



## Investigating sources of unanticipated exposure in industry stock returns

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### ABSTRACT

This paper investigates the sources of both foreign exchange rate and interest rate exposure of industry level portfolios in the G7, decomposing exposure into cash flow and discount rate effects. Initial examination of the degree of exposure on industry returns produces results consistent with the prior literature: that there is little evidence of exchange rate exposure in most industries – the *exchange rate exposure puzzle*. However, rather than relying solely on the sensitivity of industry returns, we examine the cash flow sensitivity to foreign exchange exposure, of primary interest to firm managers. Critically, decomposing the exposure into cash flow and discount rate components unlocks the exact extent and nature of exposure. Our results show industries have significant cash flow and discount rate exposures. These exposures increase with the level of trade openness and the spread between permanent cash flow exposure and transitory discount rate exposure widens.

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### 1. Introduction

According to financial theory changes in exchange rates and interest rates should affect the value of the firm. Exchange (interest) rate exposure refers to the extent to which the value of the firm is affected by changes in exchange (interest) rates. The issue of exposure to both exchange rate and interest rate risk is of importance to individual investors and firms. For example, changes in exchange rates and interest rates affect an investor holding a portfolio consisting of securities from different countries. While changes in exchange rates naturally impact the cash flows of multinational firms with operations in different foreign locations, importers and exporters and even solely domestic firms through changes in the competitive environment and the terms of trade. Bodnar et al. (2002) and Hutson and Stevenson (2010) highlight that while local firms may not trade internationally, they may still be exposed to changes in exchange rates, if for example they are in competition with foreign firms in the domestic market.<sup>1</sup> Hence there has been much interest in evaluating the level of exchange rate exposure a firm or industry faces. Similarly changes in interest rates will alter the firms' financing costs, affecting the amount of loan

interest and principal payments and impacting cash flows of the firm. However, the vast majority of recent studies assessing exposure focus solely on foreign exchange exposure and relatively few take account of interest rate exposure.<sup>2</sup>

In this paper we examine the level of exposure faced by industries to both interest rate and foreign exchange rate risk across all G7 countries using a different methodology to the previous studies in the literature. Analysing industry exposure is important since industries differ in terms of pass through and mark-ups (Bodnar et al., 2002; Allayannis and Ihrig, 2001), competitive structure (Marston, 2001; Griffin and Stulz, 2001) or industry concentration (Bartram and Karolyi, 2006) and hence may face different levels of exposure. Our approach to the measurement of unexpected exposure differs to the majority of the extant literature. Only unanticipated levels of exposure should influence firm or industry portfolio prices immediately, anticipated changes in exposure should have no effect and should already be priced into the asset by market participants. Hence the unexpected component of foreign exchange (interest rate) movements is a more appropriate measure to examine the extent of exposure. Yet, many studies adopt realized or actual changes in exchange rates as the proxy for unexpected changes (e.g., Jorion, 1990; Bodnar and Gentry, 1993; Choi and

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<sup>1</sup> Such firms may, in fact, face greater exposure since they do not have operational hedges and are unlikely to engage in financial hedging (Dominguez and Tesar, 2001a; Dominguez and Tesar, 2001b).

<sup>2</sup> Bartram and Bodnar (2007) review the exchange rate exposure literature. Limited evidence on interest rate exposure is provided by Sweeney and Warga (1986), Madura and Zarruk (1995) while Prasad and Rajan (1995), Choi et al. (1992) and Choi and Elyasiani (1997) simultaneously take account of both exchange rate and interest rate risk finding mixed levels of exposure.

Prasad, 1995; Chow et al., 1997) despite the actual change consisting of both an expected and unexpected component. Analogous to Amihud (1994) who proposes a two stage estimation approach, Choi et al. (1992) who utilise ARIMA models and Gao (2000) who adopts a macroeconomic model to generate unexpected changes in exchange rates we employ a different econometric approach, a vector autoregressive model, to generate unanticipated changes in exchange rates.

The key distinction between our paper and previous studies is that we also identify the sources of any possible exposure. Standard textbook definitions of foreign exchange exposure state that “transaction and operating exposure exist because of unexpected changes in future cash flows” ([p. 283]Eiteman et al., 2010). Managers will therefore be particularly interested in the exposure measure that identifies the cash flow sensitivity to exchange rate movements. From the theoretical perspective a large number of studies highlight the aim of the firm to manage cash flow movements, (e.g., Smith and Stulz (1985)). Empirically, Bodnar and Marston (1996), using survey data, highlight that managers are considerably more interested in keeping cash flows stable, rather than firm value in the light of foreign exchange rate movements. While Bartram (2008), using proprietary firm data, illustrates operating cash flows are significantly exposed to exchange rate changes.<sup>3</sup> The alternative is to model the extent of the exposure by examining the change in the market value of the firm or industry as a result of a change in the exchange rate. This approach, developed by Adler and Dumas (1984) and extended by Jorion (1990), has become extremely popular given the simplicity associated with using market data to determine the extent of exposure. However, the majority of literature has typically established low levels of significant exposure giving rise to the *foreign exchange exposure puzzle*.<sup>4</sup>

