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Is low inflation really causing the decline in exchange rate pass-through?

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Abstract

Recent literature has argued that exchange rate pass-through (ERPT) into domestic inflation has been declining in many countries following a dramatic change in inflation environment during the 1990s. Available empirical results face two central challenges: (i) the evidence on declining ERPT is mostly based on sample-splitting approaches and hence subject to a degree of arbitrariness; and (ii) the link between a lower ERPT and inflation environment is usually based on simple correlation analysis and hence silent about temporal causality. We address these issues by making use of a state-space model that allows ERPT to be time-varying and dependent on the inflation environment. We estimate the model for 12 developed and emerging economies and test whether inflation contains significant information about the future evolution of the ERPT. The results reinforce the view of a smooth decline in the impact of exchange rates on domestic inflation, but do not support the hypothesis that lower inflation precedes this declining ERPT.

JEL Classification: E42, E52, E58, F31, F41.

Keywords: Exchange Rate Pass-Through, Inflation, State-space Models, Causality Tests.

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1 Introduction

The degree of pass-through from exchange rate changes into domestic inflation appears to have been declining in many countries in recent years (see, e.g., Campa and Goldberg, 2005; Bailliu and Fujii, 2004; Gagnon and Ihrig, 2004; Bouakez and Rebei, 2008; Choudhri and Hakura, 2006). A common explanation for this decline is that it is a by-product of the low inflation environment of the 1990s. Taylor (2000) was the first to provide an interpretation of the declining exchange rate pass through (ERPT) related to a lower inflation environment. He argued that with staggered prices firms are more likely to pass-through cost changes, including those from the exchange rate, when inflation is high. A similar argument is developed in Devereux and Yetman (forthcoming), where the degree of pass-through is a function of the stance of monetary policy as it affects the degree of price stickiness. When firms can adjust their frequency of price changes, loose monetary policy (high inflation) leads to higher ERPT. In this sense, ERPT would be endogenous to a country's inflation performance. Campa and Goldberg (2005), Gagnon and Ihrig (2004), Choudhri and Hakura (2006), among others, have analyzed this relationship, finding a positive correlation between ERPT and inflation indicators.

Most of the existing evidence on the decline in ERPT is provided by splitting the estimation sample, as in Campa and Goldberg (2005), Gagnon and Ihrig (2004) and Choudhri and Hakura (2006), or by rolling regressions, as in Reyes (2003). Those practices do not provide a precise timing of the exchange rate parameter shift and involve a degree of arbitrary choice of the sample splitting date or the rolling window. It is also often the case with rolling regressions that the timing of shifts crucially depends on the size of the windows. Three exceptions to these approaches are Kim (1990) that applies the Kalman Filter to U.S. data until the mid-1980s; Amstad and Fischer (2005) whose approach is an application of event-study procedures used in empirical finance to Switzerland; and Sekine (2006), who estimates ERPT for some developed economies using a time-varying parameter with stochastic volatility model. The latter finds that ERPT into consumer inflation has declined over time for all economies analysed, and that there is high correlation between the estimated ERPT and the observed inflation rate.

Empirical investigations on the causes of this decline encounter the difficulty that ERPT is an unobservable variable. In this sense, testing whether inflation is driving down ERPT is not an easy task. Moreover, the previous literature has tested Taylor's hypothesis that the inflation environment is inducing a decrease in ERPT by analyzing cross-country correlations between inflation and ERPT. The main limitation of this procedure is that correlations do not imply causality. The positive correlation between ERPT and inflation may also imply causality on the other direction or that a third variable is driving both ERPT and inflation.

In order to address these issues, we model ERPT by means of a state-space model, allowing for time variation in the ERPT coefficient. The state-space model presents a flexible structure that allows testing the causal relationships postulated in the literature in terms of temporal causality. That is, we ask the question whether a decline in inflation contains significant information for the future evolution of the ERPT. The model is based on a simple backward-looking Phillips curve augmented with exchange rate and import price changes. The specification allows the ERPT to depend on lagged inflation. We then apply Wald and Likelihood ratio tests for the hypothesis that lagged inflation is a significant determinant of the ERPT coefficient.[1]

We apply these tests to a set of 12 developed and emerging market countries. Our results show that ERPT has indeed declined for all the economies under consideration, as suggested by the previous literature. Moreover, we too observe a high correlation between ERPT and the inflation environment. However, our results do not support the hypothesis that falling inflation precedes the decline in ERPT.

The remainder of the paper is structured as follows. Section 2 briefly discusses the recent literature on the declining ERPT issue. Section 3 presents the methodology. Section 4 presents the results. Finally, section 5 concludes.

2 Background

There is plenty econometric evidence that ERPT has been declining in many countries in recent years. As this decrease occurred in a period of declining inflation, several studies started to consider the possibility that ERPT is endogenous to the inflation regime. In favor of this argument lies the fact that most of the economies for which there is evidence of a falling ERPT have adopted Inflation Targeting at some point during the 1990s, and have successfully used this framework to drive down inflation.

Taylor (2000) was the first to provide a theoretical model relating the decline of ERPT to a lower inflation environment. This is explained through a model of firm behaviour based on staggered price setting and monopolistic competition. As firms

[1]Other studies such as Nogueira and León-Ledesma (2008) and Shintani et al (2009) test the hypothesis in the context of nonlinear time-series models and find that inflation appears to drive smooth changes in ERPT regimes. These studies, however, focus on specific nonlinear functional forms and are thus more restrictive.

set prices for several periods in advance, they are more responsive to cost increases due to exchange rate movements if cost changes are perceived to be persistent. As regimes with higher inflation tend to lead to persistent cost changes, Taylor argued that a high inflation environment would thus tend to increase ERPT. In other words, ERPT would be endogenous to a country's inflation performance. Devereux and Yetman (forthcoming) develop a related argument. In their model with sticky prices, they allow for the frequency prices changes to be chosen by firms. For a given menu cost of changing prices, their model shows that firms will choose a higher frequency of price adjustment the higher is the average rate of inflation and the volatility of the nominal exchange rate. The higher is the frequency of price changes, the greater is ERPT.[2]

Campa and Goldberg (2005) argue that an important implication of Taylor's argument is that there is a virtuous circle where low inflation leads to reduced ERPT, which makes it easier to keep inflation low, therefore keeping ERPT low. However, this circle is fragile, as it can be broken by adverse supply shocks. Campa and Goldberg (2005) tested Taylor's hypothesis using of correlation analysis between ERPT estimates and a set of macro and micro variables, and concluded that although the argument has some statistical merit, it is not of first importance for the low and medium inflation countries of the OECD. For those countries they argued that the lower ERPT was brought about by a change in the composition of the import bundle.[3]

Choudhri and Hakura (2006) also found strong evidence of a positive correlation between ERPT and the average inflation for a large sample of developed and emerging market economies. They also explored the influence of other variables, but found that average inflation dominates in explaining differences in observed ERPT. Similar results were found by Ca'Zorzi, Hahn and Sánchez (2007) for a sample of emerging markets.

