Globalization and Inflation: A Threshold Investigation

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Abstract

We use a threshold methodology to investigate the importance of non-linear effects in the analysis of the inflation globalization hypothesis. Accounting for potential non-linearities in the Phillips Curve, we show that trade openness is not rejected as a threshold variable for the effects of domestic and foreign slack on inflation in many advanced economies, and we find a switch of the output gap slopes from one regime to the other that is consistent with the key predictions of the inflation globalization hypothesis. For some countries the threshold Phillips Curve model also leads to improvements in out-of-sample forecast over the linear Phillips models, especially at longer horizons. Contrary to most of the previous literature which ignores such non-linearities, our new approach provides some interesting empirical evidence supportive of the effect globalization has on a country's inflation dynamics.

Keywords: Globalization, Inflation, Threshold Models, Foreign Output Gap.
JEL Classification: E31, F02, F41, F62.

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1 Introduction

The view that highly interconnected markets will allow global factors to replace domestic determinants of inflation, also known as the inflation globalization hypothesis, has received a substantial level of attention, in part due to its significant policy implications. One of the main predictions of the inflation globalization hypothesis is that the role of the foreign output gap in the determination of domestic inflation will increase at the expense of the domestic output gap as the country's economic integration increases. This prediction typically has been examined in the context of the Phillips Curve model; however, due to mixed empirical findings, there is little consensus on the importance of the foreign output gap, and thus globalization, in a country's inflation process. Borio and Filardo (2007) show that including a measure of foreign slack in a reduced Phillips Curve framework is appropriate for every country in their sample. However, their findings have come under considerable skepticism with Ihrig, Kamin, Lindner, and Marquez (2010) illustrating that these results do not hold when a more traditional approach to inflation expectations is employed in the empirical analysis. More recently, Bianchi and Civelli (2015) show the importance of accounting for time variations in the investigation of inflation dynamics, and they find that in a time-varying VAR framework the impact of the foreign output gap on domestic inflation is positively related to trade openness.

In this paper, we continue this line of inquiry but depart from the standard framework by explicitly allowing a country's level of trade openness, used as a proxy for the degree of globalization of a country, to have a non-linear role in the Phillips Curve.[1] Our goal is to show the existence and empirical relevance of a threshold effect of trade openness on the relation between inflation and the domestic and foreign output gaps, such that inflation responds to external factors only after a country achieves a certain level of openness.[2] A number of economic factors can motivate this type of non-linear behavior. For instance, Sbordone (2007) shows that one of the ways globalization can affect the structural determinants of inflation is by reducing the market power of domestic sellers through increased competition; however, it may be the case that domestic companies start to pay attention to foreign competitors only after they have captured a significant market share. This non-linearity should not be omitted from the analysis of the inflation globalization hypothesis, and exploring it in a systematic manner could lead to greater insight on the relationship between inflation and openness and assist policy makers to better deal with some of the challenges of globalization.

Applying Hansen's (1997; 2000) threshold methodology, we are able to examine the non-linear

[1] Similarly, trade openness has been found to exert non-linear effects on growth rates. See, for example, in this respect Cuaresma and Doppelhofer (2007), El Khoury and Savvides (2006) and Papageorgiou (2002).

[2] Most of the empirical evidence against the inflation globalization hypothesis ignores potential non-linearities that might affect inflation dynamics. See Section 2 for a review of these studies.

effects of openness on inflation at the individual-country level for a sample of 16 OECD economies. Considering possible threshold effects of trade openness in a Phillips Curve framework is a simple way to assess directly the effects of globalization on inflation. We follow a two-stage empirical strategy to document some interesting new evidence in favor of the use of the threshold approach in evaluating the inflation globalization hypothesis. In the first stage of the analysis, we identify the countries for which the non-linearity is statistically meaningful. It is quite possible that some countries just do not reach a level of openness to experience a shift in their inflation dynamics. In such instances the threshold methodology does not give us any additional insight in the relationship between inflation and globalization. In the second stage of the analysis, we examine the countries that do pass the test for a significant threshold and determine whether the switch of the output gap slopes from one regime to the other is consistent with the key predictions of the inflation globalization hypothesis.

