Monetary Policy, External Finance Dependence, and the Cross-section of Stock Returns: A FAVAR Approach*

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Abstract

We use an identified factor-augmented vector autoregression (FAVAR) to estimate the impact of monetary policy shocks on the cross-section of stock returns. Our FAVAR combines unobserved factors extracted from a large set of financial and macroeconomic indicators with the Federal Funds rate. We find that monetary policy shocks have heterogeneous effects on the cross-section of stock returns. These effects are well explained by the degree of external finance dependence, and by variables that arguably correlate with it. We also find that the cross-section of stock return responses to monetary policy shocks can be very well explained by the response of the Fama-French factors to those shocks.

JEL classification codes:

Keywords: monetary policy shocks, cross-section of stock returns, Fama-French factors, FAVAR

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1 Introduction

There is an enormous literature devoted to understanding and measuring the channels through which monetary policy shocks affect the economy. This paper adds to the strand of this literature that focuses on the effects of monetary policy on stock returns. We use a factor-augmented vector auto-regression (FAVAR) to identify monetary policy shocks and study how they affect the cross-section of stock returns. We find that monetary policy shocks have heterogeneous effects across different sectors of the economy. Moreover, we find that this heterogeneity can be explained by variables that shed light on the transmission mechanism of monetary policy.

The existing empirical literature usually relies on two approaches. The first, pioneered by Thorbecke (1997), uses small-scale VARs with a few relevant macroeconomic variables to identify monetary policy shocks as innovations to the monetary policy instrument – usually the Federal Funds Rate. In order to estimate the effect of policy shocks on the cross-section of stock returns, Thorbecke runs a sequence on 7-variable VARs in which the seventh variable is the return on a portfolio of stocks. This leads to as many identified policy shock histories and statistical models of the economy as the number of portfolios. The second approach, as in Bernanke and Kuttner (2005), consists of regressing stock returns on a measure of "unanticipated monetary-policy action," ignoring all other macroeconomic variables that could, in principle, be important to price stocks. Both approaches find that monetary policy indeed affects stock returns, and that this happens in a heterogeneous way.

Our FAVAR approach allows us to exploit the information contained in hundreds of macroeconomic and financial time series to identify policy shocks and analyze their effects on the cross-section of stock returns in an integrated framework. It is well-documented that the Federal Reserve and market participants spend time and resources gathering and analyzing more data than what is usually included in small-scale VARs. As argued by Bernanke *et al.* (2005) and Boivin *et al.* (2009), the larger information set included in the FAVAR reduces the risk of misspecification of the statistical model of the economy, and better approximates the information set of the relevant economic agents. This should improve the identification of policy shocks. In addition, contrary to analyses based on small-scale VARs in which stock return series are included in the system one at a time, our empirical strategy allows us to estimate the cross-section of the responses of stock prices to the same policy shock.

We use the FAVAR to estimate the impulse response of the returns of every portfolio of stocks included in our large dataset to the identified monetary policy shock. We find that policy shocks have heterogeneous effects on the cross-section of stock returns. In order to try to understand the transmission mechanism through which this happens, we then investigate which variables can help

us explain the cross-sectional variation that we uncover with our estimates.

The theoretical literature suggests a few possible mechanisms to generate heterogeneous sectorial response of stock returns to monetary policy shocks. First, and perhaps most straightforward, different degrees of "profit cyclicality" should play a role. The idea is that if profits in different sectors have different sensitivities to the business cycle, fluctuations induced by monetary policy shocks should also affect profits differently across sectors. In addition, heterogeneity of cash-flow duration for different sectors may also produce a cross-section of return responses to policy shocks. The argument is simple. Suppose that, in addition to the heterogeneity in the duration of cash flow, policy shocks are transmitted throughout the term-structure of interest rates. Then, the present value of profits will be impacted differently across sectors. In general, one should expect sectors with higher cash-flow duration to be more negatively affected by contractionary monetary policy shocks than sectors with lower cash-flow duration. Thus, profits and equity returns can, in principle, also have a sector-specific response to monetary policy innovations.

Second, as Li and Palomino (2012) show, theory implies a negative correlation between price stickiness and profitability conditional on innovations in nominal interest rates. The intuition for the result is also clear: sectors in which prices are more sticky are in a worse position to adjust to aggregate shocks.

Third, there is a vast theoretical literature on the lending and balance-sheet channels of monetary policy (e.g. Bernanke and Blinder (1992), Hart and Moore (1998), and Gertler and Gilchrist (1994)). These studies show how capital market imperfections lead monetary policy shocks to have greater impact on firms that are more dependent on external finance. Accordingly, one may expect firms with limited access to capital markets to suffer more from a contrationary monetary policy shock. Indeed, a financially constrained firm may be unable to raise enough capital to invest at its optimal level, therefore damaging its future cash flow, profits, and, ultimately, its dividends. Since stock prices should reflect the discounted present value of the flow of future dividends, following a contractionary monetary policy shock, investors would anticipate the fall in the flow of dividends, and stock prices would fall. As collateral values are known to alleviate financial frictions, it is reasonable to suppose that bigger firms are less financially constrained than smaller ones. This sugests that firm size may proxy for external finance dependence. Also, as "value stocks" are more likely to be financially constrained than "glamour stocks", one may expect firms/sectors with high book-to-market, earnings-to-price, and cash-flow-to-price ratios to be more sensitive to monetary policy shocks.

Overall, our results show that the pattern of stock-price responses to monetary shocks across sectors is very well explained by the degree of all these proxies for external finance dependence.

This relation is remarkably strong and robust. We do not find the same relationships for price stickiness or cash-flow duration.

The paper is organized as follows. Section 2 presents the econometric framework used in the analysis. Section 3 describes the data. Section 4 presents the results for the baseline framework. In section 5 we impose the Fama-French Factors as observable components and Section 6 concludes.