Bailliu and Fujii (2004) presented evidence for some developed economies that adopted Inflation Targeting. Their findings support the hypothesis that ERPT

[2]Other explanations for the existence of low ERPT are based on "micro" arguments such as the combination of monopolistic exporters that price to market and a domestic distribution sector intensive in the use of local inputs (see Corsetti and Dedola, 2005). These, however, require extra assumptions regarding the causes of the *decline* in ERPT, which could be related to changes in the structure of imports during the process of world trade integration, as in Campa and Goldberg (2005).

[3]Choudhri and Hakura (2006) argued that Campa and Goldberg (2005) have analysed ERPT to import prices and not to consumer prices. Hence, they analysed the price behaviour of foreign firms, which may not be strongly related to the home inflationary environment. In this sense, evidence on ERPT to domestic prices would provide a more appropriate test of Taylor's hypothesis.

declines with a shift to a low inflation environment brought about by a change in the monetary policy regime. More specifically, the results suggest that ERPT declined following the inflation stabilization that occurred after the adoption of Inflation Targeting, but did not decline following a similar episode in the 1980s. They argued that a potential explanation for this finding is that changes in policy implemented in the 1990s were perceived as more credible than those carried out in the 1980s.

Mishkin and Savastano (2001), Leiderman and Bar-Or (2000) and Schmidt-Hebbel and Tapia (2002) have also argued that ERPT depends on the credibility of the monetary policy. The basic hypothesis is that ERPT is likely to decline over time as the country's anti-inflationary commitment becomes clearer.[4]

As discussed by Reyes (2003) this finding is mostly important for countries that adopted Inflation Targeting. In a credible regime, expectations are likely to be in line with the authority's inflation target and, therefore, will be less influenced by short-run exchange rate changes.[5]

Choudhri and Hakura (2006) provide a link between the low inflation and the high credibility hypothesis for the falling ERPT. They derive a negative association between ERPT and the degree to which monetary policy offsets short-run price deviations from the long-run target. A regime that reacts aggressively to price deviations lowers ERPT by weakening the expected future effect of shocks. As regimes that make a stronger effort in stabilizing short-run inflation are also able to maintain low inflation in the long-run, they argue that the rate of inflation can be used as an indicator of the aggressiveness of monetary policy response to short-run price fluctuations.

A similar argument is used by Gagnon and Ihrig (2004) who explored the relationship between inflation, monetary policy credibility and ERPT for some developed economies. They analyzed the link between ERPT and parameters estimated from Taylor-rules, but failed to find a robust relationship. Their hypothesis is that, when

[4]Eichengreen (2004) argued that emerging market economies tend to have a high ERPT as their institutions lack credibility. His argument is that under imperfect credibility the market takes transitory exchange rate shocks as permanent, thus influencing the degree of ERPT.

[5]Levin, Natalucci and Piger (2004), Schmidt-Hebbel and Tapia (2002), Minella et al. (2003) and others have tested the inflation response to nominal shocks, such as those from the exchange rate, in Inflation Targeting regimes. These studies are generally based upon SVAR models. The results show that shocks are weaker and less persistent under Inflation Targeting, suggesting a reduced role for price-indexation, and reinforcing the importance of the inflation target to anchor inflation expectations and, as consequence, for lowering ERPT. Levin, Natalucci and Piger (2004) and Minella et al. (2003) actually suggest using the degree of ERPT as a proxy of monetary policy credibility.

a central bank acts aggressively to stabilize inflation, it tightens policy to offset any inflationary effect from a rise in import prices. When the market realizes about the central bank's intentions, they are less likely to pass-through cost increases, including those coming from the exchange rate. Nevertheless, they were able to find similar results to those of Choudhri and Hakura (2006), showing a strong correlation between ERPT estimates and indicators of the inflation environment.

3 Methodology

We use a state-space specification to model a time-varying ERPT. A wide variety of time-series models can be written and estimated as special cases of a state-space specification. Extensive examples of applications of state-space models can be found in Harvey (1989). One important advantage of the state-space model is that it allows unobserved variables (the state variables) to be estimated using the information contained in the the observable model. State-space models can be estimated using the Kalman Filter recursive algorithm, which is commonly employed in time-varying coefficient models. A very important feature of state equations for our purposes is their flexibility, as they may contain exogenous variables and unknown coefficients.

The state-space model consists of the measurement equations and the state equations. The Kalman filtering approach provides optimal estimates for state variables based on the information from the two sources, the measurement and the state equations. We present a simple model consisting of equations (1) and (2) below:

$$\Delta p_t = \alpha + \beta \Delta p_{t-1} + \chi \Delta p_{t-1}^{imp} + \delta \Delta y_{t-1} + \gamma_t \Delta e_{t-1} + \varepsilon_t, \tag{1}$$

$$\gamma_t = \gamma_{t-1} + \sum_{i=1}^{n} \phi_i \pi_{t-i} + \mu_t, \tag{2}$$

where (1) and (2) are the measurement and state equations respectively. Δp_t is the quarterly rate of inflation; Δp_t^{imp} is import price inflation; Δe_t is the exchange rate change; Δy_t is output growth;[6] and π_t is the inflation environment (defined as year-on-year inflation). The terms ε_t and μ_t are independent normally distributed errors, with zero mean and constant variance. The parameter γ_t is our time-varying short-run ERPT, i.e. the lagged one-quarter effect of exchange rate changes on

[6] The problem of smoothing output to obtain output gap, especially using HP Filter is discussed in several papers, as King and Rebelo (1993), Harvey and Jaeger (1993), and Cogley and Nason (1995). It is, for example, widely recognized that the smoothing parameter may be different for different countries. Besides, ad-hoc de-trending processes may eliminate information from the data. Following this, we have opted to use output growth instead of some output gap measure.

consumer prices. We only allow the ERPT coefficient to be time-varying to avoid over-parameterization given the available sample sizes. The system is estimated using the Kalman Filter technique. Note that we imposed a unit root in the state equation. As discussed in Harvey (1989) and Sekine (2006) this is a standard procedure in the literature that allows for possible level breaks or trend patterns to be captured.

