stocks' prior performance could shed light on the potential excess sensitivity channel. In particular, forming portfolios of stocks categorized as winners or losers at a 5-year, 1-year and 1-month horizon without any further information on their corporate characteristics can isolate the effect of the excess sensitivity mechanism, since the standard arguments referring to the credit channel and the external cost of finance do not apply in this case. Therefore, documenting a differential impact of monetary policy shocks on the returns of winners' portfolios versus losers' portfolios at various frequencies implies that this mechanism is active and that monetary policy shocks may well be a source of news to which investors react.

It should be acknowledged that the overreaction hypothesis has been employed to explain the size, value and contrarian premia too (see Shleifer, 2000). For example, according to this line of reasoning, stocks exhibit high earnings-to-price and book-to-market value ratios due to the overreaction of investors to bad prior earnings and corporate news, driving down their prices and market values. Therefore we do not exclude the validity of the overreaction explanation for these premia; we just claim that past performance ordered portfolios provide a more appropriate laboratory to examine this potential transmission mechanism of monetary policy shocks, since we can isolate it from the other traditional channels that may well apply to value and size ordered portfolios, as previously discussed.

3.   Methodology and data

Consider the augmented vector autoregressive model of order p (VAR(p)):

$$\mathbf{y}_t = \sum_{i=1}^{p} \mathbf{\Phi}_i \mathbf{y}_{t-i} + \mathbf{\Theta} \mathbf{z}_t + \mathbf{\varepsilon}_t \qquad (3)$$

where $\mathbf{y}_t$ is an m x 1 vector of jointly determined dependent variables, $\mathbf{z}_t$ is an q x 1 vector of deterministic and/or exogenous variables, $\boldsymbol{\Phi}_i$ and $\boldsymbol{\Theta}$ are m x m and m x q coefficient matrices, and $\boldsymbol{\varepsilon}_t$ is the vector error process. Pesaran and Shin (1998) make the following assumptions: (i) $E(\boldsymbol{\varepsilon}_t)$ = $\mathbf{0}$, $E(\boldsymbol{\varepsilon}_t\boldsymbol{\varepsilon}_t^{'}) = \boldsymbol{\Omega}$, where $\boldsymbol{\Omega}$ is an m x m positive definite matrix, and $E(\boldsymbol{\varepsilon}_t | \mathbf{z}_t) = \mathbf{0}$; (ii) All the roots of $\left| \mathbf{I}_m - \sum_{i=1}^{p} \boldsymbol{\Phi}_i z^i \right| = 0$ lie outside the unit circle, where $\mathbf{I}_m$ is the m x m identity matrix; (iii) $\mathbf{y}_{t-1},\ldots, \mathbf{y}_{t-p}$, $\mathbf{z}_t$ are not perfectly collinear. Assumption (ii) implies that $\mathbf{y}_t$ is covariance-stationary and therefore Eq. (3) can be rewritten as an infinite vector moving average process:

$$\mathbf{y}_t = \sum_{i=0}^{\infty} \boldsymbol{\Psi}_i \boldsymbol{\varepsilon}_{t-i} + \sum_{i=0}^{\infty} \boldsymbol{\Lambda}_i \mathbf{z}_{t-i} \qquad (4)$$

where $\boldsymbol{\Psi}_i = \boldsymbol{\Phi}_1 \boldsymbol{\Psi}_{i-1} + ... + \boldsymbol{\Phi}_p \boldsymbol{\Psi}_{i-p}$ $(i = 1, 2, ...)$ are the m x m coefficient matrices, $\boldsymbol{\Psi}_0 = \mathbf{I}_m$, $\boldsymbol{\Psi}_i = \mathbf{0}$ for $i < 0$, and $\boldsymbol{\Lambda}_i = \boldsymbol{\Psi}_i \boldsymbol{\Theta}$.

The Cholesky factorisation (Sims, 1980) implies that a lower m x m triangular matrix $\mathbf{C}$ exists such that $\mathbf{CC}^{'} = \boldsymbol{\Omega}$. It is well-known that the resulting impulse response functions are dependent upon the ordering of the variables in the VAR (see e.g. Lutkepohl, 1991, section 2.3.2). This is a crucial shortcoming given the uncertainty that surrounds the relationships among macro-financial variables in terms of direction of causality. Pesaran and Shin (1998) propose an alternative approach, the Generalized Impulse Response (GIR) function, which is invariant to the ordering of the variables in the VAR and show that significant differences may arise in the empirical results from the Cholesky and the GIR methods. The GIR from a shock to the j-th variable is calculated using a variable-specific Cholesky decomposition computed with the j-th variable at the top of the Cholesky ordering.

In our empirical analysis we use the GIR function for the main results. . We present and discuss both initial period (Section 4.1) and multi-period (Section 4.2) generalized impulse responses. For robustness, though, we also calculate in Section 5.1 impulse response functions using the Cholesky decomposition with an ordering scheme similar to the one adopted by

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Thorbecke (1997). The latter identification scheme places stock returns at the end of the ordering chain effectively assuming that the stock market reacts to macroeconomic developments but has no impact itself on these developments

The endogenous variables vector is $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$ where $ipn_t = 100*\Delta\log(ind_t)$ is the growth rate of industrial production (ind); $inf_t = 100*\Delta\log(cpi_t)$ is the growth rate of consumer price index (cpi) that is, the inflation rate; $gcom_t = 100*\Delta\log(com_t)$ is the growth rate of a commodity price index (com); $dfed_t = \Delta(fed_t)$ is the change in the federal funds rate (fed); $strongin_t$ is the portion of non-borrowed reserves that is orthogonal to total reserves[2]; r_{jt} is the nominal return on stock portfolio j.

[TABLE 1 HERE]

Table 1 presents some descriptive statistics for the macroeconomic variables that are included in the VAR. The growth rate of industrial production is, on average, equal to 0.21% per month (i.e. 2.5% p.a.), while consumer prices have increased, on average, by 0.38% per month (4.5% p.a.). The bad macroeconomic outlook of the mid-1970s is exemplified by the fact that industrial production growth reached a minimum of -3.6% per month in 1974.12, while inflation peaked at 1.8% per month in 1973.08. Commodity prices have not risen as fast as consumer prices, with the average monthly growth rate of the former being equal to 0.23%, but have been overall significantly more volatile. The Federal funds rate was quite volatile during the early 1980s with the largest positive change, 0.25% per month (i.e. 3.1% p.a.), recorded in 1980.03 and soon followed by the largest negative change, -0.55% per month (i.e. -6.6% p.a.), in 1980.05.

For robustness, we estimate VARs with real (net of inflation) portfolio returns as well as returns in excess of the Treasury bill rate. The price, output, and money stocks data are seasonally

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[2] The *strongin* variable is calculated as the residual from a regression of (logged) non-borrowed reserves on total reserves. Strongin (1995) argues that the Fed influences the market for reserves by modifying the mix of non-borrowed reserves to meet current reserve demand.

adjusted. The frequency of the variables in our dataset is monthly, while the sample period under investigation is 1967.01-2007.12. The source for the macroeconomic variables is IMF-International Financial Statistics. Monetary policy shocks are measured using the innovations in the federal funds rate change (*dfed*).[3] Doing so, we avoid potential problems of non-stationarity that may be present in Thorbecke's (1997) specification. The lag length of the VAR was selected by the Akaike Information Criterion (AIC). In Section 5.1 we further check the robustness of our results by using the sequential likelihood ratio (LR) test of Lutkepohl (1991) to determine the lag length of the VAR. Furthermore, we conduct sensitivity analysis with respect to model specification and subsample stability in Sections 5.2 and 5.3, respectively.

The source for stock portfolios' returns is the widely used Kenneth French's online data library.[4] For the size anomaly we use the value-weighted monthly returns of the 10 portfolios formed on the basis of stocks' market value. For the value anomaly we employ four different proxies; we utilize the value-weighted monthly returns of the 10 portfolios sorted according to stocks' cash flow-to-price ratio (where cash flow is defined as earnings before extraordinary items plus deferred tax income and common equity's share of depreciation), earnings-to-price ratio (where earnings stand for EBITDA before extraordinary items), dividend-to-price ratio and book

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[3] US monetary policy operating procedures have undergone various changes since the end of the Bretton Woods fixed exchange rate system in the early 1970s. These chronologically correspond to periods of federal funds rate (1972-1979), non-borrowed reserves (1979-1982), borrowed reserves (1982-1988) and federal funds rate (1988-present) operating procedures. As Walsh (2003, p.462) points out, "…in no case did the Fed's behaviour reflect pure examples of any one type". Nevertheless, Bernanke and Blinder (1992) and Bernanke and Mihov (1998), among others, point out that the federal funds rate has been the key policy instrument in the US and therefore unexpected changes in this rate should provide good estimates of policy shocks. Moreover, Cook (1989) finds that even during the 1979-1982 period of non-borrowed reserves operating procedure, the funds rate provides a satisfactory indicator since most of its changes reflected policy actions.