2 Empirical framework

We use the same framework described in Boivin *et al.* (2009). For a more detailed discussion on this econometric tool we also refer the reader to Bernanke *et al.* (2005) and Stock and Watson (2002).

Suppose the economy is driven by a vector of components $\mathbf{C_t}$ whose dynamics is given by

$$\mathbf{C}_t = \Phi(L)\mathbf{C}_{t-1} + \mathbf{v}_t \tag{1}$$

where

$$\mathbf{C}_t = \begin{bmatrix} \mathbf{F}_t \\ \mathbf{Y}_t \end{bmatrix}$$

and $\Phi(L)$ is finite order lag polynomial. $\mathbf{Y}_t$ is a $M \times 1$ vector of observed components, $\mathbf{F}_t$ is a $K \times 1$ vector of unobserved components, called factors, and the vector of shocks $\mathbf{v}_t$ is assumed to be i.i.d. with mean zero. The factors are supposed to capture the general concepts like " economic activity", "inflation" and "unemployment", that cannot be tied to a single time series without a certain degree of arbitrarity. Note that if $K = 0$ then we have an ordinary VAR, hence the name "factor-augmented" VAR. As in Boivin *et al.* (2009), in our benchmark case, we take $\mathbf{Y}_t$ to be a single monetary policy instrument, namely the federal funds rate: $\mathbf{Y}_t = R_t$[1]. Since (by definition) we cannot observe $\mathbf{F}_t$, we need more information to estimate this dynamic model.

We assume that we have available a large number of economic variables stacked in a panel $\mathbf{X}$ whose dynamics is given by

$$\mathbf{X}_t = \Lambda\mathbf{C}_t + \mathbf{e}_t \tag{2}$$

where $\mathbf{e}_t$ contains series specific components uncorrelated with $\mathbf{C}_t$ and are allowed to be serially correlated and weakly correlated across indicators. Equation (2) is called observational equation.

We use the two stages estimation described in Stock and Watson (2002). In this procedure, the estimator of $\mathbf{F}_t$ is a weighted averaging estimator, in which the weight is the eigenvectors matrix of the sample variance matrix. The estimation proceeds in the following steps: First, we take $\mathbf{F}_t^0$ to be

[1] This will be relaxed in the robustness analysis, where we add the fama-french factors in $\mathbf{Y}_t$.

the first K principal components of $\mathbf{X}_t$. With these components we can estimate the loading factor $\Lambda^0 = \begin{bmatrix}\lambda_F^0 & \lambda_R^0\end{bmatrix}^T$ in equation (2)´, and then define $\mathbf{X}_t^0 \equiv \mathbf{X}_t - \lambda_R^0 R_t$. Next, we take $\mathbf{F}_t^1$ to be the first K principal components of $\mathbf{X}_t^0$ and iterates this procedure until a certain convergence criterion is met. We do so because we are interested in uncovering the space spanned by the factors, but the monetary policy instrument, R_t.

Once we uncover the factors by this iteration, we can deal with $\mathbf{F}_t$ as if they were measurements and hence estimate equation (1), the dynamic equation, as a standard VAR.

In order to analyze the effects of monetary policy shocks it remains to identify the shock to the federal funds rate. This is done by assuming that all factors respond with a lag to monetary policy changes. Note that this assumption by no means implies that the economic variables in $\mathbf{X}$ cannot respond instantaneously to a monetary shock. Bernanke *et al.* (2005) shows that this identification produces plausible results.

3 Data

The data consists of a panel of 781 monthly observations ranging from 1976:1 to 2005:6. This time span allows us to use all data used in Boivin *et al.* (2009). This sample period excludes the high volatility period of the financial crisis of 2007-2008 and all the posterior period in which the monetary instrument remained in the zero-lower bound.[2],[3] This includes a comprehensive set of macroeconomic time series that we believe to be important for a study on monetary policy and stock returns, like several series on output, employment, housing sales, stock prices, exchange rates, interest rates, price indices and disaggregated series on personal consumption expenditures and producer price indices. As we are interested in measuring the effects of monetary policy in the cross-section, we augmented this panel by including time series for the stock returns of 49 industry, the Fama-French factors, and portfolios sorted by size, book-to-market, cash flow-to-price, and earnings-to-price ratios. The Rajan-Zingales measures on dependence on external finance for 36 industries are from Rajan and Zingales (1998). When necessary, the data is treated to induce stationarity.

[2] We are in the process of extending the sample until December 2008. After that the Federal Funds rate essentially hits the zero lower bound, and thus the identification strategy becomes invalid.

[3] In order to extend the study to recent years, other instruments of policy to account for unconventional monetary policy should be incorporated in the analysis. see Woodford (2012) for a recent review on unconventional instruments.

4 Results

4.1 Heterogeneous responses

We begin the analysis examining the impact of a monetary policy shock on industry portfolios excess returns. Figure 1 shows the accumulated response (percent) of 49 industry portfolios to a 25 basis points surprise increase in the Federal Funds Rate, as well as the whole market returns response (dashed black line). This market index is a value weighted average of all NYSE, AMEX, and NASDAQ firms. From this plot it's clear that the shock's impact on market excess return is nil at the time of the shock, but there is a large heterogeneity in industries' responses. Interestingly, this impact becomes pronounced one month after the shock and reaches it's peak around 4 months after the shock. At that time the accumulated excess returns of the 49 industry portfolios ranges from -10 basis points, for the Drugs industry, to -143 basis points, for the Gold industry. This cross section averages -82 basis points and has a 31 basis points standard error. All these information confirms the existence of heterogeneity on the effects of monetary policy shocks on stock returns. The red solid line is the unweighted average of these 49 portfolios.