The measurement equation (1) follows the traditional specifications used in the literature on ERPT, and is similar to that estimated in Campa and Goldberg (2005), Choudhri and Hakura (2006) and Gagnon and Ihrig (2004). The equation represents a backward-looking Phillips curve, controlling for the exchange rate and the foreign price of imports. As shown by Campa and Goldberg (2005), empirical specifications that seek to isolate ERPT should introduce controls for the foreign costs, as without such controls the measured relationship is a statistical correlation without specific interpretation in terms of ERPT.[7] In our specification (2)of the ERPT effect we included lags of the “inflation environment” measured as the year-on-year inflation rate. That is, ERPT is modeled as a function of its past value and of the inflation environment. This specification allows us to formally test for the information content of lagged inflation for current ERPT.

To obtain time-series for the state variables we applied the Kalman Smoothing procedure. The smoothing uses all the information in the sample to provide smoothed estimates of the states and variances. This procedure differs from the Kalman Filtering in the construction of the state series, as this technique uses only the information available up to the beginning of the estimation period.

We make use of Wald and Likelihood ratio tests for the null hypothesis $H_0 : \sum_{i=1}^{n} \phi_i = 0$. That is, whether the inflation environment causes the ERPT in the Granger-causal sense. The Wald test follows the traditional χ^2 distribution. Regarding the Likelihood ratio test (λ), when the sample size is large, it also follows a χ^2 distribution with degrees of freedom equal to the number of restrictions imposed by the null hypothesis. If the λ statistic exceeds the critical value at the chosen level of significance, the null hypothesis is rejected.[8]

As mentioned before, the previous literature has analyzed simple correlations between ERPT and the rate of inflation for cross-sections of countries. This approach,

[7]Note that the local currency price of a good can vary as a result of a change in the exchange rate, a change in the firm's marginal cost, and a change in the firm's mark-up (which depends on the price elasticity of the good). See Campa and Golberg (2005) and Bailliu and Fujii (2004) for a discussion.

[8]See Harvey (1989) for a discussion of these tests.

however, is silent about whether inflation is useful to predict ERPT. In addition, cross-country regressions may suffer from problems of country heterogeneity, which is not the case in a time-series context. Our model allows the ERPT to be time-varying and *simultaneously* depend on lagged inflation. This also avoids standard problems involved in two-step procedures where ERPT is estimated in a first stage and then regressed on other variables in a second step.[9]

4 Data

Quarterly data were collected for twelve countries that can be split in two groups: the first one comprises six developed economies (Australia, New Zealand, Norway, Denmark, Switzerland and U.K.), and the second of six emerging markets (Czech Republic, Mexico, Colombia, Turkey, Thailand and Chile). Data were obtained from the IMF's IFS database.

The inflation rate is the seasonally adjusted quarterly rate of growth of the consumer price index.[10] Exchange rate data is the quarterly change of the national currency per unit of US dollars, so a positive variation means a depreciation of the local currency. Output data is the quarterly change of the seasonally adjusted real GDP. The GDP data was seasonally adjusted by the authors for Chile and Thailand. Because of data availability, in the cases of Norway, New Zealand, and Mexico the industrial production index was used, whereas the output control variable was not omitted from Colombia's estimations. Import prices are defined as the change in the index of dollar price of imports. This data was not available for Mexico and Switzerland, so as a proxy we used the change in the U.S. consumer prices index. The estimation samples for each country are shown in **Table 1**.

5 Results

Table 2 presents the Log Likelihood and Akaike Information Criterion for the estimated models. According to both criteria, the model performs better for the group of advanced economies, with Switzerland performing relatively best and Turkey relatively worst. **Figure 1** plots the smoothed ERPT estimates, together with $\pm$ two standard errors. The plots show that, in accordance with previous literature, the ERPT has indeed declined over time. The short-run ERPT in fact becomes statis-

[9]Implying that the first stage may be mis-specified.

[10]CPI data for Switzerland was seasonally adjusted by the authors.

tically insignificant for most countries at the end of the sample period. Clearly, the decline in ERPT seems to have been a wide-reaching phenomenon, not restricted to the developed world. The degree of ERPT for emerging markets at the start of the sample is substantially higher than that of developed countries at the same period, and hence the decline in ERPT for these countries is faster. The figures also suggest that this decline took place gradually, and not in a regime-wise way as would be the case in sample-splitting estimates. When compared to estimates obtained from rolling regressions, such as those provided by Reyes (2003) and Sekine (2006), the results hold resemblance to those, but again the decline is smoother.[11]

Moreover, the results reinforce the common view that ERPT has been traditionally higher in emerging market economies than in developed economies (see, for e.g., Calvo and Reinhart, 2002). Nevertheless, by the end of the estimation period ERPT seems to be similar between developed and emerging economies, with the exception of Turkey, that remained with substantially higher levels of ERPT. This finding is consistent with Ca'Zorzi, Hahn and Sanchez's (2007) results, who show that ERPT tends to be similar between developed economies and emerging markets with moderate rates of inflation. As mentioned earlier, the results also show that the decline in ERPT was more pronounced in our sample of emerging market economies. This is an important and generally un-noted result, with interesting implications for policy analysis. Finally, it is possible to see the important effect of exchange rate and confidence crises for the degree of ERPT. This seems to be the case for Mexico and the Czech Republic.

Figure 2 plots the estimated ERPT series together with the inflation environment variable. **Figure 3** presents simple scatter plots of these variables, together with a regression line, representing a simple visual test along the lines of the previous literature. It is clear that there is a strong positive correlation between inflation and ERPT, with both variables declining throughout the sample period. Furthermore, simple correlation analysis show an average positive coefficient of approximately 0.70, ranging from about 0.43 in Chile to 0.92 in Norway. These results are in line with priors from the existing literature.

