E C O N O M I C S B U L L E T I N

Is a more stable exchange rate associated with reduced exchange rate pass-through?

Mark J. Holmes
University of Waikato

Abstract

Pass-through from the nominal effective exchange rate to import prices is modelled within a regime-switching environment. Evidence suggests that exchange rate pass through can be characterised as regime-specific where the probability of switching between regimes is influenced by the extent of exchange rate volatility.

Citation: Holmes, Mark J., (2007) "Is a more stable exchange rate associated with reduced exchange rate pass-through?." *Economics Bulletin,* Vol. 6, No. 39 pp. 1-12
Submitted: September 17, 2007. **Accepted:** October 9, 2007.
URL: http://economicsbulletin.vanderbilt.edu/2007/volume6/EB-07F40022A.pdf

1. Introduction

The extent of exchange rate pass-through (ERPT) from the nominal exchange rate to import prices is indicative of the extent of economic and financial interdependence with implications for the impact of exchange rate changes on the control of domestic inflation as well as net exports. Several studies have observed that ERPT has been both incomplete and varied over time with recent research suggesting that ERPT declines in response to a more stable nominal exchange rate [Devereux and Engle (2001)].

While debate over the nature of ERPT has concerned the prevalence of producer-currency versus local-currency pricing of imports, this paper focuses on the role played by variability of the nominal exchange rate. In assessing the impact of changes in the macroeconomic environment on ERPT, studies have typically pursued a methodological approach based on either (i) a two-stage process where an ERPT coefficient is estimated for each country using time-series data, and then the derived ERPT coefficients are regressed against a range of explanatory variables (see, for example, Campa and Goldberg (2005)), or (ii) dividing the study period into sub-periods and noting how the ERPT coefficient has changed over time (see, for example, McCarthy (2000)). In this study, an alternative approach is proposed where ERPT modelled within a Markov regime-switching framework giving rise to regimes of higher and lower ERPT. New insight into ERPT is obtained through analysing the inferred probability of being in a particular regime, and the influence of exchange rate volatility on the transition probabilities attached to switching between regimes. The advantages of this approach are that problems associated with estimation using generated regressors in the two stage methodology are avoided, and one avoids having to arbitrarily sub-divide the study period if the second approach is adopted. .

The following section discusses the ERPT literature and the Markov regime-switching methodology developed and employed in this paper. The third section describes the data and results. Using UK data for the study period 1980Q1-2007Q1, we find evidence of regime-switching where increased (reduced) exchange rate volatility leads to a reduction (increase) in the probability of remaining in the low ERPT regime. The final section concludes.

2. Regime-switching Exchange Rate Pass Through

In the debate over producer-currency versus local-currency pricing of imports, the traditional ERPT literature is concerned with pass-through from the exchange rate to import prices stressing the role of market power and price discrimination in international markets (pricing to market).[1] Theory argues that volatility in monetary aggregates and exchange rates of countries should influence the choice of invoice currencies in trade [for example, see Devereux and Engel (2001)]. In equilibrium, countries with low relative exchange rate variability, or stable monetary policies, would have their currencies chosen for transaction invoicing. The low-exchange-rate-variability countries would also be those with lower ERPT.

The micro-foundations of pricing behaviour by exporters are a useful starting point for understanding the dynamics of ERPT into import prices. Log import prices for any country, p_t^m, are a transformation of log export prices of that country's trading partners, p_t^x, using the log nominal exchange rate (domestic currency per unit foreign currency), e_t:

$$p_t^m = e_t + p_t^x \tag{1}$$

[1] See, for example, Goldberg and Knetter (1997), Marazzi and Sheets (2007) and references therein.

Assume that $p_t^x = mkup_t^x + mc_t^x$ is a mark-up ($mkup_t^x$) over exporter marginal costs (mc_t^x) where mark-ups are sensitive to macroeconomic conditions, expressed for simplicity as a function only of the exchange rate: $mkup_t^x = \phi + \Phi e_t$. We can specify exporter marginal costs as rising with export market wages, w_t^x, and destination market demand conditions, y_t so $mc_t^x = c_0 y_t + c_1 w_t^x$. This enables equation (1) to be written as