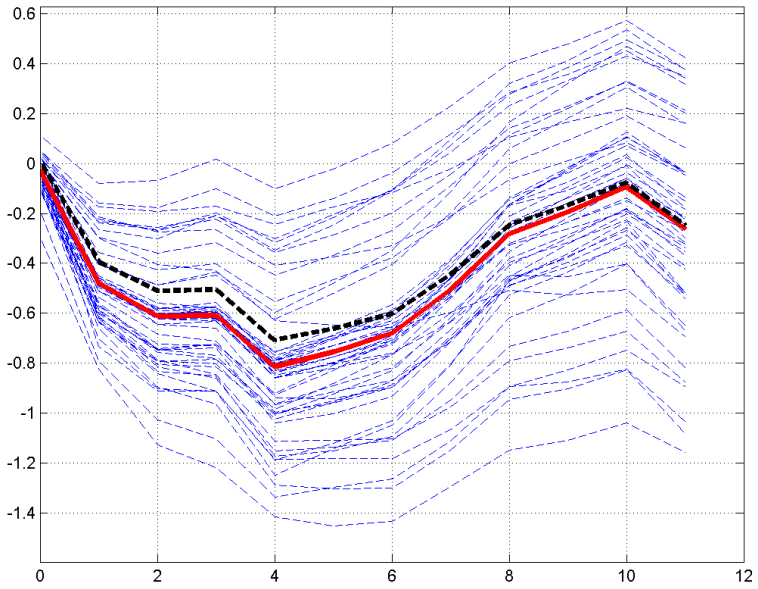


Figure 1: Impact of a monetary shock on a cross-section of portfolios.

4.2 Rajan-Zingales measure of dependence on external finance

Once we verified that stocks respond differently following a monetary shock, a natural next step in our analysis is to relate these heterogeneous responses to sectoral characteristics. We begin by analysing the relation of industries portfolios responses to their Rajan-Zingales measure of dependence on external finance. Rajan and Zingales (1998) define dependence on external finance as capital expenditures minus cash flows from operations divided by capital expenditures. In order to aggregate these ratios and make them comparable across industries and time, the authors sum these ratios for every firm over the 1980's and define the industry dependence on external finance as the median of all firms dependce on external finance in this industry. Evidently, this computed measure does not capture is exactly the desired amount of external funds, but the equilibrium external finance of an specific industry.

As in the original paper, we have the Rajan-Zingales external dependence measure for just 36 industries. Of these, only 9 industries coincide with the 49 industries for which we have impulse response functions, which leaves us with the small amount of 9 industry sectors to analyze. The response of these industries portfolios are plotted in Figure 2. With the notable exception of the Drugs industry, we observe a clear correlation between those responses and its corresponding Rajan-Zingales measure. Indeed, if we remove this observation and calculate the order correlation of the impact effect of the monetary shock and its RZ DEF it rises (in absolute value) from 0.38 to 0.97. This correlation is 0.37 four months after the shock if we keep the Drugs industry and 0.95 if we discard it. The small number of industries for which we have the Rajan-Zingales measure of external finance dependence, however, prevents us from telling if the Drugs industry is an outlier or not. Therefore we are unable to draw any decisive conclusion by analyzing just those 9 industries. This way, we turn to alternative proxies for external finance.[4]

4.3 Market capitalization ("size") and value indices

Figure 1 pointed us an interesting piece of evidence: market capitalization may explain the heterogeneous responses,once we compare the unweighted average returns with the weighted index returns. Note that the first lies below the second for the entire time horizon plotted. This indicates that, when calculating the weighted market return, greater weight is put on the stocks less impacted by the monetary shock, or equivalently, stocks with larget market cap are less sensitive to a monetary policy shock.

The second evidence that market capitalization may be responsible, at least in part, for the systematic heterogeneity of industry portfolios responses comes from Figure 3, that plots the esti-

[4] We are in the process of expanding our dataset to include alternative measures of external finance dependence.

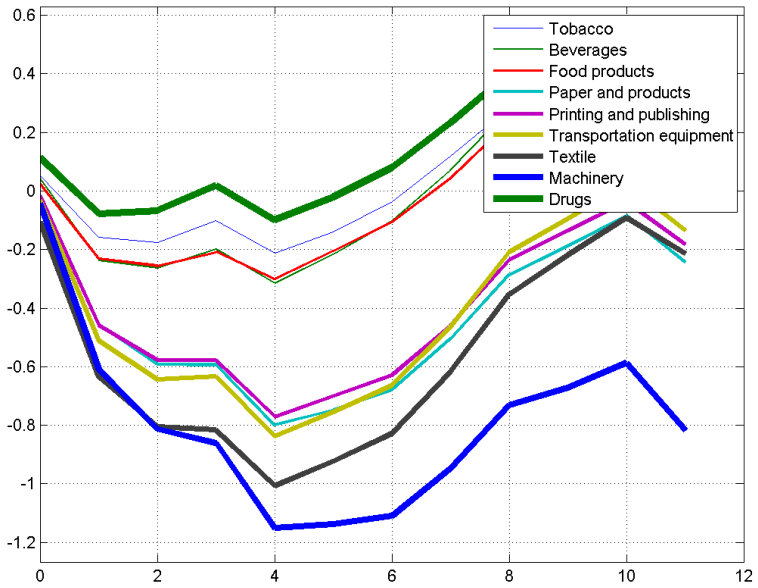


Figure 2: Impact of a monetary shock on a cross-section of portfolios sorted by industry sector.

mated accumulated impulse response of the Fama-French Factors (in percent) to a contractionary monetary shock. The monetary shock is a 25 basis points surprise increase in the Federal Funds Rate. SMB (Small Minus Big) is the average monthly return on the three small portfolios minus the average return on the three big portfolios. HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios. Mkt-RF, the excess return on the market, is the value-weight return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) minus the one-month Treasury bill rate. Note that SMB immediately falls 12 basis points and it keeps falling for half a year until it peaks -72 basis points, once again indicating that on average, large caps perform relatively better following a monetary policy shock.