As a first step for the analysis of the time-series properties of our data, we apply simple bi-variate causality tests between inflation and exchange rate changes. This helps understanding the temporal causality pattern between inflation and the

[11] Sekine (2006) observes that rolling regressions yield abrupt changes depending on whether specific dates in the sample are in the window. In addition, smoothed series tend to produce more gradual changes than filtered ones. However, as argued by Sims (2001), smoothed series provide more precise estimates of the actual time variation than filtered ones.

exchange rate. F-tests of Granger-causality are reported in **Table 3**. Evidence is mixed, as the results suggest that causality seems to run from exchange rate changes to inflation in 4 cases, while in another 4 it seems to be the contrary (inflation causes exchange rate changes). Only for Chile we found some evidence of bi-directional causality, and in 3 cases we did not find evidence of the causality running either way.[12]

These results, obviously, do not help answering the question of whether inflation temporally causes ERPT. Inflation may cause exchange rate changes without influencing the extent to which such changes are transmitted into prices. We then apply the Wald and Likelihood Ratio (λ) tests discussed in section 3 above. The results are presented in **Table 4**. They show that only in 2 (Denmark and Colombia) out of the 12 countries studied we are able to reject the null hypothesis that the inflation environment does not Granger-cause ERPT. We cannot reject the null for the other 10 countries. Moreover, for Denmark we can reject the null only for the LR test and just at the 10% confidence level. The results then show that, although there is a strong correlation between these variables, inflation does not generally help improve the in-sample forecast for the ERPT. This lack of information content suggests that the positive correlation between these variables may be driven by other events that occur in parallel. These can be macroeconomic events such as the reduced volatility of macroeconomic variables during this period, or microeconomic such as changes in the degree of openness (and competition) and the structure of international trade.

In summary, our results reinforce the view of the previous literature that ERPT has been declining over time. We observed that this is true for all the economies in our sample. However, if the kind of arguments put forward by Taylor (2000) and Devereux and Yetman (forthcoming) imply a temporal structure between the inflation environment and ERPT, our results are un-supportive of their existence. An improved inflation environment should help predict a lower degree of ERPT, which is not supported by our evidence. We note, however, that this exercise is limited to a sample of 12 countries. The results are compatible with the arguments of Campa and Goldberg (2005), who find that other similar deflationary periods did not lead to reduced ERPT. Nevertheless, the evidence presented does not necessarily reject a macroeconomic explanation of the reduction of ERPT into consumer prices. Other parallel developments during this period of increased global market integration may have been driving the positive correlation between both variables, including variables

[12] It is worth noting that the exchange rate forecasting literature has recently pointed towards the possibility that temporal causality between exchange rates and fundamentals runs both ways. See Engel and West (2005).

related to structural (microeconomic) changes and macroeconomic stability.

6 Conclusion

We present new evidence on the role of low inflation on the observed decline of the exchange rate pass-through (ERPT) into consumer prices for a group of developed and emerging market economies. As opposed to previous literature, instead of analyzing cross-sectional correlations between ERPT and inflation, we provide evidence using time-series based on information content criteria.

We estimate a state-space model of a Phillips curve, allowing for time variation of the ERPT parameter, where ERPT is *simultaneously* a function of lagged inflation. In accordance with previous literature, we observe a gradual decline in ERPT from the 1980s onwards. We then apply Wald and Likelihood Ratio tests for temporal causality (information content) running from the inflation environment to ERPT. Our results show that, out of 12 countries analyzed, evidence in favor of temporal causality can only be found for 2 of them. The close link between inflation and ERPT found in the previous literature may hence be due to other factors driving both variables down. Our findings highlight the importance of further econometric investigation on the causes of the decline in ERPT observed in the last two decades.

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Tables

Table 1

Estimation periods by country

Country	Estimation period
Australia	1980:1 - 2007:4
Denmark	1980:1 - 2007:2
New Zealand	1980:1 - 2007:4
Norway	1980:1 - 2007:4
Switzerland	1980:1 - 2007:4
U.K.	1980:1 - 2007:4
Chile	1980:3 - 2007:4
Colombia	1980:1 - 2007:4
Czech Republic	1994:2 - 2007:4
Mexico	1989:2 - 2007:4
Thailand	1993:3 - 2007:4
Turkey	1989:3 - 2006:2

Table 2

State-space model basic estimation results

	Log Likelihood	AIC
Australia	384.5314	-6.741633
Denmark	382.4475	-6.826318
New Zealand	361.4935	-6.330241
Norway	364.4102	-6.382325
Switzerland	452.0407	-7.947156
United Kingdom	352.3633	-6.167203
Chile	267.7022	-4.740040
Colombia	269.9094	-4.712667
Czech Republic	160.4010	-5.578218
Mexico	209.4397	-5.398392
Thailand	190.4914	-6.327288
Turkey	105.5648	-2.898964

Notes: Figures in the first column are the log-likelihoods of the Maximum Likelihood estimations of the model, whereas the second column shows the Akaike Information Criterion (AIC).

Table 3

Causality tests between inflation and exchange rate changes

Australia	Lags	F-stat.
Inflation does not cause Exchange rate	2	2.857*
Exchange rate does not cause Inflation		1.197
Denmark	Lags	F-stat.
Inflation does not cause Exchange rate	4	0.577
Exchange rate does not cause Inflation		3.046**
New Zealand	Lags	F-stat.
Inflation does not cause Exchange rate	2	1.387
Exchange rate does not cause Inflation		10.05**
Norway	Lags	F-stat.
Inflation does not cause Exchange rate	1	3.675**
Exchange rate does not cause Inflation		0.027
Switzerland	Lags	F-stat.
Inflation does not cause Exchange rate	1	0.175
Exchange rate does not cause Inflation		6.852**
United Kingdom	Lags	F-stat.
Inflation does not cause Exchange rate	4	1.115
Exchange rate does not cause Inflation		0.135
Chile	Lags	F-stat.
Inflation does not cause Exchange rate	2	8.365**
Exchange rate does not cause Inflation		1.609
Colombia	Lags	F-stat.
Inflation does not cause Exchange rate	4	2.292*
Exchange rate does not cause Inflation		0.521
Czech Republic	Lags	F-stat.
Inflation does not cause Exchange rate	1	0.015
Exchange rate does not cause Inflation		2.082
Mexico	Lags	F-stat.
Inflation does not cause Exchange rate	3	0.418
Exchange rate does not cause Inflation		31.74**
Thailand	Lags	F-stat.
Inflation does not cause Exchange rate	1	0.122
Exchange rate does not cause Inflation		0.614
Turkey	Lags	F-stat.
Inflation does not cause Exchange rate	1	2.971*
Exchange rate does not cause Inflation		19.94**

Notes: Lags determined using the Schwartz Information Criterion. ** indicates significance at the 5% confidence level and * indicates significance at the 10% confidence level.