$$p_t^m = \phi + \beta e_t + c_0 y_t + c_1 w_t^x \tag{2}$$

This structure permits ERPT, $\beta = (1+\Phi)$, to depend on the structure of competition in the economy with a direct analogy in the debate concerning producer- versus local-currency pricing. If $\beta = 1$ ($\Phi = 0$), producer-currency pricing takes place; if $\beta = 0$ ($\Phi = -1$), local-currency pricing occurs, and exporters fully absorb the fluctuations in exchange rates in their own mark-ups. To account for the short-run ERPT relationship, equation (2) can be rewritten as

$$\Delta p_t^m = \alpha + \sum_{i=0}^{4} a_i \Delta e_{t-i} + \sum_{i=0}^{4} b_i \Delta w_{t-i} + \sum_{i=0}^{4} c_i \Delta y_{t-i} + \sum_{i=1}^{4} d_i \Delta p_{t-i}^m + \varepsilon_t \tag{3}$$

This paper focuses on modelling and estimating ERPT within a regime-switching context. Suppose a discrete random variable S_t takes two possible values $S_t = [0,1]$ and serves as an indicator for the state of the economy at time *t*. The expected change in import prices, conditional on the value of S_t, is given as:

$$\begin{gathered} E(\Delta p_t^m \mid S_t) = [(1-S_t)\alpha_0 + S_t \alpha_1] + (1-S_t)\sum_{i=0}^{4} a_{0,i} \Delta e_{t-i} + S_t \sum_{i=0}^{4} a_{1,i} \Delta e_{t-i} + \\ \sum_{i=0}^{4} b_i \Delta w_{t-i} + \sum_{i=0}^{4} c_i \Delta y_{t-i} + \sum_{i=1}^{4} d_i \Delta p_{t-i}^m + \varepsilon_t \end{gathered} \tag{4}$$

where $\varepsilon_t \sim i.i.d.N(0, \sigma_\varepsilon^2(S_t))$. Following Hamilton (1989), the unobserved indicator variable, S_t, evolves according to a first-order Markov-switching process:

$\Pr[S_t = 0 \mid S_{t-1} = 0] = p_{00}$, $\Pr[S_t = 1 \mid S_{t-1} = 0] = (1 - p_{00})$, $\Pr[S_t = 1 \mid S_{t-1} = 1] = p_{11}$

$\Pr[S_t = 0 \mid S_{t-1} = 1] = (1 - p_{11})$ where p_{00} and p_{11} are the fixed transition probabilities of being in Regime 0 or 1 respectively. This model can be denoted as the *Fixed Transition Probabilities (FTP) Model*. This model allows ERPT to be regime-specific characterised by differing elasticities. Extending the fixed two-state Markov-switching chain to allow for the possibility of time-varying transition probabilities enables us to specify:

$$\begin{aligned} \Pr\left[S_t = 0 \mid S_{t-1} = 0, \Omega_{t-1}, \Omega_{t-2}, \cdots\right] = p_{00} = \Psi\left(\varsigma_0 + \sum_{i=1}^{m} \vartheta_i \Omega_{t-i}\right) \\ \Pr\left[S_t = 1 \mid S_{t-1} = 1, \Omega_{t-1}, \Omega_{t-2}, \cdots\right] = p_{11} = \Psi\left(\varsigma_1 + \sum_{i=1}^{n} \kappa_i \Omega_{t-i}\right) \end{aligned} \qquad (5)$$

where $\Psi(\ )$ is the cumulative normal distribution function ensuring that the transition probabilities lie in the open interval $(0,1)$ and Ω denotes exchange rate volatility. This gives rise to *Time-varying Transition Probabilities (TVP) Model* where exchange rate volatility affects the probability of being in a particular regime.

3. Data and Results

Data for the effective exchange rate are taken from the OECD database, while import price and real GDP data are taken from the IMF database. Following Campa and Goldberg (2005), exporter costs relevant the UK, w_t, are proxied by taking the log real effective exchange rate and subtracting both the log nominal effective exchange rate and the log domestic consumer price index. This provides a measure of trading-partner costs (over all partners of the UK), with each partner weighted by its importance in UK trade. Finally, nominal exchange rate volatility is based on the absolute change in the bilateral exchange rate with respect to the US dollar.[2]

Having started with a maximum of four lags, the inclusion of one lagged value of Δe, Δw and Δp in equations (4) and (5) was found to be acceptable using various model selection procedures. The estimates of the log likelihood values associated with both the single-regime OLS and FTP models are reported in Table 1. The application of the non-standard LR-test proposed by Davies (1987) produces a statistic of 139.928 that leads to the strong rejection of the single-regime OLS model in favour of the regime-switching FTP Model.