Figure 4 plots the impulse response functions for 10 portfolios sorted by size and presents our most striking result. Sectors with higher Market Values are plotted with thicker lines. We find a perfectly monotonic relation between market capitalization and stocks excess returns. Immediately after the shock all but the bigger stocks have a negative impact. Note that this is not inconsistent with previous results that a monetary shock has no immediate impact on market excess returns, since the largest caps have overwhelming weight on market indices. All portfolios reach their (negative) peaks 4 months after the shock, ranging from -51 basis points for the highest decile down to -133 basis points for the lowest decile. Furthermore, we note that the correlation of excess returns and size remains very high thought the entire time horizon of the plot.

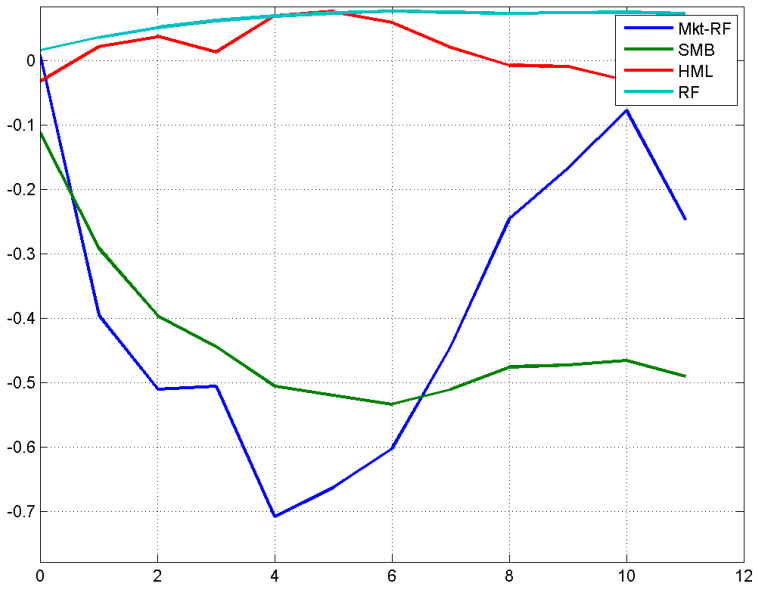


Figure 3: Impact of a monetary shock on the Fama-French Factors.

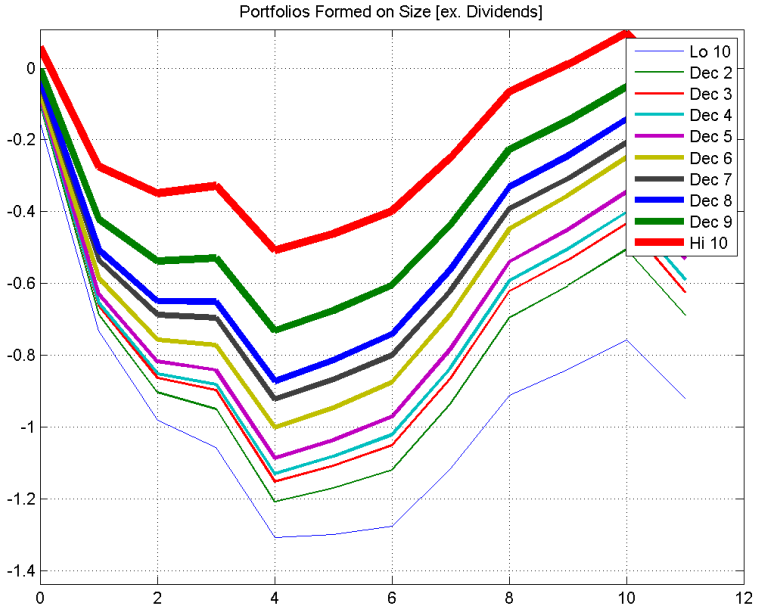


Figure 4: Impact of a monetary shock on a cross-section of portfolios sorted by Size.

We bring home the point by calculating this correlation for every time period ranging from the moment of the shock to a year after that. The results are shown on Figure 5, along with the corresponding correlations for the value proxies of dependence on external finance. The results are

impressive, as all proxies exhibit very high correlations with the portfolios returns.

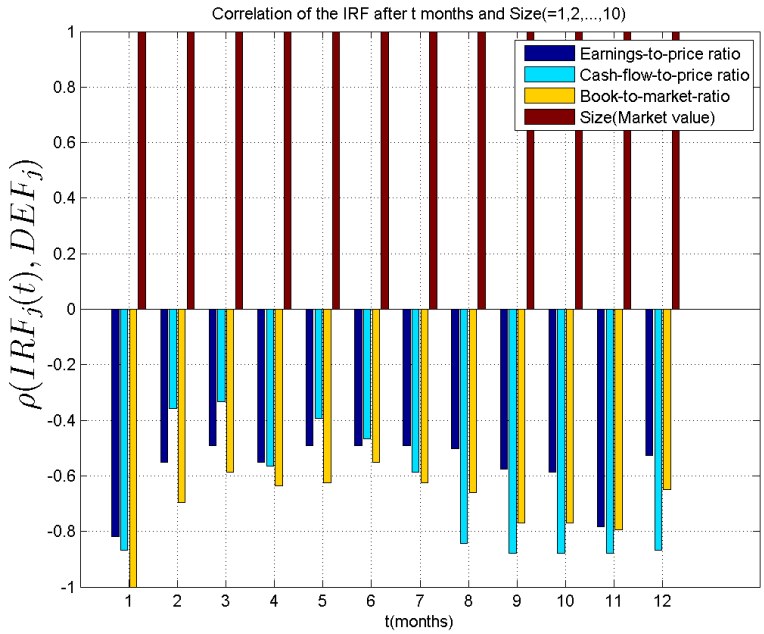


Figure 5: Correlation between impact and proxies for dependence on external finance.