The results show that for most of our sample countries the level of trade openness is a statistically significant threshold variable for the analysis of the effects of domestic and foreign slack on inflation. In the first stage, we find that openness is not a meaningful threshold in our preferred specification of the Phillips Curve for only four countries; these are typically the economies with the lowest degrees of openness, like the U.S. or Japan. In the second stage, we find a broad support of the inflation globalization hypothesis from all the remaining countries after accounting for the non-linear relationship. For half the countries the estimated output gap responses in the two regimes are fully consistent with the theoretical predictions of the hypothesis. For the other half we find a switch of the coefficient of either foreign or domestic gap that is in line with the hypothesis. Finally, we also find interesting variation in the estimated thresholds across countries, which reflects the structural differences embedded in the level of openness across economies.

Our baseline non-linear model is deliberately simple. For robustness we conduct a number of checks for this choice of specification. In particular, we find no significant impact from allowing inflation to have a downward trend; we also find that our main results are robust to the use of different definitions of inflation and to the inclusion of oil prices, real exchange rates, and import prices as additional controls. Finally, we assess the out-of-sample forecast performance of our model in comparison to its linear alternatives, finding an improvement in the forecast fit for some of the countries, especially at longer horizons.

The remainder of the paper is organized as follows. Section 2 discusses the related literature. Sections 3 and 4 respectively describe our data and the linear Phillips Curve results for our sample of countries. In Section 5, we move to the threshold analysis and examine the role of openness in a country's inflation dynamics. Section 6 illustrates the robustness checks to the baseline specification of the model. Finally, in Section 7 we examine some of the policy implications of our results and conclude.

2 Related Literature

The traditional approach in modeling inflation dynamics has been to focus on country-specific factors, such as domestic output, while leaving a limited role for external factors that were usually captured in the form of supply shocks. However, the increased level of globalization that has taken place through higher levels of trade, financial integration, and movement across factor markets might have changed the very nature of the inflation process. It may now very well be the case that a country's prices are more influenced by events happening in the global rather than the domestic markets.

A theoretical justification to focus on external factors in the inflation process is also provided by Gali and Monacelli (2005), who extend the micro-founded New Keynesian Phillips Curve to the open-economy case. Their key insight is that inflation depends on the weighted average of the domestic and foreign output gaps, where the weights represent some preference for home goods. The inclusion of the foreign output gap in the Phillips Curve shows that along with the direct effects of trade, such as import prices or real exchange rates, there is also a need for some measure of excess global demand, since low demand in one country could be countered by high demand in another.[3] Similarly, Engel (2013) investigates how the Phillips Curve for the consumer price inflation in a country is affected by openness. He compares a model that assumes producer currency pricing with one under local currency pricing, within a theoretical framework in which domestic inflation is directly affected by the global economy through the foreign output gap and imported-goods inflation. He shows that the exchange rate affects inflation not only in the producer currency pricing model due to perfect pass-through, but also in the local currency pricing model through the movements of the term of trade due to a wealth redistribution across countries. We rely on this strand of the theoretical literature to justify our empirical approach and to gain a better understanding of the overall relationship between globalization and inflation.

A number of studies have used the open-economy Phillips Curve framework to investigate the inflation globalization hypothesis. The empirical evidence, however, is still quite ambiguous as seen by the contrasting findings of Borio and Filardo (2007) and Ihrig, Kamin, Lindner, and Marquez (2010). Gamber and Hung (2001) show that globalization increased the sensitivity of U.S. inflation to foreign economic conditions in the '90s. For a group of advanced economies, the IMF (2006) and Pain, Koske, and Sollie (2006) also find a reduction in sensitivity of inflation to domestic capacity constraints due to increased globalization, although in the latter case this is primarily captured through the import channel. On the other hand, Calza (2009) finds that globalization in the form of global output gaps has little success in explaining domestic inflation for the Euro

[3] In the extreme, as pointed out by Borio and Filardo (2007), this implies that excess demand should be aggregated at the product rather than the country level.

area as a whole. Using a structural model for the G7 countries, Milani (2010) also determines that global output impacts domestic inflation indirectly, and thus it should not be included in the Phillips Curve specification. Finally, in a New Keynesian framework, Sbordone (2007) provides an analytical justification for the diminishing sensitivity of inflation to domestic output fluctuations in response to increased globalization and reduced market power of domestic producers.