Given the evidence in favour of regime-switching ERPT, this study considers whether the transition probabilities are constant or time-varying (as represented by equations (4) and (5)). Table 1 reports that the preferred model involving time-varying transition probabilities offers a significant improvement in log likelihood function. This is underlined with a LR statistic of 6.72.

Table 2 reports the estimated TVP Model. We find the short-run ERPT coefficients $a_{0,0}$ and $a_{1,0}$ are positive, significantly different from zero and each other at the 10% significance level or better. Lower ERPT occurs in Regime 0 with a coefficient of 0.261 compared with a higher ERPT coefficient of 0.492 in Regime 1 where ERPT is a balanced combination of producer- and local currency pricing Regime 0 on the other hand, has a greater leaning towards local currency pricing. These values contrast with the single short-run elasticity of 0.36 computed for the UK by Campa and Goldberg (2005). Further to this, each of the coefficients on the control

---

[2] Nominal exchange rate volatility is measured as $\Omega_t = \sum_{i=0}^{3} \frac{|\Delta e_{t-i}|}{4}$. The employment of alternative volatility measures based on different lag lengths made no qualitative difference to the results obtained.

variables- w_t and y_t - are both positive and significant and rejection of the null $\sigma_0 = \sigma_1$ throughout is consistent with the ERPT regimes being characterised by different volatilities. With regard to the transition probabilities of switching between regimes, $\vartheta_1 < 0$ indicates that an increase (decrease) in exchange rate volatility is associated with a decrease (increase) in the probability of remaining in the low ERPT Regime 0.

Figure 1 graphs the inferred probabilities of being in Regime 0 against exchange rate volatility. Regimes of high ERPT are associated with high exchange rate volatility. For example, exchange rate volatility was particularly high during periods such as 1985Q2-87Q2, 1992Q4-93Q2 and 1997Q1-97Q3. These periods are characterised by the UK moving towards a high probability of being in the high ERPT Regime 1. The event study by Cunningham and Haldane (1999) considers the 15% depreciation and Sterling following its exit from the ERM in 1992, and the roughly 15% appreciation of Sterling between September 1996 and April 1997 and suggests a remarkably small pass-through of exchange rate changes to retail prices. The regime-switching approach offers a different perspective on the UK experience. These periods of exchange rate turbulence are in fact associated with a shift to a higher ERPT regime. However, even in Regime 1 less than half the change in the nominal exchange rate is actually passed through to import prices. Following these periods of exchange rate turbulence, a regime of relatively low pass through is restored once exchange rate volatility has fallen.

4. Concluding Comments

The employment of Markov regime-switching techniques offers a new perspective on exchange rate pass through to import prices. This can be viewed as subject to regime-switching between higher and lower rates of pass through where exchange rate volatility influences the probability of switching between regimes. Episodes of sharp exchange rate fluctuations are accompanied by a shift into a higher pass through regime before a lower pass through rate is again restored. Future research might consider other potential drivers of regime-switching pass through such as inflation, or gain additional insight through an examination at a more disaggregated, industrial sector, level.

Table 1. Tests for Regime-Switching

LL: OLS	LL:FTP	LL: TVP	LR_1	LR_2
-224.103	-154.139	-151.053	139.928 (0.000)	6.172 (0.046)