4.4 Price Stickiness

In this section, we empirically check the asset price implications of the theoratical channel presented in Li and Palomino (2012), i.e. are the sectors in which prices are more sticcky more strongly affected by monetary policy shocks? In theory, one should expect this result. Given any macro shock, a firm with higher price stickiness should be less flexible to adjust prices. This would affect profits and equity returns.

Figure 6 plots the equity returns impulse response functions to a monetary policy shocks for sectors with different degrees of price stickiness. Thicker lines stand for sectors in which prices are more sticky.[5] While it is clear that all sectors have returns impacted by interest rate innovation, there is no clear pattern between stickiness and the effects of monetary shocks.

Figure 7 reinforces this point by plotting correlation between the degree of price stickiness and relative sectorial effects of the monetary policy shock in different periods, raging from the moment of the shock to year after that. Most p-values of these correlations are above 10%.

[5] We borrow the measures of price stickiness from Nakamura and Steinsson (2009).

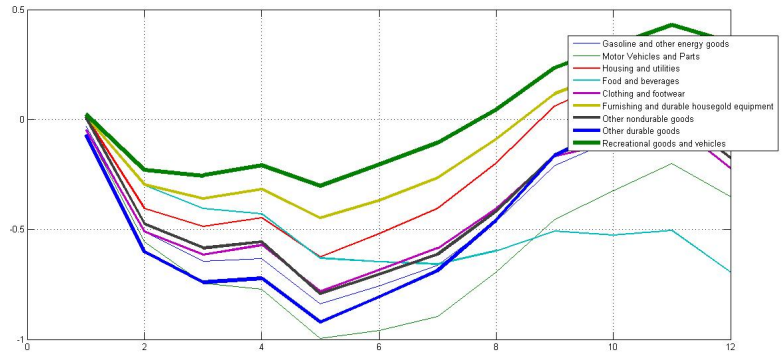


Figure 6: Impulse response functions for portfolios sorted by price stickness.

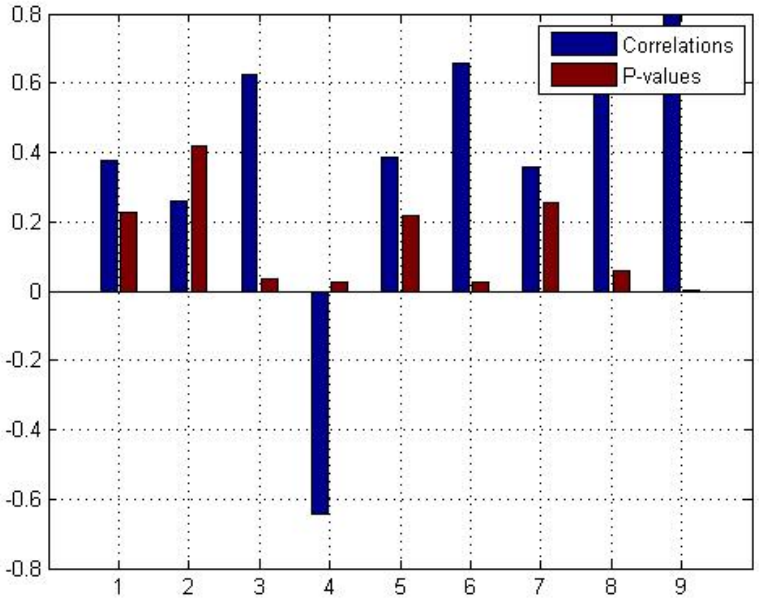


Figure 7: Correlations between impulse response functions and price stickness.

4.5 Cash-flow duration

Another possible explanation for the results in section 4.1 is heterogeneity in cash-flow duration. The intuition would go as follows: (i) a monetary policy shock shifts the entire yield curve through the shock in the short-term rate; (ii) sectors whose cash-flow have larger duration are more exposed to movements in the yield curve and should experience larger price movements.

In fact, the necessary first step of the argument holds in our FAVAR estimates, i.e., the monetary policy innovations do affect longer horizons of the yield curve. Moreover, sorting sectors by their avarage cash-flow duration following Da (2009) reveals significant heterogeneity in this dimension.

The results, however, do not support this cash-flow duration channel. Figure 8 plots the equity return impulse response functions to a monetary policy shock for sectors with different cash-flow durations. Thicker lines stand for higher duration. All sectors are affected by interest-rate shocks, but there is no pattern between cash-flow duration and the effects of monetary shocks.

Figure 9 makes this point clear by plotting the order correlation between the cash-flow duration and relative sectorial effects of the monetary policy shock in different periods, ranging from the moment of the shock to one year after that. The p-values of these correlations are well above 10%.