[4] This library is available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

equity-to-market value of equity ratio. Moreover, we use the value-weighted monthly returns of the 25 double-sorted Fama-French portfolios on size and book-to-market value. With respect to past performance anomalies we use value-weighted monthly returns of 10 portfolios formed at the end of month t-1 on the basis of stocks' past returns. In particular, for the long-term reversal anomaly, prior performance refers to stocks' returns from month t-60 to month t-13. For the momentum anomaly, the sorting criterion is stocks' returns from month t-12 to month t-2, while for the short-term reversal anomaly, prior performance corresponds to the return of month t-1. Finally, we use CRSP value-weighted returns as a proxy for market return.

4. Empirical results, full sample, 1967-2007

4.1 Initial period impulse responses

Table 2 reports the full sample VAR estimation results and the average returns for our portfolios. The AIC selects two lags in all cases.[5] We show the initial period generalized impulse response of the first and tenth deciles for each of the value, size and past performance related portfolios to a monetary policy shock. The standard errors indicate that in all cases the impulse response point estimates are statistically different from zero at the 10% level of significance, with the great majority of the cases being significant at the 5% level.[6]

The results show that a one standard deviation innovation in the federal funds rate change depresses value portfolio returns more than growth portfolio returns, across all proxies of value. For example, using the book-to-market ratio, we find that following a contractionary shock, value (decile 10) portfolio returns are on average 0.86% lower per month, while growth (decile 1)

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[5] The estimated VARs are stationary, since all roots of the characteristic VAR polynomials lie outside the unit circle implying that the impulse responses eventually die out to zero and that their standard errors are valid (results available upon request).

[6] Analytic (asymptotic) standard errors are used. Monte Carlo standard errors yield very similar results.

portfolio returns are depressed by 0.51%, generating a monthly impact differential of 0.35%. For comparison, note that the initial period generalized impulse response of the market index's monthly return to a monetary policy shock is -0.65% (i.e. -7.8% p.a.), lying close to the middle of the distance between the value and growth impulse responses.[7] The monthly value-growth impact differential corresponds to an annualized figure of 4.14%, suggesting that value stocks portfolios are considerably more exposed to monetary policy risk.

[TABLE 2 HERE]

Similar monetary policy impact differentials are obtained using the other value proxies, with the annualized differential ranging from 3.14%, using the dividend-to-price ratio, to 4.56%, using the earnings-to-price ratio. At the same time, Table 2 shows that value investment strategies provide higher returns, as compared to investment in growth stocks, with the returns' differential reaching 6.72% p.a. in the case of book-to-market portfolios. Thus, the results suggest that the high exposure of value stocks to monetary policy risk may be an important factor behind the premium that value stocks offer over growth stocks. These findings highlight the importance of the balance sheet transmission channel; they are also supportive for Bernanke and Kuttner's (2005) risk premium argument.[8]

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[7] The R^2 for the market return regression is 3% indicating that only a small portion of stock market volatility is explained by aggregate economic variables. The R^2 takes values between 1% and 10% across the various value, size and past performance portfolio returns regressions, with a mode of 3%. These findings are broadly consistent with Shiller's (1981) finding of excess stock market volatility.

[8] Results for the remaining deciles are not shown to save space but are available upon request. Overall, they indicate the presence of two general trends. Moving from extreme growth (decile 1) towards extreme value (decile 10) portfolios, the average return differential and the monetary policy impact differential increase in magnitude. Movements along these trend lines, however, are not strictly monotonic. Similar non-strictly monotonic trends are present in the size and past-performance related portfolios. Thorbecke's (1997) evidence for size sorted portfolios is consistent with our findings regarding lack of strict monotonicity.

Moving on to size sorted portfolios and comparing small market value portfolios (decile 1) with large market value portfolios (decile 10), findings in Table 2 indicate that small stocks are more exposed to monetary policy risk and provide higher returns. The results suggest that the bank lending channel has been active, while this evidence is in line with the risk premium explanation too. Nevertheless, the monetary policy impact differentials and corresponding premia are generally smaller as compared to the cases of the value portfolios. The impulse response to a monetary tightening shock is -0.66% for small stocks and -0.56% for large stocks, suggesting an annualized impact differential of 1.22%. As the following subsection shows, significant subsample instability plays a crucial role in explaining the relatively low magnitude of the risk premium associated with small stocks.

[TABLE 3 HERE]

To gain some insight in the interaction of the value and size anomaly, we report in Table 3 the results from double-sorted size and book-to-market portfolios. Four interesting features arise. First, all of the estimated impulse responses are significantly different from zero. Second, the evidence supports the existence of a value gradient with respect to monetary policy shocks since in each size-related quintile the impact of shocks is stronger for value stocks. Third, there is also a size gradient since comparison of growth (or value) stocks' responses across size quintiles reveals an increase in the magnitude of the reaction as we shift from large to small stocks. Fourth, large growth stocks display the weakest monetary policy impact (-0.49%) and small value stocks the strongest (-0.84%), generating an annualized impact differential of 4.17%. This finding suggests that the historical premium of around 9% p.a. for small value stocks over large growth stocks may be driven by the significantly higher exposure of the former to monetary policy risk. Hence, value and size premia appear to be jointly related to monetary policy shifts, not only in isolation.

Finally, we turn our attention back to Table 2 to examine the results from past performance related portfolios. The general pattern that emerges is that the impact of monetary

policy shocks is stronger for a portfolio of stocks that have performed poorly in the past (losers), irrespectively of the time horizon used for their classification, i.e. distant past (5-years), recent past (1-year) and very recent past (1-month). Results from short-term reversal portfolios indicate that, following a contractionary monetary policy shock, returns are on average 0.81% lower per month for very recent past losers (decile 1) and 0.57% lower for very recent past winners (decile 10). This loser-winner differential impact on returns corresponds to an annualized figure of 2.84%. This is the highest differential across past performance related portfolios, with the corresponding figure for momentum and long-term reversal portfolios being equal to 1.43% and 1.67%, respectively. Furthermore, in every case examined, the impulse response of past losers to unexpected tightening is more pronounced when compared to response of the market index, indicating excess sensitivity of past losers to policy actions.

The previous results show that there is no overall correspondence between premia and impact differentials for past winners and losers. Therefore, a risk premium based explanation may not uniformly apply, especially for the case of momentum portfolios. In fact, Shleifer (2000) argues that risk premium explanations of the momentum anomaly are not prevalent, while Jegadeesh and Titman (1993, 2005) and Fama and French (1996) cannot explain momentum either using multi-factor models. This may be true since these portfolios are based solely on the companies' past stock market performance, with no reference to their corporate characteristics. Consequently, the evidence for a cross-sectional differential in the response to monetary policy shocks, with past losers being more heavily penalized than past winners, regardless of the employed horizon of past returns, supports the excess sensitivity conjecture of Bernanke and Kuttner (2005). Nevertheless, we should mention that the risk premium explanation may still be valid for the long-term and short-term reversal anomalies, since the premia that losers offer are

accompanied by a greater sensitivity to monetary policy shocks.[9]

4.2   Multiperiod impulse responses

In order to examine the stock portfolios' response to a monetary policy shock over time, in Figures 1 to 3 we correspondingly plot the generalized impulse responses of value (book-to-market), size and past performance (past year) related portfolios to a one-standard deviation shock to the change in the Federal funds rate over an 8-month period. Likewise, Figure 4 shows multiperiod impulse responses using double-sorted size and book-to-market portfolios.   Two interesting features are apparent.[10] First, the point estimate of the impulse response does not immediately die out following the initial period. Indeed, it takes a number of months, typically five months, for the point estimate of the impulse response function to collapse to zero. This implies that monetary policy shocks are not immediately fully absorbed, indicating the possibility that stock market investors may underreact over time to monetary policy news. Nevertheless, as the second common feature of the graphs indicates, beyond the first month we cannot make strong statistical inferences. With the exception of the third month impulse response point estimate in certain cases, taking the 95% confidence interval into account typically suggests that the impulse responses are not significantly different from zero. Thus, the multiperiod impulse response analysis points out that the negative impact of unexpected changes in the federal funds rate upon the stock market is relatively short-lived but not strictly instantaneous as a perfectly efficient market would imply. However, one should be cautious in extracting strong conclusions since

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[9] Indeed, as Fama and French (1996) point out, the reversal of long-term returns documented by De Bondt and Thaler (1985) can be explained within their three factor model given that stocks with low long-term past returns tend to be smaller and relatively distressed.