3 Data Description

The data for our empirical analysis comes from Bianchi and Civelli (2015) and consists of quarterly observations from 1985 to 2006 for a panel of 16 OECD countries: Australia, Austria, Canada, Denmark, France, Germany, Ireland, Italy, Japan, Korea, Mexico, Netherlands, Spain, Switzerland, UK, and the U.S. For each country, the dataset for the baseline specification of the non-linear model includes domestic inflation measured by the Consumer Price Index, the domestic and foreign output gaps, a measure of trade openness, and the effective real exchange rate.

The foreign output gap and the real exchange rate are respectively constructed as trade-weighted averages of the domestic output gaps and pairwise exchange rates of the country's trade partners. The weights are obtained starting from the series of the pairwise import and export flows among a set of about 50 countries which, besides the 16 countries in our sample, includes all the OECD countries, the major Asian economies, and some other emerging countries. The weights are computed following the approach used by the Federal Reserve Board in the construction of its effective real exchange rate. The weights are meant to measure the relative importance of an international partner for a country. This is achieved accounting both for the direct relations between two countries, given by the relative share of imports and exports from one country to the other, and for the so-called third-party relations, which are used to take into account the indirect effects due to international competition among countries.[4,5]

[4] The formulas for the imports, w^m, exports, w^x, and third-party weights, w^3, are the following:

$$w^m_{i,j,t} = \frac{M_{i,j,t}}{\sum_{j=1}^{N_t} M_{i,j,t}}; \quad w^x_{i,j,t} = \frac{EX_{i,j,t}}{\sum_{j=1}^{N_t} EX_{i,j,t}}; \quad w^3_{i,j,t} = \sum_{k\neq j,\neq i}^{N_t} w^x_{i,k,t} \frac{w^m_{k,j,t}}{1 - w^m_{k,i,t}}$$

where $M_{i,j}$ and $EX_{i,j}$ indicate imports from country j to country i and exports from country i to country j. The weights are then aggregated as

$$w_{i,j,t} = 0.5w^m_{i,j,t} + 0.5(0.5w^x_{i,j,t} + 0.5w^3_{i,j,t})$$

[5] The trade flows data come from the IMF-DOT database. See Bianchi and Civelli (2015) for the details on the construction of the foreign output gap and real exchange rate, for the list of countries used in the trade-weights sample, and for a full description of all data sources.

Table 1: OECD data (1985-2006)

Country	Code	Open	Inf
US	US	0.170	3.01
Japan	JPN	0.176	0.68
Australia	AUS	0.296	3.86
Spain	SPN	0.333	4.42
Italy	ITA	0.353	3.95
France	FRA	0.388	2.23
UK	UK	0.400	3.63
Mexico	MEX	0.401	23.0
Germany	GER	0.472	1.83
Denmark	DEN	0.528	2.57
Korea	KOR	0.564	4.41
Canada	CAN	0.565	2.68
Switzerland	SWZ	0.568	1.83
Austria	AUT	0.654	2.19
Netherlands	NET	0.903	2.05
Ireland	IRE	1.032	3.08

Note: Quarterly averages, sorted by a country's level of openness.

The domestic output gap of a country is constructed as the percentage deviation from the HP-filtered real GDP series taken as a proxy for the potential GDP. The source for the real GDP is the OECD National Account Statistics or the IMF. For each of the 16 countries in our non-linear analysis the domestic output gaps of all the other countries are then weighted to form the trade-based measure of the foreign gap. The foreign output gap is then specific to each country. The same procedure applies to the construction of the country-specific real exchange rates. The pairwise nominal exchange rates, generally obtained from Global Insight, are deflated by the CPI of the respective country, and aggregated using the same trade-based weights.

Trade openness is defined as the ratio to GDP of the sum of imports and exports of a country. Following Borio and Filardo (2007) and Bianchi and Civelli (2015), the inflation rate is computed as the log-difference of the domestic CPI index relative to the same quarter of the previous year. The CPI values usually come from the IMF or OECD Main Economic Indicators (MEI) datasets, with base year set to 2000. Finally, for the robustness exercises we obtain data for core inflation using CPI (excluding all food and energy prices) from the OECD MEI while the import price deflator and global oil prices are from the OECD Economic Outlook dataset.

