



# Time-varying nature and macroeconomic determinants of exchange rate pass-through



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## ABSTRACT

The objectives of this study are two-fold: i) to derive time-varying exchange rate pass-through (ERPT) degree and ii) investigate the macroeconomic determinants of the degree of ERPT. For this purpose, the study adopts a distinct methodology combining Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) and panel threshold regression analyses. The data from a large sample of countries are used and time-varying ERPT measure is obtained with an application of DCC-GARCH to each country in the sample. Then the macroeconomic determinants of ERPT are examined by making use of both cross country and time variations in a panel regression model. The time varying structure of ERPT clearly shows that the ERPT degree has been low over the last three decades and declining dramatically since mid-1990s. Further, ERPT responds positively to average inflation and inflation rate volatility while negatively to exchange rate volatility, the degree of openness and output gap.

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## 1. Introduction

Transmission of the movements in exchange rates to import prices and domestic prices is known as *exchange rate pass-through*, a phenomenon that has policy implications in many ways. As it is well-known, the fluctuations in exchange rates may have a direct impact on price stability, financial stability as well as trade balance. Especially, the fact that many central banks have adopted inflation targeting strategy in recent decades makes it necessary to closely follow the linkage between exchange rates and prices. The literature extended to include emerging market economies since many developing countries have adopted flexible exchange rate regime along with inflation targeting strategy for the last two decades. The degree and speed of ERPT play an important role in the choice of optimal monetary policy and exchange rate regime. Thus many theoretical and empirical studies have been conducted to understand different aspects of the ERPT phenomenon.

One of the stylized facts in the literature is that the degree of ERPT is time-varying and more specifically is declining substantially over the last decades (Bouakez & Rebei, 2008; Bussiere & Peltonen, 2007; Campa & Goldberg, 2005; Goldberg & Campa, 2010; Gust, Leduc, & Vigfusson, 2006; Marazzi et al., 2005; Olivei, 2002; Sekine, 2006). The theoretical studies examining the potential reasons for the decline in ERPT put forward micro- and macro-based approaches. Micro-based approach brings several explanations regarding the structural features of goods markets such as pricing to market and local currency pricing behaviors (Devereux & Engel, 2001; Dornbusch, 1987; Knetter, 1993; Krugman, 1986; María-Dolores, 2010). Whereas, macro-based approach primarily adopting new

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open economy macroeconomic models discusses the issue in a staggered price setting (Devereux & Yetman, 2010; Engel, 2002) or focuses on the effects of average inflation rate (monetary policy stance) on the degree of ERPT (Taylor, 2000).

Some studies in the literature investigate time-varying ERPTs with an application of rolling regressions, split sample estimations, Kalman filtering or Stochastic volatility (time-varying parameter) model (Campa & Goldberg, 2005; Ghosh & Rajan, 2009a, 2009b; Marazzi et al., 2005; Otani, Shiratsuka, & Shirota, 2003; Sekine, 2006). Ghosh and Rajan (2009a) apply a recursive estimation methodology (rolling regression) for Korea and Thailand and Ghosh and Rajan (2009b) apply Kalman Filtering technique for Singapore to obtain time-varying ERPT degrees and document a downward trend in ERPT. The study by Choudhri and Hakura (2006) obtain the time-varying ERPT degrees for 71 countries over the periods of 1979–2000 by splitting the sample period based on inflation levels (low, medium, high inflation regimes). They find low degrees of ERPT in these countries during the low inflation periods. Marazzi et al. (2005) and Otani et al. (2003) document an abrupt and large decline after 1997 for some major industrialized economies. However Sekine (2006) using a stochastic volatility model finds that there is a gradual (smooth) decline in ERPT and the timing of decline is not the same. Sekine (2006) and Holmes (2009) criticize rolling regressions and split sample estimation methods in that these techniques assume parameter constancy during the selected window or divided sample period. Moreover, nonlinearities and/or asymmetries in time-varying ERPTs are considered by employing Markov-switching or STAR models where inflation rate is taken as the regime shifting or transitioning variable (Herzberg, Kapetanios, & Price, 2003 for UK; Holmes, 2009 for New Zealand and Shintani, Terada-Hagiwara, & Yabu, 2013 for the US). These studies generally confirm the Taylor's hypothesis that ERPT becomes lower in low inflation regimes.