[10] Similar features are displayed by the remaining value and past performance related portfolios. Results are available upon request.

these findings lie only at the border of statistical significance.

[FIGURES 1-4 HERE]

5. Further results

5.1 Full sample, robustness analysis

Table 4 reports the full sample VAR estimation results using real portfolio returns. The estimated impulse responses and standard errors are almost identical to those reported in Table 2 using nominal returns. Thus, the patterns that we identified in nominal returns are also present in real returns and our results are robust to adjusting for the effect of inflation.[11] This finding can be explained on the basis of the stylized fact that the volatility of nominal stock returns is much greater as compared to inflation volatility and consequently the volatility of real returns is dominated by the volatility of nominal returns. For example, in the case of market portfolio's returns, the ratio of the standard deviations of nominal returns to real returns is equal to 0.99 over the full sample period.

[TABLE 4 HERE]

Table 5 shows the full sample VAR estimation results using the Cholesky decomposition to calculate impulse responses. This identification scheme follows the ordering of variables in the y_t vector and is therefore similar to Thorbecke (1997). The estimated impulse responses and standard errors are very similar to those reported in Table 2 implying that the results are robust to the choice of methodology that underlies the impulse response function's calculation.

[TABLE 5 HERE]

Finally, Table 6 shows the findings from a sensitivity check regarding the criterion used to specify the VAR's lag length. The reported full sample VAR estimation results are based upon the

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[11] Similar findings were obtained when we used returns in excess of the T-bill rate. Results are available upon request.

sequential LR test of Lutkepohl (1991) as means of lag length selection. The LR criterion selects a greater number of lags as compared to the AIC. Particularly, across all portfolios, either 10 or 12 lags are selected resulting into richer dynamics for the VAR. Comparison with the evidence provided in Table 2 indicates that the estimated impulse responses generally decline when additional lags are introduced in the VAR, while the standard errors are not affected. The decline in magnitude of the impulse responses is rather mild, so 14 out of 16 total responses remain significantly different from zero.

[TABLE 6 HERE]

Results from the sensitivity analysis with respect to alternative measures of returns, definition of impulse response functions and lag length selection criterion indicate that the full sample results are quite robust. Overall, implied impulse response differentials suggest that small, value, and loser stocks are more exposed to monetary policy shifts.

5.2 Alternative VAR specifications

In order to examine whether innovations in the federal funds rate reflect risks that are already embedded in existing factors, we alternatively augment the baseline VAR with the factors proposed earlier by Fama and French (1993) and Carhart (1997), and more recently by Chen, Novy-Marx and Zhang (2010). Inclusion of these factors in the VAR system ensures that, by construction, the resulting monetary policy shocks will be orthogonal to them. Hence, finding that innovations in the federal funds rate continue to exert a negative and statistically significant impact upon the returns of different portfolios would imply that the impact of monetary policy shocks is not subsumed by the risk factors that have been used in the literature.

We consider four alternative cases to the baseline VAR. Case I refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, r_{jt}]'$ where $xmark_t$ stands for the excess market

returns, as implied by the CAPM. Case II adds the Size (smb_t) and Value (hml_t) factors of Fama

and French (1993): $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, smb_t, hml_t, r_{jt}]'$. Case III further

augments the baseline VAR specification using Carhart's (1997) Momentum (mom_t) factor:

$\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, smb_t, hml_t, mom_t, r_{jt}]'$. Finally, Case IV refers to the

structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, roa_t, inv_t, r_{jt}]'$ where roa_t and inv_t stand for

the Return-on-Assets and Investment factors of Chen et al. (2010).[12]

Table 7 reports the full sample VAR estimation results under Cases I-IV for the value, size

and past performance related portfolios.[13] In line with the baseline VAR results in Table 2, the

initial period generalized impulse response point estimates in all four alternative cases are negative

and significantly different from zero for all portfolios. The estimated impulse responses and

standard errors are very similar to those of the baseline model. For example, using the book-to-

market ratio, we find that following a contractionary shock, value portfolio returns decline by

between 0.82% (Case III) and 0.86% (Case I) per month, with the corresponding figure in the

benchmark VAR being 0.86%. Overall, the corresponding impulse response differentials suggest

that the finding that small, value, and loser stocks are more affected by monetary policy shocks is

robust to model specification. Hence, our results indicate that the impact of monetary policy

shocks is not subsumed by the traditional and recently proposed risk factors.

[TABLE 7 HERE]

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[12] Chen et al. (2010) three-factor model is motivated by q-theory (see e.g. Tobin, 1969). According to this model, the

expected return on a portfolio of stocks in excess of the risk-free rate is described by the sensitivity of its return to

three factors: the excess market returns, the difference between the return on a portfolio of stocks with high Returns-

on-Assets (ROA) and the return on a portfolio of stocks with low ROA, and the difference between the return on a

portfolio of low-investment stocks and the return on a portfolio of high-investment stocks.

[13] It should be noted that Case IV results are not fully comparable with the rest of the findings, since the database

made available on Lu Zhang's website starts from January 1972.

Table 8 shows the full sample estimation results for double-sorted size and book-to-market portfolios using the augmented VAR models I-IV. Comparing these results with those in Table 3 for the baseline VAR, it is apparent that the estimated impulse responses and standard errors remain largely unchanged when the additional factors enter the VAR. For example, in Case I, we find that following an unexpected monetary policy tightening, small value stocks display the strongest decline, 0.87% per month, as compared to the benchmark VAR finding of 0.84%. Hence, the baseline findings of statistical significance of the negative impulse point estimates, and existence of size and value gradient appear robust to controlling for the effects of the commonly used risk factors.

[TABLE 8 HERE]

5.3   Subperiod analysis

The appointment of Paul Volcker as chairman of the Fed in the summer of 1979 and the adoption of a strict anti-inflationary stance represented a major shift in US monetary policy. As Alan Greenspan (2007, p.84) characteristically notes, "From the moment he was sworn in, Volcker knew that his job was…to 'slay the inflationary dragon'".[14] Nevertheless, as Goodfriend and King (2005) point out, the adjustment of inflation expectations towards a lower level was not rapid. Mojon (2008) also argues that the first years of the Federal Reserve under Volcker correspond to an ''incredible disinflation''. In line with these arguments, Clarida et al. (2000) suggest removing the first three years of the Volcker era from the entire Volcker-Greenspan sample since this period exhibits some idiosyncratic features.[15] More specifically, it is

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[14] Indeed, Clarida et al. (2000) estimate a forward looking monetary policy reaction function and show that US interest rate policy in the Volcker-Greenspan period seems more sensitive to changes in expected inflation than in the pre-Volcker period.

[15] The post-1983 period is dominated by Greenspan's tenure (1987.08-2006.01) but it also includes the first twenty three months of Bernanke's tenure (2006.02-2007.12) as Fed chairman.

characterized by non-borrowed reserves targeting and a large one-off disinflationary episode. The Federal funds rate was high and quite volatile between 1979 and 1982. A large portion of this increased interest rate volatility can be attributed to the imposition and then removal of credit controls during the early 1980s (Walsh, 2003).