Table 4

Causality tests between inflation and ERPT

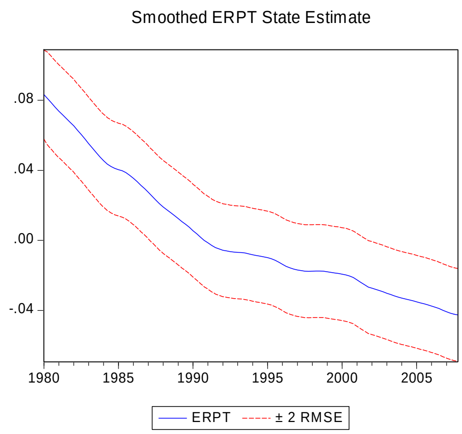
	df	$\lambda - stat$	$\chi^2 - stat$
Australia	1	2.627	2.161
Denmark	1	2.763*	2.334
New Zealand	1	1.363	0.816
Norway	1	1.697	1.347
Switzerland	1	0.783	0.499
United Kingdom	1	0.725	0.433
Chile	1	1.151	1.155
Colombia	1	6.019**	3.278*
Czech Republic	1	0.016	0.026
Mexico	1	0.749	0.802
Thailand	1	0.091	0.093
Turkey	1	1.598	0.576

Notes: ** indicates significance at the 5% confidence level and * indicates significance at the 10% confidence level. The $\lambda - stat$ refers to the Log-likelihood ratio test statistic, and the $\chi^2 - stat$ refers to the Wald test statistic.