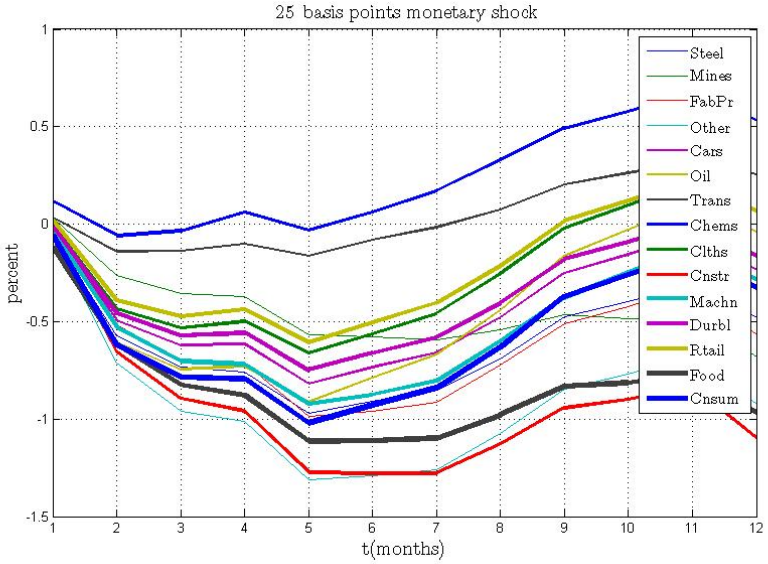


Figure 8: Impulse response functions for portfolios sorted by cash-flow duration

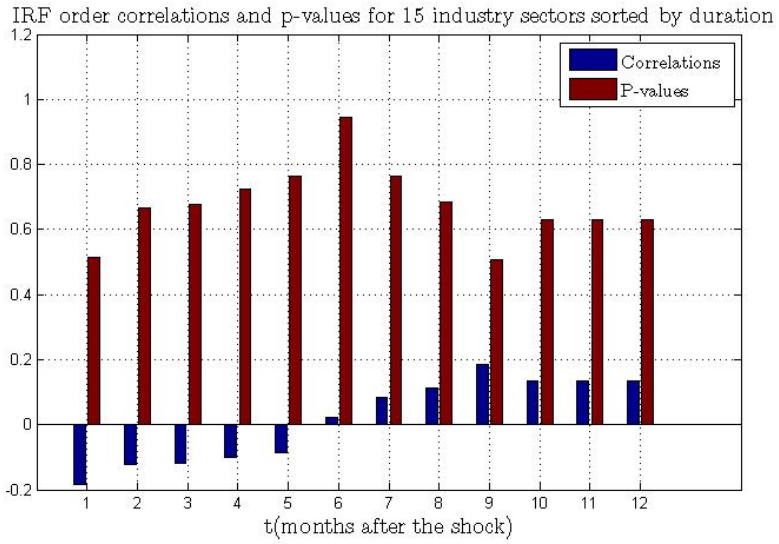


Figure 9: Correlations between impulse response functions and cash-flow duration.

4.6 Identified shocks

A common critique (e.g. Rudebusch (1998)) of the VAR approach to measure the effects of monetary policy is that the estimated interest rate shocks from different VARs fail to agree among themselves. Is our FAVAR framework subject to this critique? To answer this question we compare the estimated shocks for several model setups. The first is our benchmark model, with the just the Federal Funds Rate as observed component. The second FAVAR model is the one in Boivin *et al.* (2009). We compare the shocks of these two models with ten standard VAR models that include the growth rate of industrial production, an inflation rate, the log of a commodity price index, the federal funds rate, the log of nonborrowed reserves, the log of total reserves, and the returns of the k^{th} Size portfolio ($k = 1, 2, ..., 10$). Table 1 shows the correlations among the 12 estimated shocks. From this table it is clear that both FAVAR specifications are capturing essentially the same shock. The correlations with the shocks estimated with standard VARs are sensibly smaller.

	Benchm.	BGM	VAR 1	VAR 2	VAR 3	VAR 4	VAR 5	VAR 6	VAR 7	VAR 8	VAR 9	VAR 10
Benchm.	1.00	0.99	0.69	0.70	0.70	0.70	0.70	0.69	0.70	0.69	0.69	0.69
BGM	0.99	1.00	0.70	0.71	0.71	0.71	0.71	0.70	0.71	0.71	0.71	0.71
VAR 1	0.69	0.70	1.00	1.00	0.99	0.99	0.98	0.98	0.98	0.97	0.97	0.96
VAR 2	0.70	0.71	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.98	0.97
VAR 3	0.70	0.71	0.99	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97
VAR 4	0.70	0.71	0.99	0.99	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.98
VAR 5	0.70	0.71	0.98	0.99	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.98
VAR 6	0.69	0.70	0.98	0.99	0.99	1.00	1.00	1.00	1.00	0.99	0.99	0.98
VAR 7	0.70	0.71	0.98	0.99	0.99	0.99	0.99	1.00	1.00	1.00	0.99	0.99
VAR 8	0.69	0.71	0.97	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	0.99
VAR 9	0.69	0.71	0.97	0.98	0.98	0.99	0.99	0.99	0.99	1.00	1.00	0.99
VAR 10	0.69	0.71	0.96	0.97	0.97	0.98	0.98	0.98	0.99	0.99	0.99	1.00

4.7 VAR vs FAVAR dynamics

Even though the identified monetary shocks uncovered by the FAVAR approach retain some similarity to the ones obtained with small-scale VARs, should we expect similar dynamics? Figure 10 compares the impulse response functions of the ten size-portfolios obtained with the two approaches following a contractionary monetary policy shock of 25 basis points. This picture shows that for this model setup (number of lags = 13 and sample ranging from 1976:1 to 2005:5), there is an apparently small difference in the impulse responses functions. This small difference, however, is enough to destroy the perfect monotonicity in the responses of the ten size portfolios. This is illustrated in Figure 11. The left pictures show the impulse responses of all the size-portfolios in the same plot. As before, large caps are represented by thicker lines. The pictures on the right of

Figure 11 show the order correlation between these responses and market capitalization. We plot again in this same picture the order correlation obtained with the FAVAR approach for comparison. The bottom pictures show analogous results for the estimation using the subsample ranging from 1984:1 to 2005:1.