By 1983 Volcker's disinflation mission was largely accomplished with inflation reduced to 3% p.a. from around 12% p.a. in 1980. This allowed interest rates to decline and eventually ushered a new era of low overall macroeconomic volatility, the so-called "great moderation" period. Lettau, Ludvigson and Wachter (2007) find that the reduction in macroeconomic risk explains, to an extent, the declining equity premium and persistently high stock market valuations that were observed towards the end of last century. Thus, there is strong motivation from both a monetary policy and an asset pricing viewpoint to examine the structural stability of our findings with respect to a sample split related to the completion of Volcker's disinflation mission and the beginning of a new regime characterized by lower macroeconomic risk. Moreover, a structural break at the start of 1983 is strongly supported by our findings from applying Candelon and Lutkepohl's (2001) break-point Chow-type test for parameter stability of the estimated VAR models.[16]

[TABLE 9 HERE]

Table 9 reports the VAR estimation results and the average returns for the value, size and past performance related portfolios during the subsample periods 1967.01-1982.12 and 1983.01-2007.12. Evidence from value portfolios indicates that all impulse responses are significantly different from zero during the pre-Volcker period and the first three years of Volcker's era. The

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[16] See Candelon and Lutkepohl (2001) for more details on the calculation of the test. Using 1982.12 as the potential break date, the test is significant at the 1% level. We also examined the possibility of a break related to Volcker's appointment at 1979.08. In this case, the break-point test statistic is reduced by around 50% and is significant at the 5% or 10% level only. Results are available upon request.

magnitude of these responses indicates that value stocks are more affected by a monetary policy shock than growth stocks. The implied impact differentials are larger as compared to the full sample results reported in Table 2. For example, using book-to-market ratio portfolios, we find that a contractionary shock depresses value stocks returns by 1.39% per month and growth stocks returns by 0.78%, generating a monthly impact differential of 0.61%, which exceeds the corresponding full sample figure of 0.35%. On the other hand, during the 1983.01-2007.12 subperiod, the majority of the impulse responses of value-sorted portfolios are not statistically significant. This suggests that the full sample results are largely driven by developments that took place prior to the "great moderation".

Since the early 1980s, value stocks are less exposed or not exposed at all to monetary policy risk, depending on the value proxy, offering at the same time a smaller premium over growth stocks. Referring still to book-to-market value ratio portfolios, the value-growth premium falls from around 9% p.a. to 5% p.a. as we move from the first subsample to the second. Hence, the impact of monetary policy shocks on value portfolios and the value premium itself both decrease in the second subsample period.

Similar patterns are observed in size-sorted portfolios. The difference in average returns between small and large stocks stands quite high, at around 10% p.a., during the first subperiod but disappears in the second subperiod. Moreover, the impulse responses to monetary policy shocks become similar in magnitude and statistically insignificant for both small and large stocks. These findings suggest that the premium that small stocks were offering during the 1970s was related to exposure to monetary policy risk.

The time-variation of the monetary policy impact on value and size portfolios supports the conjecture of Bernanke and Gertler (1995) that some channels of the monetary policy transmission may become less active in some periods. Bernake and Gertler (1995) argue that the bank lending channel has been weakened due to financial deregulation in the 1980s, including the

removal of "Regulation Q" which placed limits on the deposit rates that banks could offer and was therefore hampering the ability of banks to compete for funds. Moreover, since the 1980s banks have gained greater access to funds by issuing certificates of deposits, while the market for bank liabilities has also expanded. From the borrowers' viewpoint, the deepening of the market for commercial paper during the 1980s and the 1990s enhanced the availability of non-bank sources of finance. Finally, we should also point out that the establishment and subsequent popularity of the futures market on Federal funds rate in 1989 has improved the ability of companies to hedge interest rate risk. The aforementioned developments have enhanced the ability of small and value firms to endure tight money periods, putting a downward pressure on the related risk premia.

Subsample analysis for portfolios sorted on the basis of stocks' past performance reveals that the estimated impulse responses are generally statistically significant during 1967-1982 with loser stocks being more affected by monetary policy shocks, as compared to winners. The implied monetary policy impact differentials exceed those observed in the full sample. During 1983-2007, however, all impulse responses turn out to be statistically insignificant. This result implies that the excess sensitivity mechanism, according to which investors penalize past losers more severely than past winners when unexpected monetary tightening occurs, is not stable over time. Therefore, this potential transmission mechanism may have become inactive too.

6.   Conclusions

This study has investigated whether stocks with different characteristics are affected in a differential manner by unexpected monetary policy actions. We have utilized a VAR framework to study how monetary policy shocks, as measured by innovations to the change in Federal funds' rate, affect returns of portfolios formed according to value, size, and past performance, using US data from the United States over the period 1967-2007. Our full sample results show significant

differences in the initial period impact of policy shocks across the sample portfolios, with value, small and loser stocks being more exposed to monetary policy risk. Interestingly, albeit on the border of statistical significance, the point estimates of the portfolios returns' impulse responses do not immediately die out following the initial period as a perfectly efficient market setup would imply.

Furthermore, we have examined the structural stability of these relationships and found that a significant break occurred in early 1980s, associated with the accomplishment of Volcker's disinflation mission and the beginning of the "great moderation" period, characterized by lower inflation, interest rates and overall macroeconomic volatility. The subsample analysis indicates that monetary policy impact differentials and premia for value and small stocks appear to covary through time, being quite high during the 1970s and declining substantially, from the early 1980s onwards. The change in the response of small and value stocks to monetary policy shocks that we documented during the post-1983 period suggests that the bank lending and balance sheet mechanisms that underlie the credit channel of the monetary transmission process are not necessarily always active. We finally document that the response of past performance sorted portfolios displays remarkable instability over time, with losers' portfolios being more sensitive to monetary policy shocks relative to winners' portfolios, only prior to the "great moderation" period.

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Table 1
Descriptive statistics for macroeconomic variables

	ipn	*inf*	*gcom*	*dfed*	*strongin*
Mean	0.2094	0.3782	0.2257	-0.0002	-0.00004
Median	0.2427	0.3116	0.2325	0.0008	0.0085
Maximum	2.2611	1.7761	15.1420	0.2550	0.0589
Minimum	-3.6218	-0.5352	-11.0082	-0.5525	-0.4300
Standard Deviation	0.6979	0.3075	3.0679	0.0506	0.0439

Notes: This Table shows the descriptive statistics for the macroeconomic variables that we employ in the VAR model. $ipn_t = 100*\Delta\log(ind_t)$ is the growth rate of industrial production (*ind*); $inf_t = 100*\Delta\log(cpi_t)$ is the growth rate of consumer prices index (*cpi*) that is, the inflation rate; $gcom_t = 100*\Delta\log(com_t)$ is the growth rate of a commodity price index (*com*); $dfed_t = \Delta(fed_t)$ is the change in the Federal funds rate (*fed*), which itself is expressed in monthly percentage terms; $strongin_t$ is the portion of non-borrowed reserves which is orthogonal to total reserves. The frequency of the variables in our dataset is monthly, while the sample period extends from January 1967 to December 2007. The source for the macroeconomic variables is IMF-International Financial Statistics.

Table 2
Generalized impulse responses of value, size and past performance sorted portfolios'
returns to one-standard deviation shock to the change in the Federal funds rate

Sorting criterion for portfolios	Low Decile Portfolio		High Decile Portfolio	
	Impulse Response	Average Returns (p.a.)	Impulse Response	Average Returns (p.a.)
Book-to-market value ratio	-0.51 ** (0.24)	10.01%	-0.86 ** (0.24)	16.73%
Cash flow-to-price ratio	-0.46 * (0.25)	10.18%	-0.73 ** (0.23)	16.09%
Earnings-to-price ratio	-0.48 * (0.26)	10.16%	-0.86 ** (0.23)	16.73%
Dividend-to-price ratio	-0.51 ** (0.25)	11.39%	-0.77 ** (0.17)	13.09%
Market capitalization (size)	-0.66 ** (0.28)	14.85%	-0.56 ** (0.19)	10.87%
Returns during months t-60 to t-13	-0.80 ** (0.29)	16.26%	-0.66 ** (0.27)	11.17%
Returns during months t-12 to t-2	-0.71 ** (0.34)	1.48%	-0.59 ** (0.28)	19.50%
Returns at month t-1	-0.81 ** (0.32)	12.91%	-0.57 ** (0.25)	8.52%