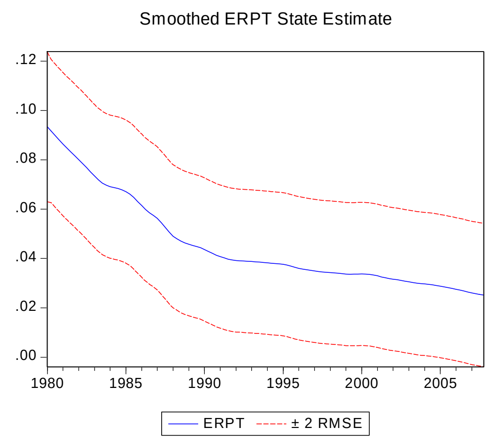
Figures

Figure 1. Exchange rate pass-through estimates

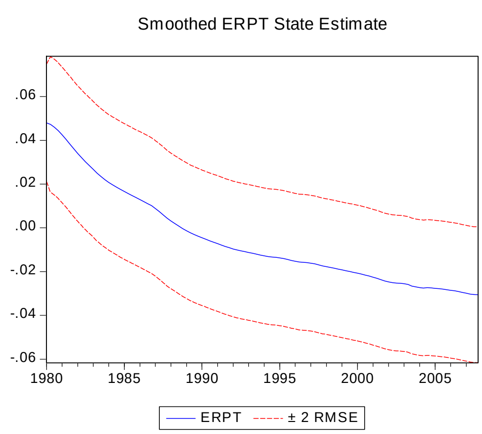
Australia



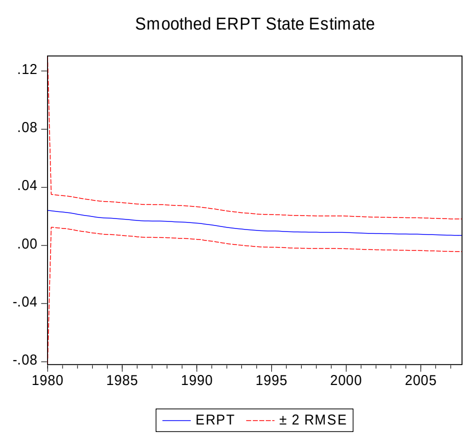
New Zealand



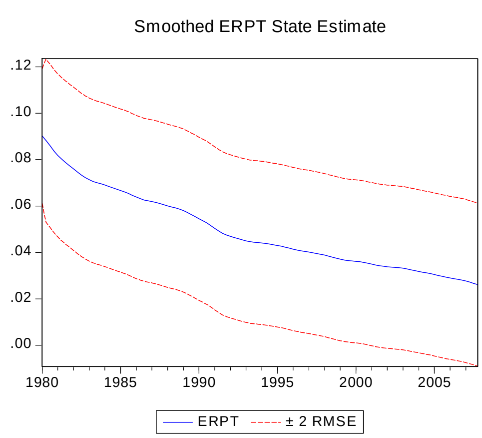
Norway



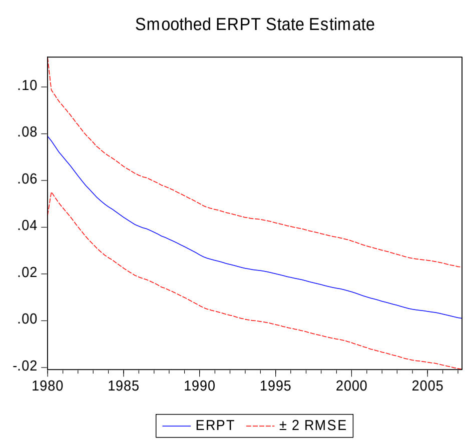
Switzerland



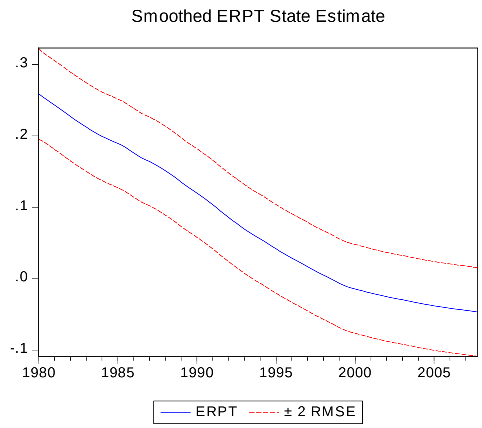
United Kingdom



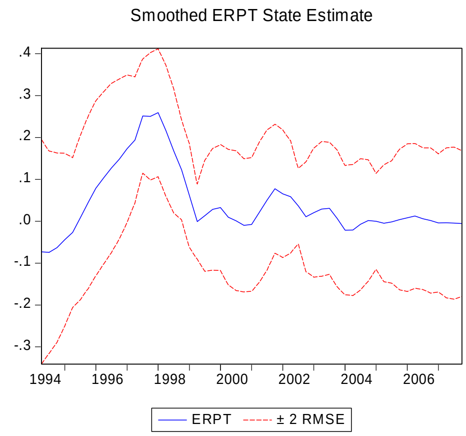
Denmark



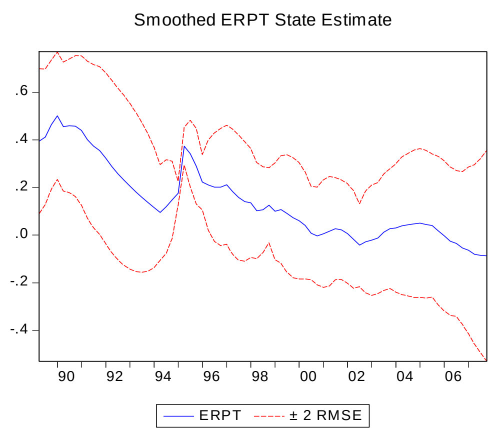
Colombia



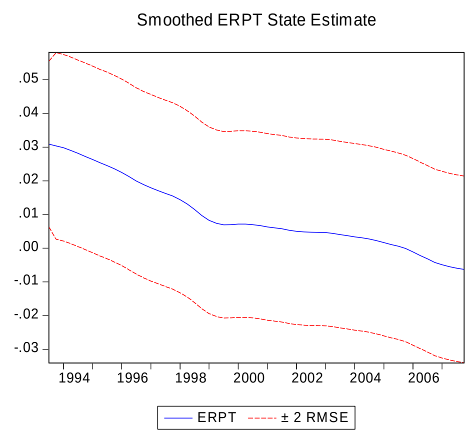
Czech Republic



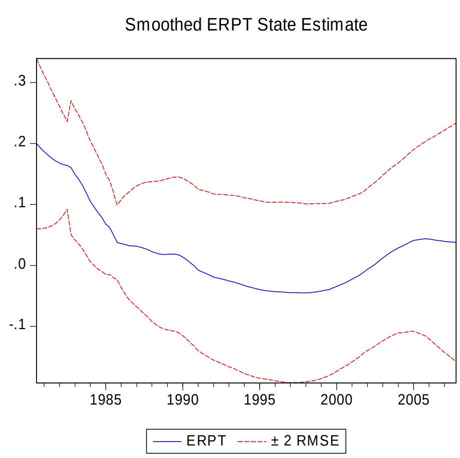
Mexico



Thailand



Chile



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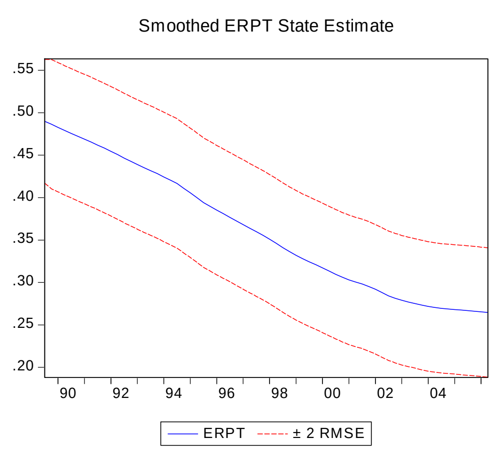
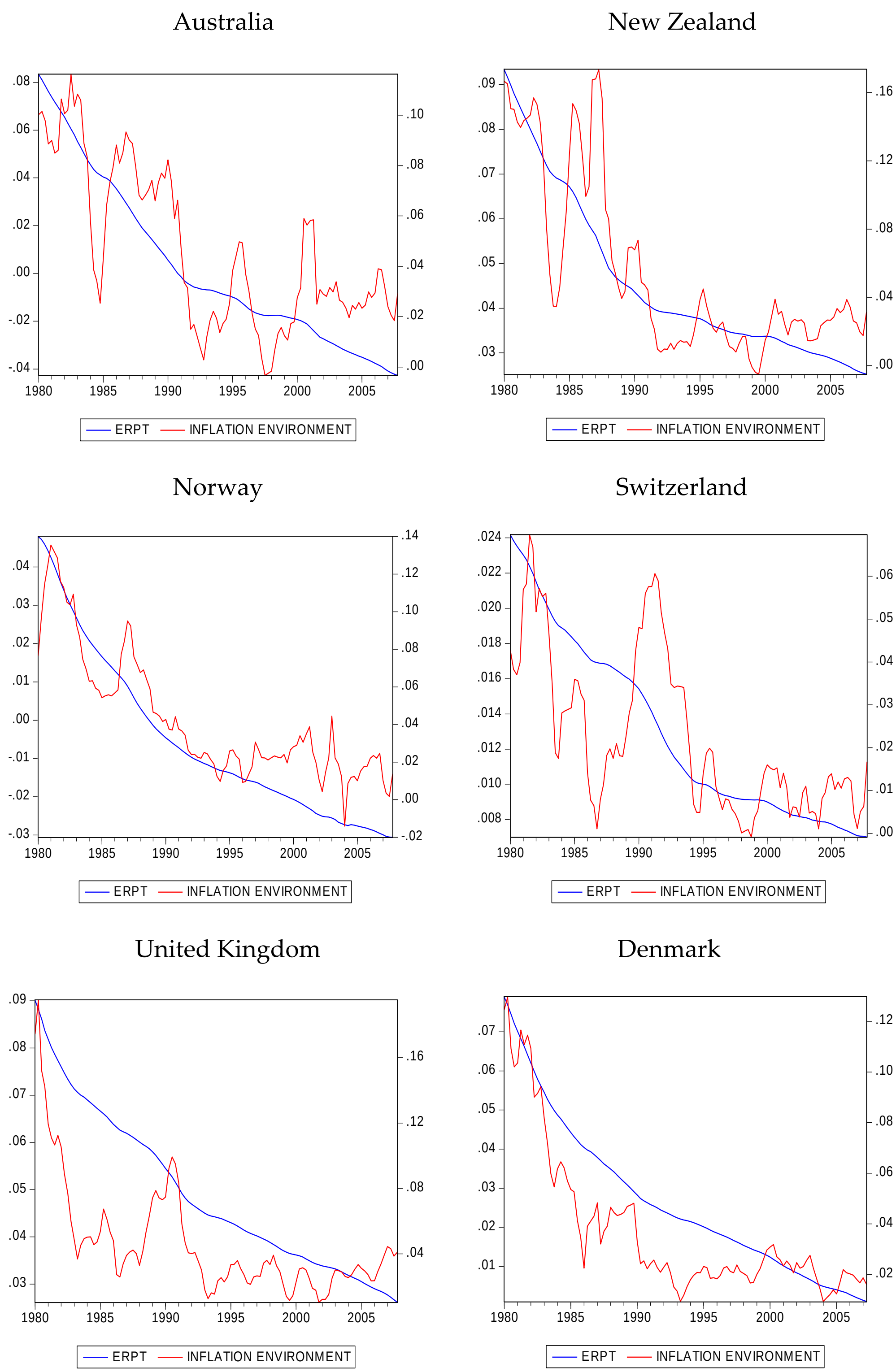
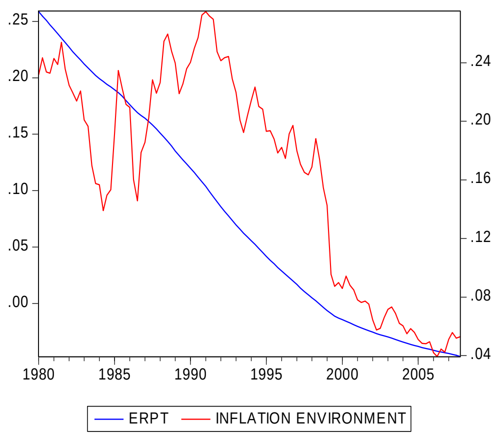