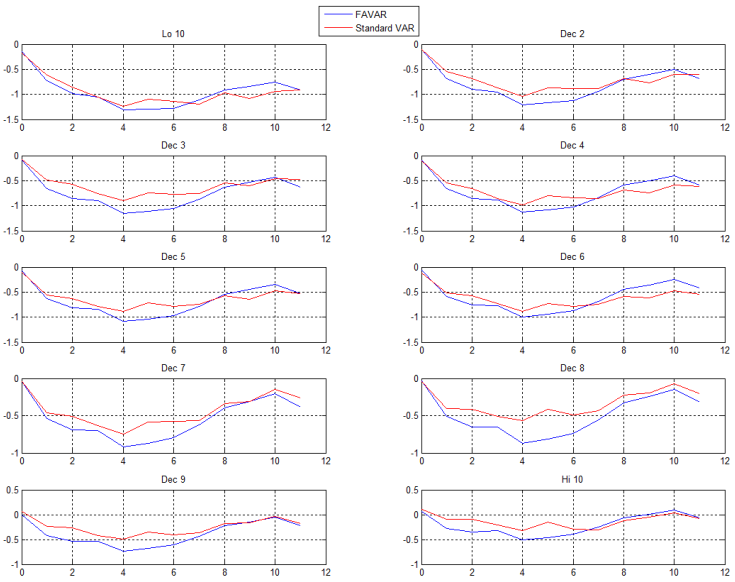


Figure 10: FAVAR x VAR impulse response functions for 10 size portfolios.

With this subsample the small-scale VARs completely fail to explain the heterogeneity of stock responses to a monetary shock. Although we do not report the results here, we observe a similar deterioration of the explanatory power of the other proxies for dependence on external finance. We believe that this happens due to the failure of the standard VARs to incorporate all relevant macroeconomic and financial information. This is where the FAVAR approach proves to be most valuable. Indeed, to estimate the FAVAR we use a dataset with hundreds of time series. This could not be done with an ordinary VAR due to degrees-of-freedom problem. Indeed, most VARs in the related literature (e.g. Leeper *et al.* (1996)) do not use more than 20 variables. Given such limitation, a researcher has to make a somewhat arbitrary choice of the series to be used in the analysis. For example, it is believed that a measure of "economic activity" is important in most macroeconomic empirical studies. But what time series should be used to represent "economic activity"? Gross domestic product? Gross national product? Unemployment? Industrial production? This situation is still more uncomfortable if we have to choose among several measures of "price pressures". The very existence of a whole plethora of inflation indices suggests that maybe no single inflation index captures the notion of "price pressures" in an exhaustive way. If we are forced to choose only one

index to include in a model and discard the remaining ones due to the degrees-of-freedom problem, we may be throwing away useful information. The FAVAR approach spares us having to make such arbitrary choices.

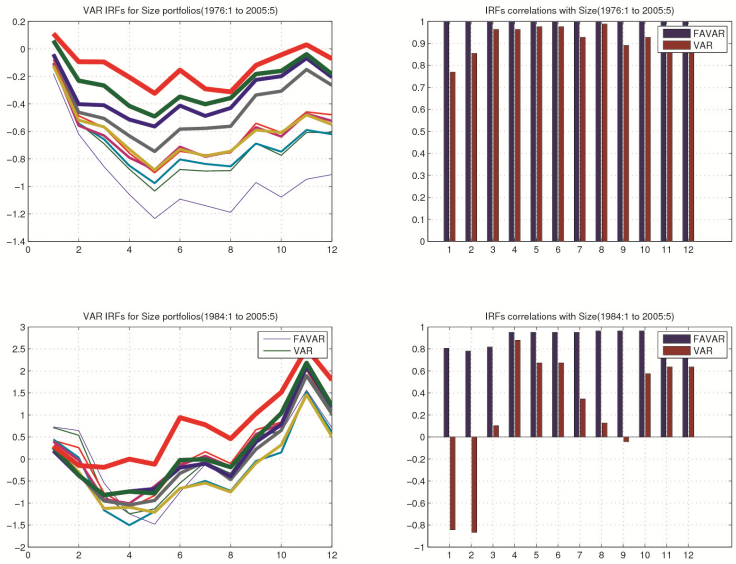


Figure 11: Impulse response functions and for size portfolios and their order correlation.

5 Fama-French factors and the cross-section of stock returns in response to monetary policy shocks

It is known from the empirical Asset Pricing literature that the Fama-French factors explain the cross-section of stock returns very well. With this in mind, we can ask ourselves how important they are in explaining the behavior of equity returns following a monetary shock. In this section we depart from our parsimonious benchmark model that includes only the Federal Funds as observed components by including the Fama-Fench Factors in Y_t, that is:

$$Y_t = \begin{bmatrix} R_t \\ Mkt_t - RF_t \\ SMB_t \\ HML_t \end{bmatrix}, \tag{3}$$

in which R_t is the Federal Funds Rate, Mkt_t is the market return, RF_t is the return on one-month t-bills (and therefore $Mkt_t - RF_t$ is the market excess return), SMB_t is the small minus big index and HML_t is the high minus low index. As we are adding 3 variables to our formerly 6-dimensional

VAR, we set the number of extracted unobseved factors to 3, in order to keep the low dimensionality of the VAR.

The top panel of Figure 12 shows how the impulse response functions for the 49 industry portfolios for the two specifications. At first we can see no clear qualitative difference and the main results of the previous analysis remain valid. This model setup also shows a large heterogeneity in the portfolios responses, and the magnitude of those responses are the same as before. Note, however, that the difference between the whole market returns and the unweighted mean of the 49 industry portfolios becomes bigger under this model specification. By the same reasoning we used to explain the analogous figure in the last section, we conclude that even more weight is put on the stocks less impacted by the monetary shock. In short, what this picture points out is that by imposing the Fama-French Factors as observed components we may be explaining an even bigger difference in the response of big and small caps. If this intuition is right, than we would expect the SMB to be more severely hit by the shock in this specification. Moreover the gap between different size portfolios should widen. These very two predictions are confirmed in Figure 12 panels B and C, respectively.