The present study revisits the time varying nature of ERPT, proposing an alternative way of gauging the degree of time-varying ERPTs. To this end, this paper employs a DCC-GARCH (Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity, Engle, 2002) model to a large and heterogeneous sample of 88 countries. This method is successfully applied in different contexts such as contagion and interdependencies of stock prices, exchange rates and goods prices across countries. This paper, to the best of our knowledge, is the first to use DCC-GARCH method to obtain time-varying ERPT degrees (coefficients). An important advantage of this method is that it allows us to take into account of the effects of time-varying conditional correlations between exchange rates and prices on the ERPT coefficient. Therefore, it improves the estimates of ERPT coefficients by considering the dynamic structure of the link between exchange rates and prices as a result of a change in monetary or exchange rate policies. Further, this method allows us to obtain conditional correlation coefficients from the standardized residuals and thus overcome the problem of heteroskedasticity (Chiang, Jeon, & Li, 2007). Another advantage is that it takes into consideration the time-dependent excessive volatility in the link between exchange rates and prices and hence addresses the bias problems resulting from volatility (Cho & Parhizgari, 2008).

After applying DCC-GARCH method to each country in the sample over 1980–2013 and obtaining the time-varying ERPT elasticities as the first step, we examine potential macroeconomic factors (such as average inflation rate, inflation volatility and exchange rate volatility as well as output gap and openness measures) affecting the ERPT degree as the second step. In this sense, this study follows a two stage methodological approach similar to the studies by Gagnon and Ihrig (2004), Choudhri and Hakura (2001, 2006) and Devereux and Yetman (2002a, 2010). These studies focus on the determinants of time-varying ERPTs using split sample estimation technique. Whereas this paper measures the degrees of time-varying ERPTs using DCC-GARCH method, which is not subject to the criticized assumption of parameter constancy. This also, along with the other advantages, makes it convenient to investigate the posited explanations for time-varying ERPTs in the context of panel regressions. In this setting, we also investigate the nonlinear responses of ERPT to average inflation by means of panel threshold regression.

Furthermore, since our sample consists of rather heterogeneous economies (41 developing, 19 less developed, 28 advanced countries) that have different experiences; one expects the behavior of ERPT over time is likely to differ across these groups of countries for a number of reasons. Calvo and Reinhart (2000) for instance document that the ERPT is larger in developing than in advanced countries. While ERPT is found to be lower in advanced countries that experience low inflation over the last three decades (Engel, 2002), it is reported to be higher in developing countries that face historically high inflation rates (Calvo & Reinhart, 2002; Devereux & Yetman, 2010) or low credibility of monetary policy (Schmidt-Hebbel & Werner, 2002). A study by Choudhri and Hakura (2006) supports this, finding that it is mainly the average inflation rate that leads to different ERPT in these countries. Moreover, Frankel, Parsley, and Wei (2012) argue that low pass-through is no longer a luxury for advanced economies but developing economies also start to enjoy lower ERPT in the 2000s. Therefore, this paper investigates the questions of whether the ERPT differs across country groups over time and, if so, responds differently to potential determinants.

The rest of the paper is organized as follows. The second section discusses the potential macroeconomic factors influencing the degree of ERPT and explains underlying mechanisms through which the ERPT is affected. The third section lays out how DCC-GARCH method is used to obtain time-varying ERPT coefficients and specifies a panel regression in order to investigate the determinants of ERPT. In the fourth section, the data set is introduced and results are evaluated. The last section concludes with some policy implications.

## 2. Macroeconomic factors affecting the degree of ERPT

The studies adopting new open economy macroeconomic models under the setting of staggered pricing and monopolistically competitive markets provide some intuition regarding the ERPT (Taylor, 2000). Accordingly, firms set their prices beforehand and increase the prices only if a rise in costs due to the movements in exchange rate is perceived to be persistent. A high inflationary environment provides a suitable condition for the perception of persistent increases in costs resulting from fluctuations in exchange rates. In this case, firms tend to reflect increasing costs on their prices easily. Therefore, ERPT is expected to be higher (lower) in high (low)

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