Table 1 sorts these countries based on their average level of openness. We see that there is significant variation, ranging from relatively closed countries such as the U.S. and Japan with levels of openness close to 20% of GDP to more open economies such as the Netherlands and Ireland with levels of openness close to 100% of GDP. Given these strong differences it would not be surprising if openness affected these countries asymmetrically.

In our analysis, we focus only on observations from 1985 onward to account for the structural break in inflation that was seen for most advanced economies in the early 80's (Rapach and Wohar, 2005). Since this decrease in inflation rates was a result of more aggressive central bank actions, it would be inappropriate to link it solely with increased globalization (Calza, 2009). Thus we adopt a conservative approach and avoid the earlier periods, even though these were also years that experienced relatively steady growth in international trade. Finally, ending the sample in 2006 allows us to compare our results directly with earlier literature, while also avoiding the impact of the global financial crisis and the subsequent decline in international trade (Wynne and Kersting, 2009).

4 Linear Phillips Curve

We begin our empirical exercise with a linear Phillips Curve model that lays the groundwork for the non-linear analysis in Section 5. To analyze the effect of globalization on domestic inflation, we employ an open-economy version of the Phillips Curve so that the foreign output gap is added to the baseline empirical specification with the domestic output gap only and obtain a set of standard results for our 16 OECD countries. The linear model can be expressed in general form as

$$\pi_t = \alpha + \sum_{k=1}^{L} \rho_k \pi_{t-k} + \beta Y_t^d + \gamma Y_t^f + \varepsilon_t \quad (1)$$

where inflation, π_t, is related to its L lagged realizations and the contemporaneous domestic and foreign output gaps, Y_t^d and Y_t^f respectively. While this purely backward-looking specification may lack some of the structural interpretation of an explicit forward-looking New Keynesian Phillips Curve (Gali and Monacelli, 2005), it still provides a suitable reduced-form analysis of inflation dynamics. Furthermore, there is also some strong evidence that the backward-looking model is a better empirical fit (Rudd and Whelan, 2007) and more structurally stable (Estrella and Fuhrer, 2003) than pure forward-looking models. Using this same specification, Ihrig, Kamin, Lindner, and Marquez (2010) show that the foreign output gap is not statistically significant for any country in their sample.[6]

[6] Ihrig, Kamin, Lindner, and Marquez (2010) also employ a variety of controls for supply shocks such as energy and food prices as well as tax dummies, but these did not impact their main results. We explicitly consider some of these controls for the robustness analysis in Section 6.

Table 2 illustrates the estimates of a specification of model (1) in which we include one lagged value of inflation and the average of the subsequent four lags for the 16 countries in our sample. Our results are broadly consistent with those in Ihrig, Kamin, Lindner, and Marquez (2010) (see their Table 1), with most of the countries showing very little role for the foreign output gap. As in Ihrig, Kamin, Lindner, and Marquez (2010), the foreign output gap coefficient is often negative and nearly always insignificant. The only exception is Ireland, which, being a very open economy, sees an impact from the foreign output gap on its inflation significant at 10%. This is an interesting result because Ireland is the most open country in our analysis, based on the trade index adopted here, with a level of openness about two times the average. Furthermore, Table 2 shows that the domestic output gap is also insignificant for most of the countries, a recurrent finding in the estimation of open-economy Phillips Curves.[7] Finally, the LM tests for serial autocorrelation and hetroskedasticity along with the Ramsey RESET tests indicate that equation (1) is properly specified for most of the countries.[8]

[7]Indeed, the domestic output gap gains significance for more countries, such as the U.S., when we exclude the foreign output gap from the estimation.

[8]As a robustness check, we also estimate (1) using a Seemingly Unrelated Regression framework as in IMF (2006), allowing for common shocks. The results reported in Table A1 of the the Appendix are quite similar.

