



# The joint response of stock and foreign exchange markets to macroeconomic surprises: Using US and Japanese data

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## ABSTRACT

This paper investigates the joint response of stock and foreign exchange (FX) market returns to macroeconomic surprises, employing a system method of estimation that allows for the cross-country and cross-market interaction for asset returns and risk premia. Using US and Japanese data, we find that US stock markets are asymmetrically responsive to domestic developments in output growth and interest rates but are not influenced by macroeconomic surprises from Japan. The surprise in the FX market seems to affect stock markets in the US and Japan, respectively. In particular, we find that the interest rate surprise in the US and inflation surprise in Japan tend to overstate the impact that these surprises would have on the respective stock market. The impact of the surprises would appear smaller if macroeconomic developments induced by the FX market were incorporated into the model.

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## 1. Introduction

Macroeconomic developments can affect the market's expectation about economic conditions, and these expectations reverberate throughout the financial system by influencing the returns expected on all asset classes. Multifactor asset pricing models suggest that assets influenced by systematic risk factors should earn a risk premium in a risk-averse economy (see Ross, 1976). Macroeconomic variables provide multiple sources of systematic risk factors in addition to the risk premium on the market portfolio through their effect on the firm's expected cash flows and the required rate of return commensurate with the cash flows' riskiness.<sup>1</sup> In an open economy that has liquid financial markets, macroeconomic surprises can be transmitted to cross-border asset returns through international trade and financial market integration or spillovers so that any surprise about macroeconomic fundamentals in one country is likely to have repercussions in other countries. In particular, the growing international integration of financial markets provides a channel for the cross-market/country linkage between stock and FX markets. As documented by Anderson, Bollerslev, Diebold, and Vega (hereafter ABD&V, 2007), stock return and exchange rate

dynamics are jointly linked to macroeconomic fundamentals and the linkage is significantly contemporaneous between stock and FX markets. Thus, it is important to recognize that the market response to macroeconomic developments should be modeled within a simultaneous framework linking stock and FX markets.<sup>2</sup>

Previous empirical investigations of the relation between macroeconomic surprises and subsequent market responses have overwhelmingly focused on the effect of the surprises either on the stock market or on the FX market in a separate framework without linking the two markets. For example, one class of these studies focuses on the connection between macroeconomic surprises and subsequent movements in stock prices (see Flannery and Protopapadakis (2002), Boyd et al. (2005), Bernanke and Kuttner (2005), Basistha and Kurov (2008), Bhamra et al. (2010), Birz and Lott (2011), Gilbert (2011), and Rangel (2011), among others), while the other class of these studies examines the influence of macroeconomic surprises on the exchange rate movement (see Almeida et al. (1998), Anderson et al. (2003), Simpson et al. (2005), Bergin (2006), Evans and Lyons (2008), and Chen and Gau (2010), among others). This isolated analysis of only a particular market response ignores cross-market information effects of macroeconomic surprises and the results may not simultaneously hold true.

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<sup>1</sup> As suggested by various models for exchange rate determination, the exchange rate, similar to stock prices, is a forward-looking variable that reacts to changes in the market's expectation of future macroeconomic variables (see, for example, Engel and West, 2005).

<sup>2</sup> There is a large empirical literature supporting the linkage between stock returns and exchange rates (see, for example, De Santis and Gerard (1998), Patro et al. (2002), Phylaktis and Ravazzolo (2005), Dominguez and Tesar (2006), Mun (2007), and Dungey and Martin (2007), among others).

In contrast to the separate approach, the simultaneous responses of stock and FX markets to macroeconomic surprises have been largely ignored. A notable exception is the paper by Anderson et al. (2007), in which FX markets as well as the domestic and foreign stock and bond markets are characterized by the joint response to real-time US macroeconomic surprises. They measure the magnitude of response coefficients using a two-step weighted least squares procedure with error terms following the GARCH process and find that bad news has a negative impact on stock markets during economic contractions, but a positive impact during expansions. The current empirical literature including ABD&V (2007) on market responses to macroeconomic surprises has two major shortcomings. First, it fails to take into account the surprise emanating from the FX market that can feed through to stock markets of relevant countries. Second, although allowing for cross-market and cross-country linkages for asset returns, it neglects to acknowledge risk premia in the joint modeling of the stock and FX return generating process.

The purpose of this paper is to investigate the joint response of stock and FX market returns to the macroeconomic surprises emanating from the US, Japan, and the FX market within a simultaneous system of equations that allows for the cross-market and cross-country linkages for asset returns and risk premia.<sup>3</sup> In particular, we develop a unified framework by integrating two strands of the literature on market responses to macroeconomic surprises: studies on stock market responses to macroeconomic surprises and studies on FX market responses to macroeconomic surprises.