Notes: This Table shows the generalized impulse responses of low and high decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate. The sorting criteria for stock portfolios at time t are value proxies (book-to-market value ratio, cash flow-to-price ratio, earnings-to-price ratio and dividend-to-price ratio), market capitalization (size) and past performance at three horizons, i.e. returns from month t-60 to month t-13, returns from month t-12 to month t-2 and returns at month t-1. The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998). The endogenous variables vector is $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$ where $ipn_t = 100*\Delta\log(ind_t)$ is the growth rate of industrial production (ind); $inf_t = 100*\Delta\log(cpi_t)$ is the growth rate of consumer prices index (cpi) that is, the inflation rate; $gcom_t = 100*\Delta\log(com_t)$ is the growth rate of a commodity price index (com); $dfed_t = \Delta(fed_t)$ is the change in the federal funds rate (fed); $strongin_t$ is the portion of non-borrowed reserves which is orthogonal to total reserves; r_{jt} is the return on stock portfolio j. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007. The source for the macroeconomic variables is IMF-International Financial Statistics while the source for stock portfolios' returns is Kenneth French's online data library. This table also shows the average annualized nominal returns of the corresponding portfolios. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Table 3
Generalized impulse responses of double-sorted, size and value Fama-French portfolios' returns to one-standard deviation shock to the change in the Federal funds rate

	Smallest market value (size) quintile		Highest market value (size) quintile	
	Impulse Response	Average Returns (p.a.)	Impulse Response	Average Returns (p.a.)
Lowest book-to-market value ratio quintile	-0.65 * (0.36)	8.12%	-0.49 ** (0.22)	10.72%
Highest book-to-market value ratio quintile	-0.84 ** (0.25)	19.44%	-0.72 ** (0.21)	13.43%

Notes: This Table shows the generalized impulse responses of the extreme (i.e. combinations of lowest and highest) quintiles of double-sorted, size and value Fama-French stock portfolios' nominal returns to one-standard deviation shock to the change in the Federal funds rate. The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998). The endogenous variables vector is $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$ where $ipn_t = 100*\Delta\log(ind_t)$ is the growth rate of industrial production (ind); $inf_t = 100*\Delta\log(cpi_t)$ is the growth rate of consumer prices index (cpi) that is, the inflation rate; $gcom_t = 100*\Delta\log(com_t)$ is the growth rate of a commodity price index (com); $dfed_t = \Delta(fed_t)$ is the change in the federal funds rate (fed); $strongin_t$ is the portion of non-borrowed reserves which is orthogonal to total reserves; r_{jt} is the return on stock portfolio j. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007. The source for the macroeconomic variables is IMF-International Financial Statistics while the source for the double-sorted, size and value stock portfolios' returns is Kenneth French's online data library. This table also shows the average annualized nominal returns of the corresponding portfolios. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Table 4

Generalized impulse responses to one-standard deviation shock to the change in the Federal funds rate using real returns

Sorting criterion for portfolios	Low Decile Portfolio		High Decile Portfolio	
	Impulse Response	Average Returns (p.a.)	Impulse Response	Average Returns (p.a.)
Book-to-market value ratio	-0.52 ** (0.24)	5.52%	-0.87 ** (0.24)	12.23%
Cash flow-to-price ratio	-0.47 * (0.26)	5.69%	-0.74 ** (0.23)	11.59%
Earnings-to-price ratio	-0.49 * (0.26)	5.68%	-0.88 ** (0.23)	12.22%
Dividend-to-price ratio	-0.52 ** (0.26)	6.86%	-0.78 ** (0.18)	8.56%
Market capitalization (size)	-0.67 ** (0.28)	10.30%	-0.57 ** (0.19)	6.36%
Returns during months t-60 to t-13	-0.81 ** (0.29)	11.73%	-0.67 ** (0.27)	6.65%
Returns during months t-12 to t-2	-0.72 ** (0.34)	-3.12%	-0.60 ** (0.28)	14.97%
Returns at month t-1	-0.82 ** (0.32)	8.37%	-0.58 ** (0.25)	3.98%

Notes: This Table shows the generalized impulse responses of low and high decile stock portfolios' real value-weighted returns to one-standard deviation shock to the change in the Federal funds rate. The sorting criteria for stock portfolios at time t are value proxies (book-to-market value ratio, cash flow-to-price ratio, earnings-to-price ratio and dividend-to-price ratio), market capitalization (size) and past performance at three horizons, i.e. returns from month t-60 to month t-13, returns from month t-12 to month t-2 and returns at month t-1. The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998). The endogenous variables vector is $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$ where $ipn_t = 100*\Delta\log(ind_t)$ is the growth rate of industrial production (ind); $inf_t = 100*\Delta\log(cpi_t)$ is the growth rate of consumer prices index (cpi) that is, the inflation rate; $gcom_t = 100*\Delta\log(com_t)$ is the growth rate of a commodity price index (com); $dfed_t = \Delta(fed_t)$ is the change in the federal funds rate (fed); $strongin_t$ is the portion of non-borrowed reserves which is orthogonal to total reserves; r_{jt} is the return on stock portfolio j. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007. The source for the macroeconomic variables is IMF-International Financial Statistics while the source for stock portfolios' returns is Kenneth French's online data library. Real returns are calculated deducting the inflation rate implied by CPI from nominal returns. This Table also shows the average annualized real returns of the corresponding portfolios. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Table 5

Impulse responses of value, size and past performance sorted portfolios' returns to one-standard deviation shock to the change in the Federal funds rate using Cholesky decomposition

Sorting criterion for portfolios	Low Decile Portfolio		High Decile Portfolio	
	Impulse Response	Average Returns (p.a.)	Impulse Response	Average Returns (p.a.)
Book-to-market value ratio	-0.45 * (0.23)	10.01%	-0.87 ** (0.23)	16.73%
Cash flow-to-price ratio	-0.39 (0.25)	10.18%	-0.74 ** (0.22)	16.09%
Earnings-to-price ratio	-0.43 * (0.26)	10.16%	-0.86 ** (0.23)	16.73%
Dividend-to-price ratio	-0.44 * (0.25)	11.39%	-0.77 ** (0.18)	13.09%
Market capitalization (size)	-0.64 ** (0.28)	14.85%	-0.53 ** (0.19)	10.87%
Returns during months t-60 to t-13	-0.73 ** (0.29)	16.26%	-0.57 ** (0.27)	11.17%
Returns during months t-12 to t-2	-0.70 ** (0.33)	1.48%	-0.51 * (0.28)	19.50%
Returns at month t-1	-0.79 ** (0.31)	12.91%	-0.56 ** (0.25)	8.52%

Notes: This Table shows the impulse responses of low and high decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate. The sorting criteria for stock portfolios at time t are value proxies (book-to-market value ratio, cash flow-to-price ratio, earnings-to-price ratio and dividend-to-price ratio), market capitalization (size) and past performance at three horizons, i.e. returns from month t-60 to month t-13, returns from month t-12 to month t-2 and returns at month t-1. Impulse responses have been calculated by means of Cholesky decomposition. The endogenous variables vector is $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$ where $ipn_t = 100*\Delta\log(ind_t)$ is the growth rate of industrial production (ind); $inf_t = 100*\Delta\log(cpi_t)$ is the growth rate of consumer prices index (cpi) that is, the inflation rate; $gcom_t = 100*\Delta\log(com_t)$ is the growth rate of a commodity price index (com); $dfed_t = \Delta(fed_t)$ is the change in the federal funds rate (fed); $strongin_t$ is the portion of non-borrowed reserves which is orthogonal to total reserves; r_{jt} is the return on stock portfolio j. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007. The source for the macroeconomic variables is IMF-International Financial Statistics while the source for stock portfolios' returns is Kenneth French's online data library. This Table also shows the average annualized returns of the corresponding portfolios. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Table 6
Generalized impulse responses to one-standard deviation shock to the change in the Federal funds rate using the sequential Likelihood Ratio test to determine the VAR order

Sorting criterion for portfolios	Low Decile Portfolio		High Decile Portfolio	
	Impulse Response	Average Returns (p.a.)	Impulse Response	Average Returns (p.a.)
Book-to-market value ratio	-0.41 * (0.24)	10.01%	-0.77 ** (0.24)	16.73%
Cash flow-to-price ratio	-0.43 * (0.26)	10.18%	-0.66 ** (0.23)	16.09%
Earnings-to-price ratio	-0.45 * (0.26)	10.16%	-0.70 ** (0.23)	16.73%
Dividend-to-price ratio	-0.37 (0.26)	11.39%	-0.67 ** (0.18)	13.09%
Market capitalization (size)	-0.58 ** (0.28)	14.85%	-0.51 ** (0.20)	10.87%
Returns during months t-60 to t-13	-0.54 * (0.29)	16.26%	-0.60 ** (0.28)	11.17%
Returns during months t-12 to t-2	-0.69 ** (0.34)	1.48%	-0.36 (0.29)	19.50%
Returns at month t-1	-0.89 ** (0.32)	12.91%	-0.46 * (0.25)	8.52%