A potential implication of the empirical findings to date is that firm value is not exposed to foreign exchange movements, implying that firms successfully handle exposure via pass-through, operational or financial hedging. Bartram et al. (2010) show that the combination of these factors significantly reduces the level of observed exposure. Choi and Kim (2003) argue that operational strategies as well as financial hedging alter the exposure profile of firms.<sup>5</sup> Yet the market value approach results may be unreliable for two further reasons. First, Chow et al. (1997) argue that although foreign exchange exposure relates distinctly to cash flows, stock returns embed both cash flow and interest rate effects which may produce offsetting effects masking the actual level of exposure. Naturally the value of industry returns may fall either because exchange rates affect expected cash flows, the discount rate or cost of capital applied to the cash flows changes. Bodnar and Wong (2003) further illustrate the significance of these interaction effects. Additionally, Bartram (2004) indicates that foreign exchange rate exposure effects are likely to be non-linear and that this may be as a result of cash flows being a non-linear function of foreign exchange rates. Second, while it may be feasible that a successful hedging strategy is adopted for current cash flows, this is unlikely to be the case for future cash flows. Chow et al. (1997) highlight the difficulty associated with stabilizing future cash flows in the face of foreign exchange movements using hedging instruments.

<sup>3</sup> Muller and Verschoor (2009) find that US multinational stock return variability increases significantly in the aftermath of a currency crisis.

<sup>4</sup> For example, Jorion (1990), Bodnar and Gentry (1993), Amihud (1994), Choi and Prasad (1995) and Chow et al. (1997). See Muller and Verschoor (2006) and Bartram and Bodnar (2007) for comprehensive surveys.

<sup>5</sup> Further evidence is provided by Pantzalis et al. (2001) and Choi and Jiang (2009) in this regard, showing that exposures are smaller and less significant for multinational firms (i.e., those that engage in operational hedging) while Kim et al. (2006) show non-operationally hedged firms tend to make greater use of financial hedging.

Here, we first highlight the empirical evidence of the puzzle, adopting the market value approach, then we formally examine the components of industry return exposure, namely cash flows and interest rates (discount rates). Thus we isolate the exposure of principal interest to managers, the cash flow effects representing transaction and operating exposure, and also examine the relationship to any interest rate effect. Finally and most importantly, our identification extends Chow et al. (1997) in that we examine the *future* cash flow effects and specifically whether there is a complementary effect with the *future* interest rate channel. We use the rational valuation formula (RVF) for stock prices as our starting point to analyse the unexpected exposures.<sup>6</sup> The RVF states that prices will equal the discounted present value of future dividends (cash flows) and discount rates. The metric we employ draws on the multi factor asset pricing model, the arbitrage pricing theory (APT), which indicates the sensitivity of the portfolio ( $\beta$ ) to the particular factor (foreign exchange or interest rate). It is this approach that leads to the identification of the cash flow and interest rate components of exposure.

Our results for the direct effects of both foreign exchange and interest rate exposure applied to industrial sectors in the G7 are weak, but fully consistent with those found previously in the literature. Although we find limited evidence of foreign exchange exposure, the findings are generally consistent with the openness of the market, with France, Italy, Germany and Canada indicating some exposure. However, it is only when we decompose the channels that we identify the full extent of foreign exchange and interest rate exposure. The first point to note is that exchange rate exposure is evident for the vast majority of G7 countries and industries. Our results are also intuitively appealing. Open markets such as France, Germany and Italy are particularly exposed to movements in foreign exchange. However, we also find that all US and Japanese industries in our sample are exposed to foreign exchange movements. Although, the levels of the exposure faced by the US and Japan are relatively low compared to more open markets, they are none the less statistically significant. Our results are consistent with the previous findings on the link between openness and exposure and in particular that smaller and more open markets also have the largest dispersion in inter-industry foreign exchange exposure (see Friberg and Nydahl, 1999; Hutson and Stevenson, 2010). In particular, Hutson and Stevenson (2010) provide a detailed and large sample analysis across 23 developed countries finding consistent evidence of a positive relationship between openness and foreign exchange exposure, using a number of openness proxies. Our results indicate the dominant role played by the cash flow channel and the particularly large divergence in relation to the discount rate channel, the more open the market.

The formal identification of the channels of foreign exchange exposure will be of interest to both international investors and corporate managers. Investors concern in relation to unexpected changes in foreign exchange is driven by the potential impact on industry portfolio values. Our results indicate the dominant role played by the cash flow channel, compared to the discount rate channel. For the investor the implications of our results are that the permanent effects on wealth are greater than the transitory effects on wealth and so future investment opportunities are reduced. Campbell and Vuolteenaho (2004) refer to this as the ‘bad’ beta outweighing the ‘good’ beta. From the corporate managers perspective, our results highlight the significant role played by both transaction and operating exposure via the cash flow channel, in particular for open markets. However, more importantly, our results indicate the influence of foreign exchange exposure on future

<sup>6</sup> For robustness and comparison with the existing literature we also report results from the Jorion (1990) model in Section 3.3.

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