Table 2: Linear Philips Curve

	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Constant	0.376**	0.387***	0.360**	0.316**	0.270***	0.282**	0.537***	0.142*	0.077	0.686***	1.411	0.234**	0.322**	0.158**	0.486**	0.572***
	(0.18)	(0.13)	(0.18)	(0.13)	(0.10)	(0.15)	(0.16)	(0.10)	(0.06)	(0.23)	(0.91)	(0.09)	(0.14)	(0.08)	(0.22)	(0.18)
Lag Inf	1.021***	0.874***	0.878***	0.864***	0.882***	0.896***	0.955***	1.093***	0.828***	0.968***	1.192***	1.062***	0.851***	1.12***	0.996***	0.940***
	(0.06)	(0.09)	(0.05)	(0.10)	(0.08)	(0.07)	(0.05)	(0.04)	(0.07)	(0.04)	(0.08)	(0.07)	(0.08)	(0.05)	(0.05)	(0.06)
Avg Lag Inf	-0.090	-0.047	-0.013	-0.006	-0.004	-0.042	-0.119**	-0.135**	0.059	-0.114	-0.259***	-0.164***	0.069	-0.192***	-0.116*	-0.124*
	(0.06)	(0.07)	(0.06)	(0.09)	(0.08)	(0.11)	(0.06)	(0.05)	(0.07)	(0.06)	(0.08)	(0.05)	(0.07)	(0.04)	(0.06)	(0.07)
Dom Gap	0.097**	0.052	0.092	0.071	0.052	-0.029	-0.003	0.008	0.096	0.032	-0.147	-0.023	0.010	-0.033	0.111**	0.075
	(0.05)	(0.08)	(0.06)	(0.06)	(0.04)	(0.11)	(0.04)	(0.04)	(0.06)	(0.08)	(0.34)	(0.09)	(0.09)	(0.05)	(0.05)	(0.05)
For Gap	-0.048	0.108	-0.036	-0.010	-0.029	0.131	0.128*	0.053	0.086	0.187	-0.064	0.120	0.154	0.095	0.041	0.010
	(0.13)	(0.07)	(0.12)	(0.06)	(0.06)	(0.09)	(0.07)	(0.07)	(0.08)	(0.14)	(0.48)	(0.11)	(0.11)	(0.07)	(0.11)	(0.08)
RMSE	0.81	0.38	0.63	0.43	0.38	0.63	0.51	0.35	0.52	1.00	4.73	0.39	0.56	0.42	0.62	0.47
Adjusted R^2	0.90	0.83	0.81	0.84	0.88	0.74	0.84	0.97	0.83	0.79	0.96	0.90	0.91	0.93	0.90	0.79
Tests *(p-val)* †																
Serial LM(4)	0.08	0.55	0.00	0.32	0.97	0.19	0.00	0.05	0.35	0.35	0.00	0.77	0.86	0.05	0.00	0.08
ARCH LM(4)	0.71	0.08	0.37	0.00	0.67	0.48	0.81	0.07	0.32	0.74	0.00	0.19	0.00	0.30	0.75	0.46
RESET	0.90	0.01	0.35	0.58	0.11	0.90	0.15	0.50	0.55	0.58	0.24	0.13	0.66	0.00	0.62	0.51

Notes: Inflation is the four quarter difference in CPI. Lag Inf is π_{t-1} while Avg Lag Inf is $\frac{1}{4}(\sum_{k=2}^{5} \pi_{t-k})$. HAC robust standard errors in parenthesis.

† LM serial correlation test that all coefficients equal to zero (4 lags). ARCH test of conditional homoskedasticity (4 lags). RESET is the Ramsey misspecification test using $\hat{y}^2$ and $\hat{y}^3$. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5 Non-linear Analysis

5.1 Main Threshold Results

Based just on the linear estimates in Table 2 one may conclude that, save for Ireland, the inflation process in all other countries has not been greatly influenced by globalization, and that policy makers should continue to focus on the domestic determinants of inflation. However, as has been pointed out by Bianchi and Civelli (2015), a simple linear Phillips Curve model is insufficient to assess satisfactorily the inflation globalization hypothesis. The evolution of globalization needs to be explicitly embedded in the analysis, allowing for the possibility of both non-linearity and heterogeneity across countries in order to gain a better understanding of this complex relation.

One simple and effective way to allow for non-linear effects of globalization on inflation is to modify the Phillips Curve model in (1) as a threshold model. The Threshold Phillips Curve is then given as

$$\pi_t = \alpha + \sum_{k=1}^{L} \rho_k \pi_{t-k} + \begin{cases} \beta_1 Y_t^d + \gamma_1 Y_t^f + \varepsilon_t & when\; Openness \leq \theta_0 \\ \beta_2 Y_t^d + \gamma_2 Y_t^f + \varepsilon_t & when\; Openness > \theta_0 \end{cases} \tag{2}$$

where trade openness acts as the threshold variable and is responsible for the switch in the relation between inflation and the output gaps from one regime to another.