Notes: This Table shows the impulse responses of low and high decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate. The sorting criteria for stock portfolios at time t are value proxies (book-to-market value ratio, cash flow-to-price ratio, earnings-to-price ratio and dividend-to-price ratio), market capitalization (size) and past performance at three horizons, i.e. returns from month t-60 to month t-13, returns from month t-12 to month t-2 and returns at month t-1. The endogenous variables vector is $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$ where $ipn_t = 100*\Delta\log(ind_t)$ is the growth rate of industrial production (ind); $inf_t = 100*\Delta\log(cpi_t)$ is the growth rate of consumer prices index (cpi) that is, the inflation rate; $gcom_t = 100*\Delta\log(com_t)$ is the growth rate of a commodity price index (com); $dfed_t = \Delta(fed_t)$ is the change in the federal funds rate (fed); $strongin_t$ is the portion of non-borrowed reserves which is orthogonal to total reserves; r_{jt} is the return on stock portfolio j. The lag order of the estimated Vector Autoregression was determined using the sequential Likelihood Ratio test of Lutkepohl (1991). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007. The source for the macroeconomic variables is IMF-International Financial Statistics while the source for stock portfolios' returns is Kenneth French's online data library. This Table also shows the average annualized nominal returns of the corresponding portfolios. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Table 7
**Generalized impulse responses of stock portfolios' returns to one-standard deviation shock
to the change in the Federal funds rate under alternative VAR specifications**

Sorting criterion for portfolios	Impulse Response of Low Decile Portfolio				Impulse Response of High Decile Portfolio			
	CASE I	CASE II	CASE III	CASE IV	CASE I	CASE II	CASE III	CASE IV
Book-to-market value ratio	-0.50 **	-0.47 **	-0.50 **	-0.48 *	-0.86 **	-0.83 **	-0.82 **	-0.82 **
	(0.23)	(0.23)	(0.23)	(0.25)	(0.24)	(0.24)	(0.24)	(0.25)
Cash flow-to-price ratio	-0.45 *	-0.44 *	-0.47 *	-0.44	-0.76 **	-0.68 **	-0.68 **	-0.74 **
	(0.25)	(0.25)	(0.25)	(0.27)	(0.22)	(0.22)	(0.22)	(0.24)
Earnings-to-price ratio	-0.48 *	-0.44 *	-0.48 *	-0.46 *	-0.87 **	-0.87 **	-0.88 **	-0.84 **
	(0.26)	(0.26)	(0.26)	(0.28)	(0.23)	(0.23)	(0.23)	(0.25)
Dividend-to-price ratio	-0.53 **	-0.48 *	-0.50 **	-0.48 *	-0.78 **	-0.79 **	-0.78 **	-0.70 **
	(0.25)	(0.25)	(0.25)	(0.27)	(0.18)	(0.18)	(0.18)	(0.19)
Market capitalization (size)	-0.71 **	-0.70 **	-0.72 **	-0.63 **	-0.51 **	-0.54 **	-0.57 **	-0.50 **
	(0.28)	(0.28)	(0.28)	(0.29)	(0.19)	(0.19)	(0.19)	(0.21)
Returns during months t-60 to t-13	-0.84 **	-0.80 **	-0.78 **	-0.77 **	-0.65 **	-0.65 **	-0.69 **	-0.65 **
	(0.29)	(0.29)	(0.29)	(0.31)	(0.27)	(0.27)	(0.27)	(0.29)
Returns during months t-12 to t-2	-0.73 **	-0.72 **	-0.75 **	-0.60 *	-0.60 **	-0.58**	-0.60 **	-0.63 **
	(0.34)	(0.34)	(0.34)	(0.36)	(0.28)	(0.28)	(0.28)	(0.30)
Returns at month t-1	-0.81 **	-0.83 **	-0.82 **	-0.73 **	-0.58 **	-0.56 **	-0.60 **	-0.55 **
	(0.32)	(0.31)	(0.32)	(0.34)	(0.25)	(0.25)	(0.25)	(0.27)

Notes: This Table shows the generalized impulse responses of low and high decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate. The sorting criteria for stock portfolios at time t are value proxies (book-to-market value ratio, cash flow-to-price ratio, earnings-to-price ratio and dividend-to-price ratio), market capitalization (size) and past performance at three horizons, i.e. returns from month t-60 to month t-13, returns from month t-12 to month t-2 and returns at month t-1. The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998) for 4 different augmented VAR specifications. Case I refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, r_{jt}]'$ where $xmark_t$ stands for the excess market returns. Case II refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, smb_t, hml_t, r_{jt}]'$ where smb_t and hml_t stand for the Fama-French Size and Value factors correspondingly. Case III refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, smb_t, hml_t, mom_t, r_{jt}]'$ where mom_t stands for the Momentum factor. Finally, Case IV refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, roa_t, inv_t, r_{jt}]'$ where roa_t and inv_t stand for the Return-on-Assets and Investment factors of Chen et al. (2010). The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The sample period extends from January 1967 to December 2007, with the exception of Case IV, where the sample period starts from January 1972. The source for the macroeconomic variables is IMF-International Financial Statistics, the source for stock portfolios' returns, excess market, Size, Value and Momentum factor returns is Kenneth French's online data library, while the Return-on-Assets and Investment factor returns are from Lu Zhang's online data library. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Table 8
Generalized impulse responses of double-sorted, size and value Fama-French portfolios' returns to one-standard deviation shock to the change in the Federal funds rate under alternative VAR specifications

	Smallest market value (size) quintile				Highest market value (size) quintile			
	CASE I	CASE II	CASE III	CASE IV	CASE I	CASE II	CASE III	CASE IV
Lowest book-to-market value ratio quintile	-0.67 *	-0.69 *	-0.69 *	-0.58	-0.44 **	-0.45 **	-0.48 **	-0.43 *
	(0.37)	(0.36)	(0.36)	(0.39)	(0.22)	(0.21)	(0.22)	(0.23)
Highest book-to-market value ratio quintile	-0.87 **	-0.88 **	-0.87 **	-0.82 **	-0.74 **	-0.73 **	-0.73 **	-0.71 **
	(0.25)	(0.25)	(0.26)	(0.27)	(0.21)	(0.21)	(0.21)	(0.23)

Notes: This Table shows the generalized impulse responses of the extreme (i.e. combinations of lowest and highest) quintiles of double-sorted, size and value Fama-French stock portfolios' nominal returns to one-standard deviation shock to the change in the Federal funds rate. The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998) for 4 different augmented VAR specifications. Case I refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, r_{jt}]'$ where $xmark_t$ stands for the excess market returns. Case II refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, smb_t, hml_t, r_{jt}]'$ where smb_t and hml_t stand for the Fama-French Size and Value factors correspondingly. Case III refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, smb_t, hml_t, mom_t, r_{jt}]'$ where mom_t stands for the Momentum factor. Finally, Case IV refers to the structure $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, xmark_t, roa_t, inv_t, r_{jt}]'$ where roa_t and inv_t stand for the Return-on-Assets and Investment factors of Chen et al. (2010). The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The sample period extends from January 1967 to December 2007, with the exception of Case IV, where the sample period starts from January 1972. The source for the macroeconomic variables is IMF-International Financial Statistics, the source for stock portfolios' returns, excess market, Size, Value and Momentum factor returns is Kenneth French's online data library, while the Return-on-Assets and Investment factor returns are from Lu Zhang's online data library. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Table 9
Subperiod generalized impulse responses of value, size and past performance sorted portfolios' returns to one-standard deviation shock to the change in the Federal funds rate