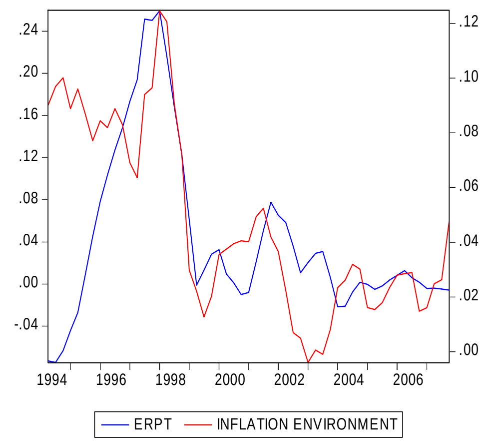
Figure 2. Exchange rate pass-through and inflation environment



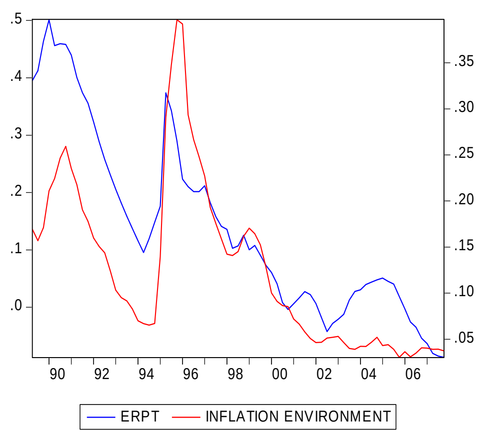
Colombia



Czech Republic



Mexico



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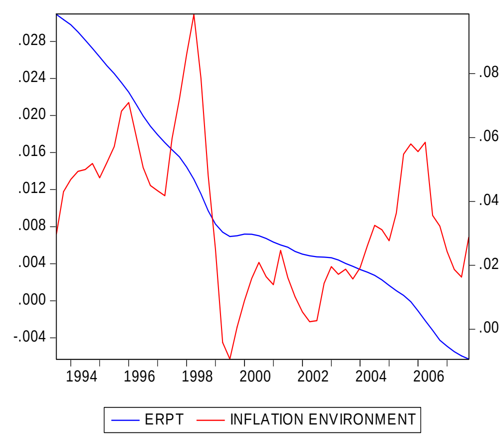

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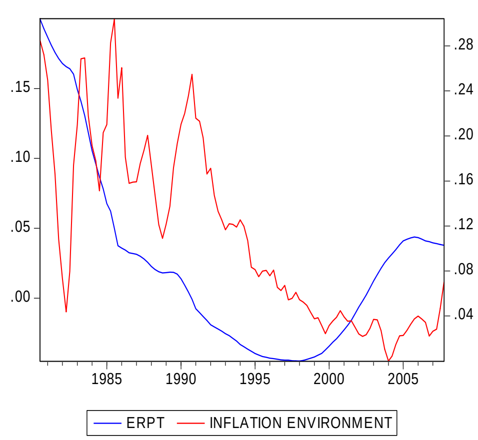