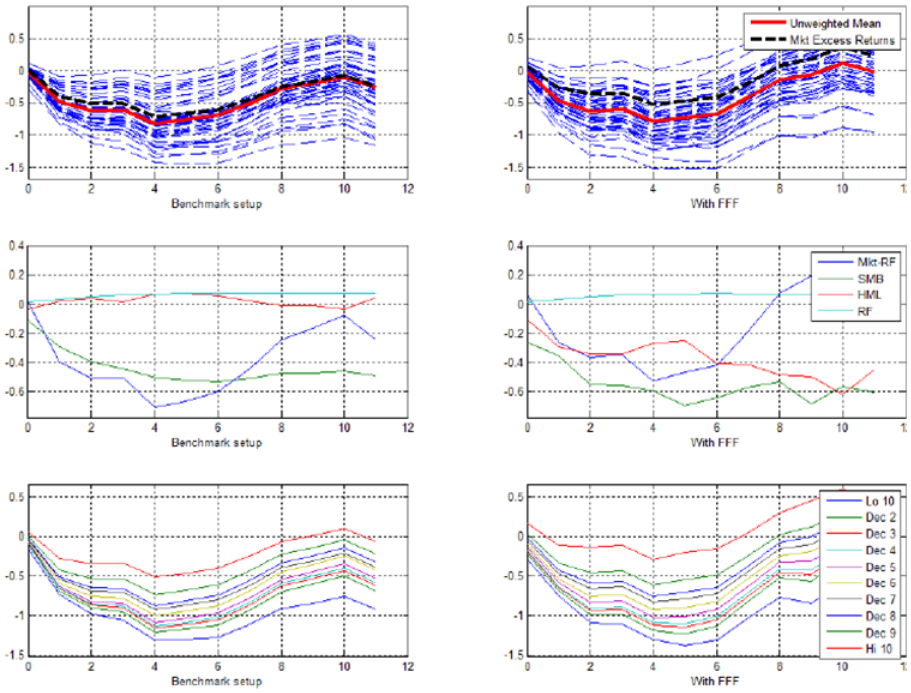


Figure 12: Impulse response functions for the benchmark specification(left) and the specification with the Fama-French Factors as observable components(right).

Finally, we ask if the effects of monetary policy shocks in stock returns are nothing but a reflection of the effects of such policy shocks on the Fama-French factors. In order to answer this

question, we compute "indirect impulse response functions" that represent the effects of monetary policy shocks on stock returns that can be attributed to the effects of the shocks on the Fama-French factors. To that end we regress the portfolio excess returns on the Fama-French factors to obtain the factor loadings, and apply those loadings to the impulse response functions of the Fama-French factors to the identified monetary policy shocks. Figure 13 plots these "indirect" impulse response functions and the "direct" impulse response functions from our baseline FAVAR. It is clear that the Fama-French factors are the key determinants for sectors such as Business Services and only part of the story for other such as Coal.

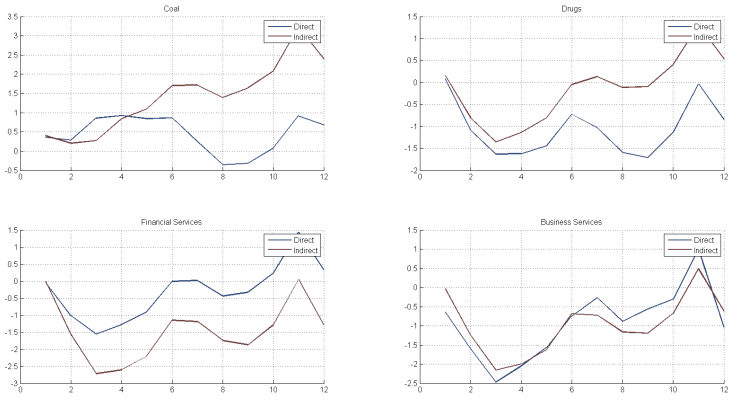


Figure 13: Impulse response functions for monetary policy shocks(direct) and for monetary policy shocks only via Fama-French Factors (indirect).

5.1 Other specifications and robustness

To check the robustness of the results we stressed the model in various dimensions[6]. We perturbed the number of factors and lags around the benchmark setup (5 and 13, respectively) and noticed no clear difference in our results. Also, we experimented including a few key macroeconomic variables (e.g. GDP, industrial production) as observed components in the VAR equation and the results once again remained robust. Finally, we did the same analysis using the subsample period of 1984:1 to 2005:5, and the qualitative results remained unchanged.

6 Conclusion

In this paper we investigated whether monetary policy shocks affect the cross-section of stock returns. To that end, we used a macro factor-augmented VAR. This technology allowed us to use

[6] A software that computes these results under general model setups is available upon request.

hundreds of macroeconomic and financial time series that in principle could be useful to identify monetary policy shocks. This virtually eliminates the problem of the small scope of the informational set that is typical in small scale VARs. Furthermore with the FAVAR approach we could measure the monetary shock impact on several equity portfolios and indexes within a single empirical framework.

We find that monetary policy shocks have differential effects on different stock portfolios, and that this heterogeneity is extremely well explained by observable portfolio characteristics. In particular, the effects of policy shocks are strongly correlated with measures of external finance dependence, in a way that is consistent with previous theoretical work on the monetary transmission mechanism, which predicts that firms that rely more heavily on external finance should be more heavily affected by changes in the monetary policy. Using size (market capitalization) as a proxy to dependence of external finance yields the most striking results. Indeed, we showed in 3 different ways that large caps are much less sensible to monetary policy than small caps. First by analysing the difference between the whole market returns and the unweighted industry returns mean from a cross section of 49 industries. Second by estimating the response of the SMB (small-minus-big) index. Third, by computing the impulse response functions of 10 portfolios sorted by size, that exhibit a perfectly monotonic relationship.

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