Panel A: 1967.01-1982.12

| Sorting criterion for portfolios	Low Decile Portfolio		High Decile Portfolio	
	Impulse Response	Average Returns (p.a.)	Impulse Response	Average Returns (p.a.)
Book-to-market value ratio	-0.78 * (0.40)	7.32%	-1.39 ** (0.44)	16.40%
Cash flow-to-price ratio	-0.79 * (0.42)	7.40%	-1.16 ** (0.40)	14.31%
Earnings-to-price ratio	-0.84 ** (0.42)	7.11%	-1.34 ** (0.40)	15.02%
Dividend-to-price ratio	-0.88 * (0.45)	9.49%	-1.29 ** (0.30)	10.32%
Market capitalization (size)	-1.01 ** (0.50)	17.52%	-0.84 ** (0.31)	7.79%
Returns during months t-60 to t-13	-1.40 ** (0.48)	16.42%	-1.05 ** (0.47)	5.69%
Returns during months t-12 to t-2	-1.22 ** (0.53)	-0.78%	-0.73 (0.47)	20.55%
Returns at month t-1	-1.34 ** (0.51)	15.37%	-0.81 ** (0.41)	7.44%

Panel B: 1983.01-2007.12

| Sorting criterion for portfolios	Low Decile Portfolio		High Decile Portfolio	
	Impulse Response	Average Returns (p.a.)	Impulse Response	Average Returns (p.a.)
Book-to-market value ratio	-0.26 (0.29)	11.81%	-0.36 (0.26)	17.00%
Cash flow-to-price ratio	-0.29 (0.32)	12.04%	-0.32 (0.25)	17.29%
Earnings-to-price ratio	-0.27 (0.33)	12.20%	-0.54 * (0.28)	17.87%
Dividend-to-price ratio	-0.28 (0.31)	12.62%	-0.44 ** (0.22)	14.88%
Market capitalization (size)	-0.26 (0.32)	13.13%	-0.28 (0.24)	12.89%
Returns during months t-60 to t-13	-0.11 (0.35)	16.18%	-0.40 (0.33)	14.71%
Returns during months t-12 to t-2	-0.38 (0.43)	2.83%	-0.47 (0.35)	18.84%
Returns at month t-1	-0.32 (0.40)	12.00%	-0.27 (0.31)	9.20%

Notes: This Table shows the generalized impulse responses of low and high decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate. Data details and sources, model specification and estimation procedure are the same as the ones outlined in Table 2. The only difference is that the sample period is split in two subsamples. Panel A refers to the first subperiod of the sample that extends from January 1967 to December 1982, while Panel B refers to the second subperiod that covers the period January 1983 to December 2007. Analytic (asymptotic) standard errors for the impulse responses are shown in parentheses. (*) stands for statistical significance at 10% level, while (**) stands for statistical significance at 5% level.

Figure 1

Generalized impulse responses of low and high book-to-market value decile portfolios'
returns to one-standard deviation shock to the change in the Federal funds rate

**Panel A: Low book-to-market value decile portfolio**
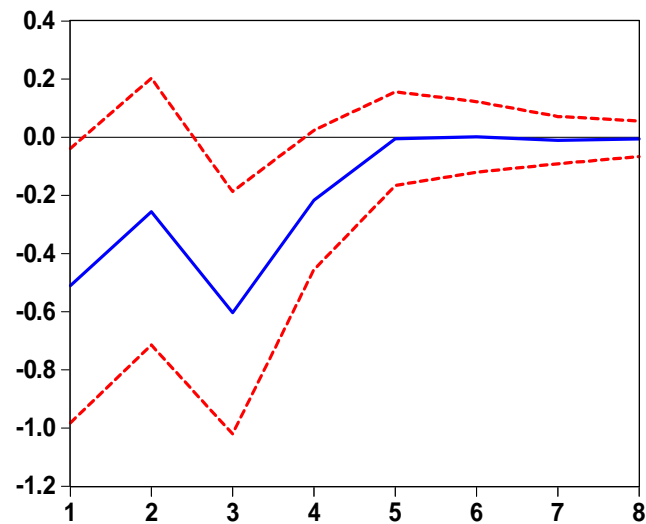
**Panel B: High book-to-market value decile portfolio**
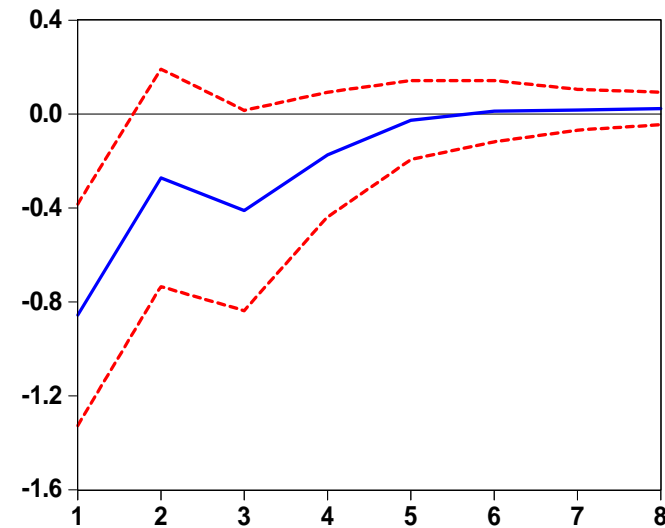
Notes: This Figure shows the generalized impulse responses (solid curves) of low (Panel A) and high (Panel B) book-to-market value decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate for an 8-month period. 95% confidence intervals, calculated from analytic (asymptotic) standard errors are also drawn (dashed curves). The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998). The endogenous variables vector is given by: $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$. The definition of the variables and the source of the data are as in Table 2. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007.

Figure 2
Generalized impulse responses of small and big capitalization decile portfolios'
returns to one-standard deviation shock to the change in the Federal funds rate