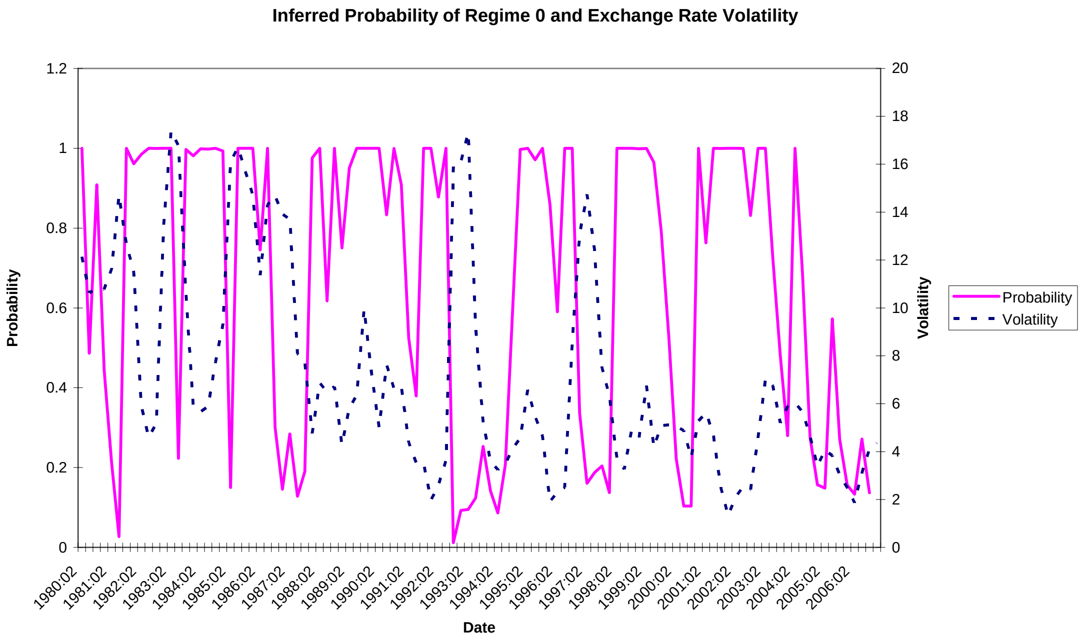
LL: log likelihood values derived from estimation of the FTP and TVP models: LR_1: LR statistic for testing the null of no regime-switching against the alternative of regime-switching with fixed transition probabilities. Each LR_1 statistic is distributed as $\chi^2(5)$ on the null. LR_2: LR statistic for testing the null of regime-switching with fixed transition probabilities against the alternative of regime-switching with varying transition probabilities. Each LR_2 statistic is distributed as $\chi^2(2)$ on the null. Figures reported in the brackets are Davies (1987) upper bound p-values.

Table 2. Estimation of the TVP Model

α_0	-0.720*** (0.161)
α_1	-0.154*** (0.061)
$a_{0,0}$	0.261*** (0.060)
$a_{1,0}$	0.492*** (0.025)
σ_0	1.741*** (0.266)
σ_1	0.083*** (0.030)
b_0	0.829*** (0.055)
c_0	0.251*** (0.063)
d_1	0.307*** (0.018)
ς_0	3.525*** (0.483)
ς_1	1.317*** (0.462)
ϑ_1	-0.194*** (0.042)
κ_1	-0.025 (0.054)
Null[1]	38.280***
Null[2]	12.769***

Standard errors are reported in parentheses. Null[1]: null hypothesis $\sigma_0 = \sigma_1$; Null[2]: null hypothesis $a_{0,0} = a_{1,0}$; *** : rejection of the null at the 1% significance level.

Figure 1



Inferred Probability of Regime 0 and Exchange Rate Volatility
Probability
Volatility
Date
1.2
1
0.8
0.6
0.4
0.2
0
20
18
16
14
12
10
8
6
4
2
0
1980:02
1981:02
1982:02
1983:02
1984:02
1985:02
1986:02
1987:02
1988:02
1989:02
1990:02
1991:02
1992:02
1993:02
1994:02
1995:02
1996:02
1997:02
1998:02
1999:02
2000:02
2001:02
2002:02
2003:02
2004:02
2005:02
2006:02
Probability
Volatility

References

Campa, J. M. and L. S. Goldberg (2005), "Exchange rate pass through into import prices", *Review of Economics and Statistics*, 87, 679-90.

Cunningham, A., and A. Haldane (1999). "The Monetary Transmission Mechanism in the United Kingdom: Pass Through and Policy Rules." in *Monetary Policy: Rules and Transmission Mechanisms*, edited by Loayza, N. and K. Scmidt-Hebbel, Banco Central de Chile, Santiago, Chile.

Davies, R. B. (1987) "Hypothesis Testing when a Nuisance Parameter is Present only under the Alternative", Biometrika 74, 33-43.

Devereux, M.B., and C. Engel (2001). "Endogenous Currency of Price Setting in a Dynamic Open Economy Model," National Bureau of Economic Research, Working Paper No. 8559.

Goldberg, P.K., and M. Knetter (1997). "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature* 35, 1243-72.

Hamilton, J. D. (1989) "A new approach to the economic analysis of nonstationary time series and the business cycle", *Econometrica*, 57, 357-384.

Marazzi, M., and N. Sheets (2007) "Declining exchange rate pass-through to U.S. import prices: The potential role of global factors", *Journal of International Money and Finance*, 26, 924-47.

McCarthy, J. (2000). "Pass-through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies." mimeo, Federal Reserve Bank of New York.