Our paper contributes to the extant literature on market responses to macroeconomic surprises in two important respects. First, we take into consideration the surprise emanating from the FX market that can account for the peculiar characteristics of the FX market and thus capture the cross-market spillover effects. We assert that unanticipated movements in the terms of trade ratio between two countries can conveniently capture the surprise in the FX market. This is because exchange rate changes in the FX market can be naturally explained by exogenous shifts in the terms of trade due to the fact that (i) the exchange rate is a relative price of two currencies and is closely related to the trading relationship between two countries; and (ii) the terms of trade shock has an especially marked impact on the FX market because of the heavy reliance of the Japanese economy on commodity exports and the long-term decline in the US trade balance.<sup>4</sup> The terms of trade for a given country is conventionally measured by the ratio of export prices to import prices. The terms of trade shock affects exchange rates through changes in export revenues and a subsequent change in the demand for currency. In addition, the increased integration of goods and capital markets would make it possible for the terms of trade shock to influence the stock market. The terms of trade shock can cause large shifts in relative earnings and costs among firms located in different countries and affects the prices of goods sold in domestic and foreign markets, and hence stock prices.

Second, in addition to the fact that US surprises can affect the stock market in Japan and the FX market, our model allows for the possibility that surprises emanating from the FX market and Japan influence US stock markets. As the two economies are highly linked through international trade and investment, any surprise about economic fundamentals in the FX market is most likely to have implications through interest and exchange rates in the US stock market. Cash flows with increased financial market integration and a high

degree of cross-listings of equities between the two countries provide a channel for macroeconomic surprises in the FX market and Japan to have repercussions in the US stock market (see Lin et al. (1994) and Peek and Rosengren (2000), among others). The investigation of the impact of macroeconomic surprises in the FX market and Japan on US stock markets can provide important evidence on several hypotheses concerning the cross-country and cross-market information effects of macroeconomic surprises.

The empirical analysis in this paper is conducted based on the vector autoregressive model with error terms following the GARCH in-mean process, employing US and Japanese data for five macroeconomic variables: (i) money growth, (ii) output growth, (iii) inflation, (iv) interest rates, and (v) terms of trade. The results indicate that US stock markets are asymmetrically responsive to domestic developments in output growth and interest rates but are not influenced by macroeconomic surprises in Japan. In contrast, Japanese stock and FX markets appear to be significantly influenced by the cross-country and cross-market transmission of US macroeconomic developments in most of the selected economic variables.

We find that some macroeconomic developments in the FX market feed through to stock markets in the US and Japan. For instance, a positive terms of trade shock in the FX market seems to lead to rising stock markets in the US and Japan, respectively. One of the intriguing features of our findings is that a fall in the US stock market due to higher-than-expected domestic interest rates can be mitigated by the cross-market transmission effect. This effect involves a case where a positive shock in the US interest rate triggers a dollar appreciation in the FX market, which in turn boosts the US stock market. Similarly, the Japanese stock market will fall in response to higher-than-expected domestic inflation, but the fall can be partly offset by the effect that the Japanese inflation surprise triggers a yen depreciation in the FX market, which in turn boosts the Japanese stock market, perhaps due to an export-dominant economy.<sup>5</sup> It follows that the interest rate surprise in the US and inflation surprise in Japan tend to overstate the impact that these surprises would have on the respective stock markets if macroeconomic developments emanating from the FX market were incorporated into the model.

The paper is organized as follows. Section 2 presents theoretical links and predictions for macroeconomic surprises. Section 3 provides data and empirical model to be estimated. Section 4 presents empirical results for the effects of macroeconomic surprises. Finally, conclusions are given in Section 5.

## 2. Theoretical link and predictions

Beginning with Chen et al. (1986), a number of articles have tried to identify economic factors that influence the equity market return generating process. While there exists a wide array of sets of macroeconomic factors that explain equity market returns, there is no general consensus as to what is the correct set of factors. The same is true for the set of factors determining exchange rates. By examining factors previously identified in the literature, we select the following set of macroeconomic factors as a fair and parsimonious representation of the macroeconomic fundamentals that can influence stock and FX markets: (i) money growth; (ii) output growth; (iii) inflation; (iv) interest rates; and (v) terms of trade.

This section briefly describes the theoretical link between asset prices and macroeconomic surprises and makes predictions for the effect of the five macroeconomic surprises by examining possible mechanisms by which macroeconomic shocks are transmitted into domestic and foreign asset prices/returns. Also, cross-country

<sup>3</sup> Given that risk premia have common characteristics across different assets and the FX market is characterized by nonzero conditional risk premia (see Giovannini and Jorion, 1989; Dominguez and Tesar, 2006), FX risk premia can affect stock market returns if exchange rates affect stock returns.

<sup>4</sup> It is suggested that the long-term US trade deficit is highly attributable to the decline in its terms of trade (Backus et al., 1994; Shaikh, 1999).

<sup>5</sup> It has been documented by Ma and Kao (1990) and Pritamani et al. (2004) that domestic currency appreciation negatively affects the domestic stock market for an export-dominant economy and positively affects an import-dominant economy.

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