Panel A: Small size decile portfolio

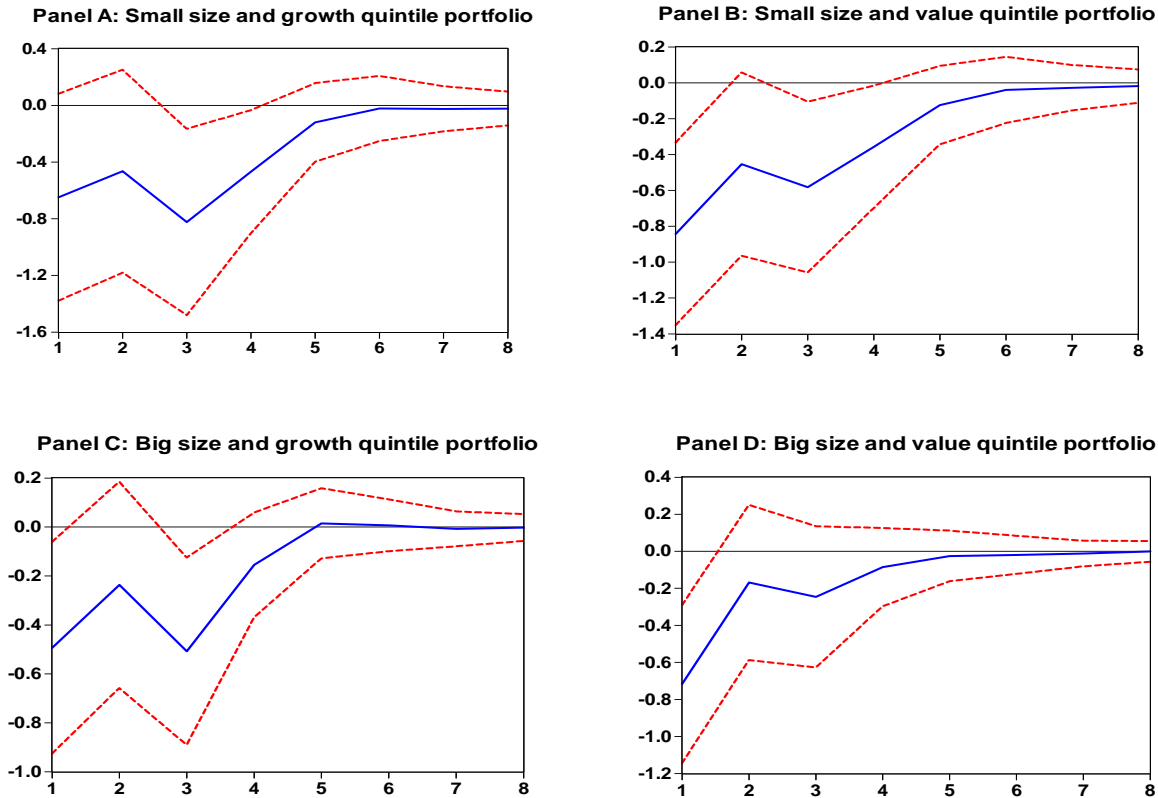**Panel B: Big size decile portfolio**
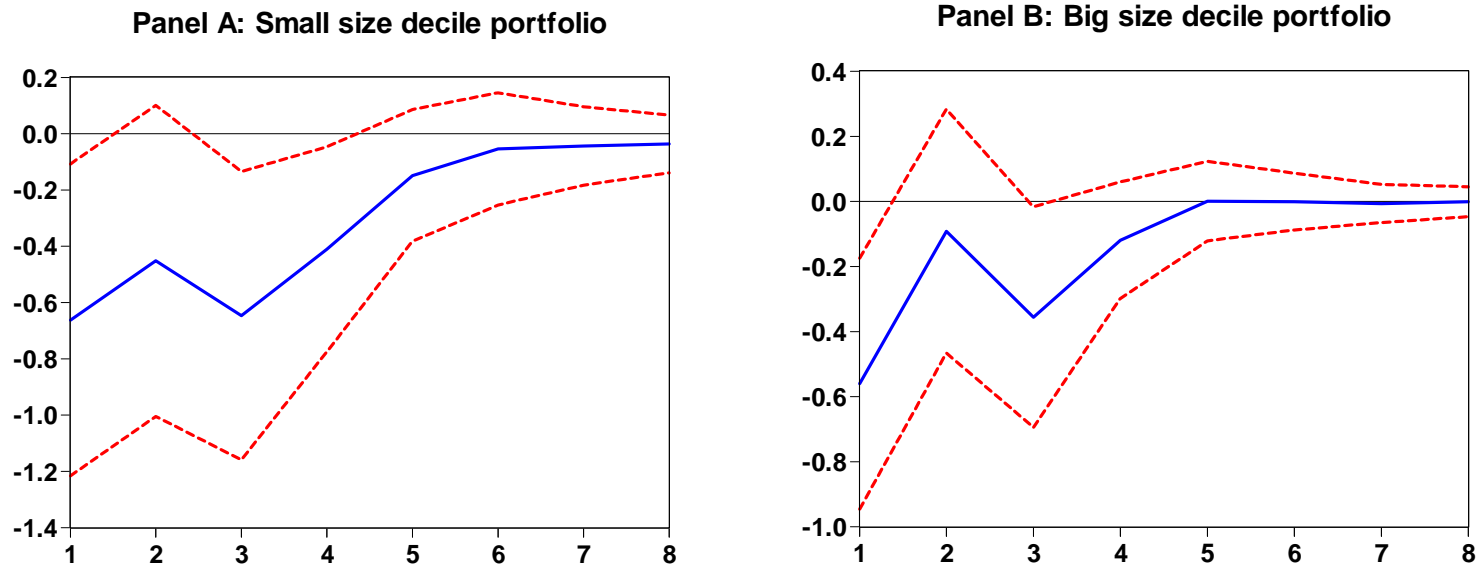
Notes: This Figure shows the generalized impulse responses (solid curves) of small (Panel A) and big (Panel B) capitalization decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate for an 8-month period. 95% confidence intervals, calculated from analytic (asymptotic) standard errors are also drawn (dashed curves). The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998). The endogenous variables vector is given by: $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$. The definition of the variables and the source of the data are as in Table 2. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jaury 1967 to December 2007.

Figure 3
Generalized impulse responses of past year losers and winners decile portfolios'
returns to one-standard deviation shock to the change in the Federal funds rate

Panel A: Bottom losers' decile portfolio   **Panel B: Top winners' portfolio decile**
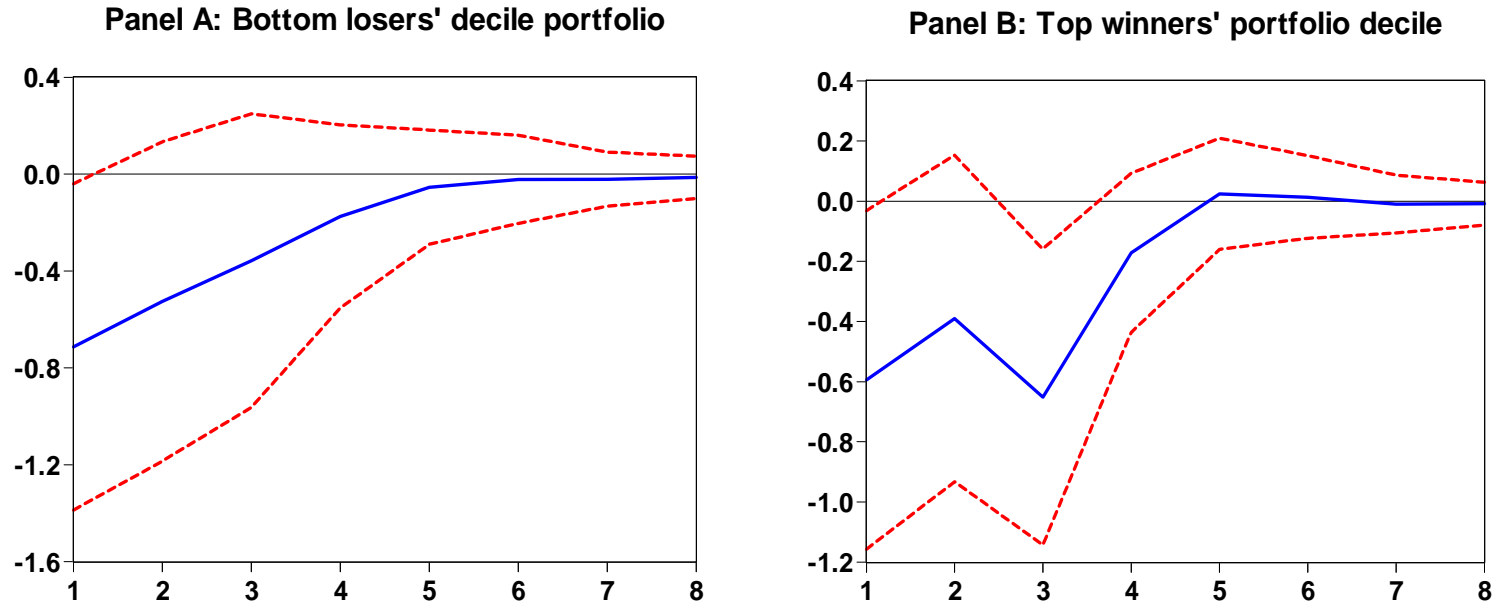
Notes: This Figure shows the generalized impulse responses (solid curves) of past year losers (Panel A) and winners (Panel B) decile stock portfolios' nominal value-weighted returns to one-standard deviation shock to the change in the Federal funds rate for an 8-month period. 95% confidence intervals, calculated from analytic (asymptotic) standard errors are also drawn (dashed curves). The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998). The endogenous variables vector is given by: $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$. The definition of the variables and the source of the data are as in Table 2. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007.

Figure 4

**Generalized impulse responses of extreme quintiles of double-sorted Fama-French portfolios'
returns to one-standard deviation shock to the change in the Federal funds rate**

Panel A: Small size and growth quintile portfolio

Panel B: Small size and value quintile portfolio

Panel C: Big size and growth quintile portfolio

Panel D: Big size and value quintile portfolio

Notes: This Figure shows the generalized impulse responses (solid curves) of the extreme quintiles of double-sorted Fama-French stock portfolios' nominal returns to one-standard deviation shock to the change in the Federal funds rate for an 8-month period. Panel A refers to the combination of smallest size and lowest book-to-market value quintile portfolio, Panel B refers to the combination of the smallest size and highest book-to-market value quintile portfolio, Panel C refers to the combination of the biggest size and lowest book-to-market value quintile portfolio, while Panel D refers to the biggest size and highest book-to-market value quintile portfolio. 95% confidence intervals, calculated from analytic (asymptotic) standard errors are also drawn (dashed curves). The generalized impulse responses are calculated following the methodology of Pesaran and Shin (1998). The endogenous variables vector is: $\mathbf{y}_t = [ipn_t, inf_t, gcom_t, dfed_t, strongin_t, r_{jt}]'$. The definition of the variables and the source of the data are as in Table 2. The lag order of the estimated Vector Autoregression is determined using the Akaike Information Criterion (AIC). The frequency of the variables in our dataset is monthly, while the sample period extends from Jauary 1967 to December 2007.