Turkey

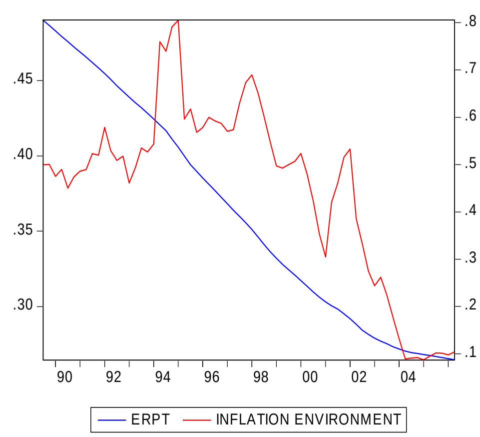
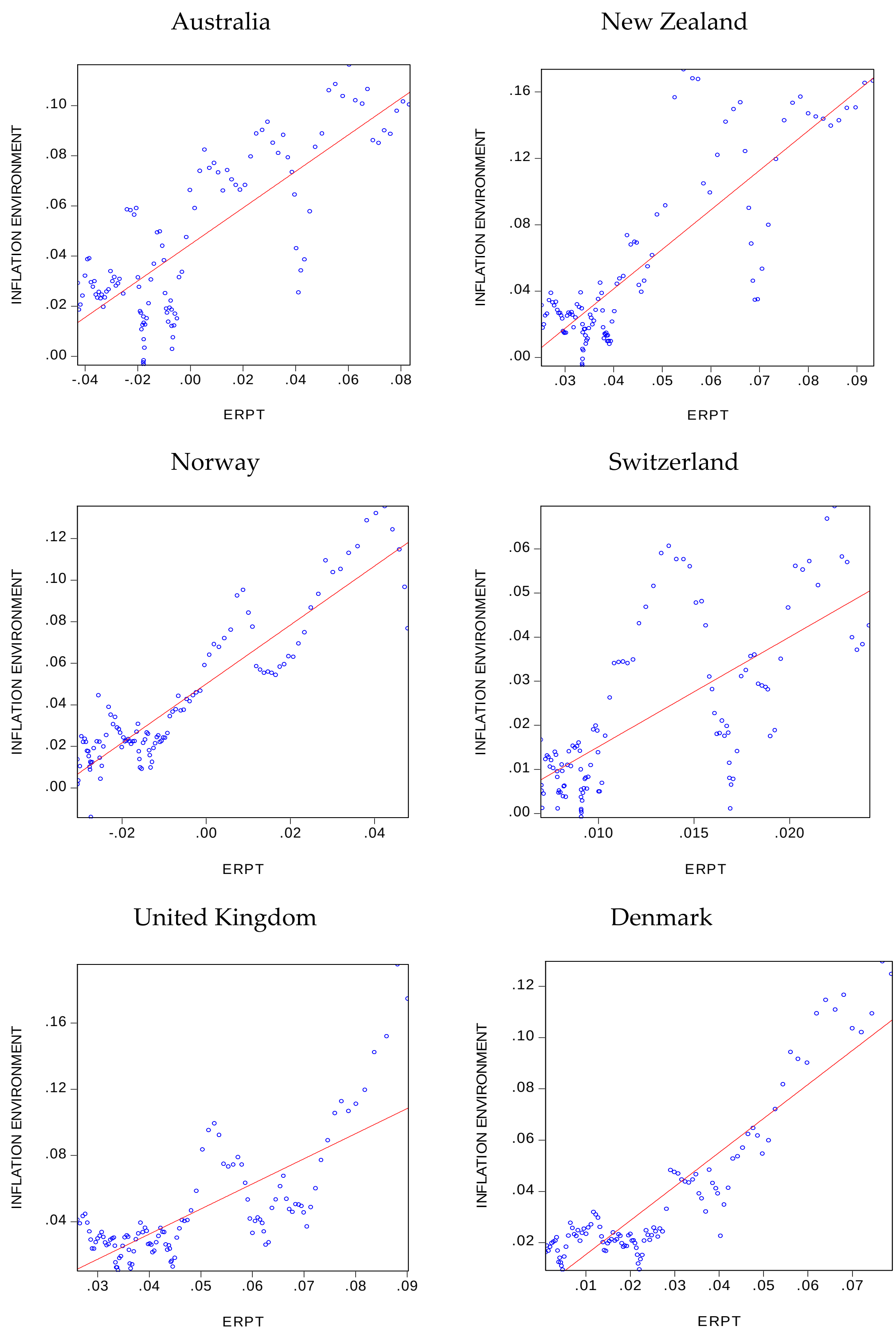
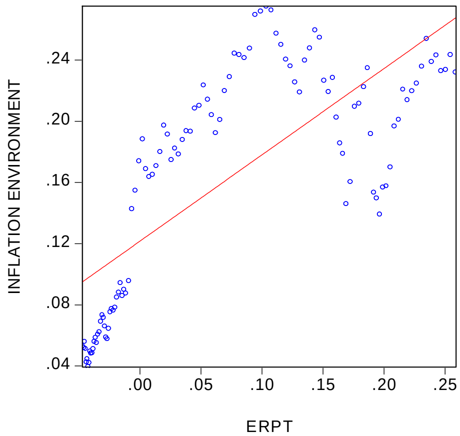


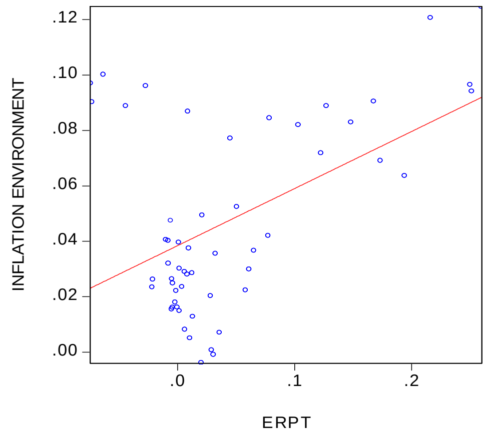
Figure 3. ERPT and inflation: cross-plots



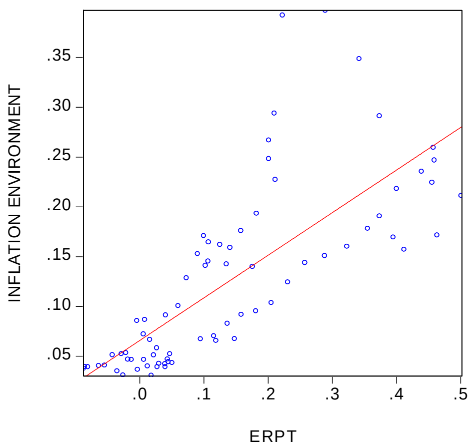
Colombia



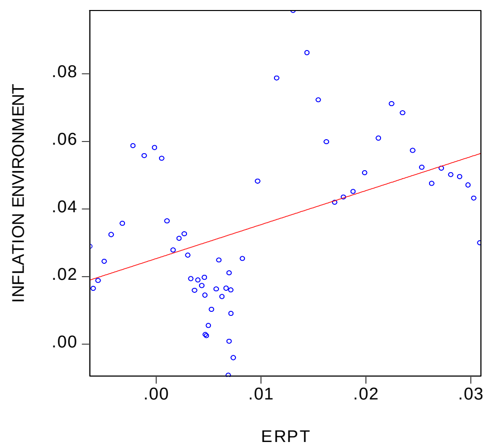
Czech Republic



Mexico



Thailand



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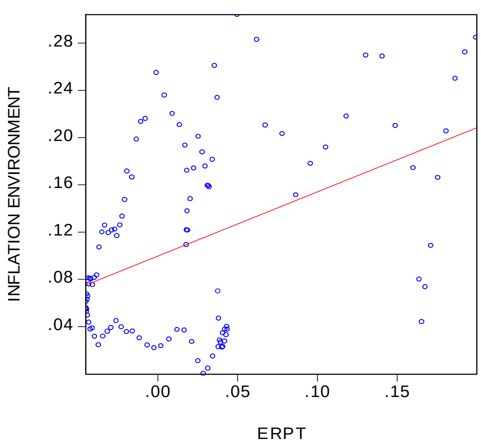

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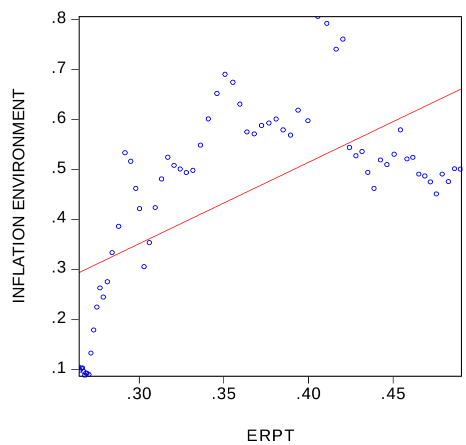

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