Globalization can be measured over several dimensions besides trade openness; we choose to use trade openness mainly for two reasons. First, trade openness has often been used as a proxy for the degree of globalization of a country in empirical work, and it is especially relevant for our purposes since inflation in an open-economy Phillips Curve framework is directly affected by external factors through the trade channel. Second, as illustrated for instance by Engel (2013), in the theoretical open-economy models of the New Keynesian Phillips Curve not only is domestic inflation affected by the foreign output gap and movements in the exchange rates, but also the importance of these international factors increases as trade openness increases.

An important caveat to bear in mind about our approach is that trade might not fully capture the full complexity of the globalization process. Clearly, a limitation of our approach is that using trade openness as a threshold variable and trade-based weights for the construction of the relevant foreign output gap of a country might not be exhaustive if other aspects of globalization are relevant for the dynamics of domestic prices. A couple of other channels come to mind. First, integration of financial markets plays an important role in wealth distribution across countries and, hence, international consumption sharing. So the degree of financial globalization could also affect domestic prices through the foreign output gap. Second, when domestic markets are contestable, the influence of higher globalization on domestic prices could manifest itself through the effects of a stronger threat of entry by new international competitors that lowers domestic prices; this channel, for example, would be independent of trade per se.

Initially, we opt for a deliberately parsimonious specification for our baseline non-linear model in (2), in which we allow openness to influence only the slopes of the gaps, while the lagged inflation terms and the intercept are the same in each regime. In our analysis, we found that possible non-linear effects on the autoregressive component were quite modest for most countries, with basically no gain in the in-sample fit of the model from allowing the lag coefficients to switch as well.[9] Bick (2010) has pointed out that regime intercepts can often play a significant role in threshold analysis; however, as illustrated in Section 6, our main results our robust to allowing the constant term to change between regimes. In this stage of our analysis, we also do not include in the baseline specification other factors, such as import prices or the real exchange rate, as we prefer to more tightly focus on the predictions of the globalization hypothesis on the output gap coefficients. In Section 6 we also see that the baseline results are generally robust when these factors are added as control variables. Overall, our preferred model in (2) is a very simple way to incorporate potential non-linearities that allow the foreign output gap to matter for the inflation process only for certain levels of openness.

We follow Hansen (1997, 2000) to both estimate and test our threshold models. A consistent estimate of θ_0 is one that minimizes the residual variance of (2) and can be found by a grid search over all the possible values of the threshold variable. For a given θ_0, the rest of the model becomes linear in the parameters and can be then estimated by OLS. θ_0 is also a nuisance parameter in standard F or LM tests that check for the significance of the threshold model by testing the null hypothesis $H_0 : \beta_1 = \beta_2,\ \gamma_1 = \gamma_2$. Thus, as in Hansen (1997), we apply a bootstrap method to approximate the distribution of the test statistics under the null, and then use it to obtain the corresponding bootstrapped p-values for these tests.

Our empirical strategy will proceeds in two stages. First, we analyze the thresholds to identify the countries for which the non-linearity in the relation is actually statistically meaningful. We formally test for the significance of the threshold model, and we relate the results to the level of openness of the countries. Clearly, the threshold methodology will not give us any additional insight for the relationship between inflation and globalization for the countries that do not pass

[9] In order to further isolate possible non-linearities in the autoregressive component of the inflation equation, we also estimate a non-linear model that keeps the coefficients of the two output gaps fixed instead, and find that for the overwhelming majority of our sample countries the Hansen (1997) F-test rejects a switch in the lag coefficients due to openness. This is not surprising as generally central bank policies are considered to be the main factor that drives shifts in the formation of inflation expectations (Bianchi, 2013).

Table 3: Hansen Test for Threshold Effect

	Aus	Aut	Can	Den	Fra	Ger	Ire	Ita	Jpn	Kor	Mex	Net	Spn	Swz	UK	US
F-test	1.83	3.81	2.62	6.38	1.13	2.91	7.15	3.47	2.77	1.94	6.53	2.51	3.73	4.37	5.31	2.00
p-value	.13	.00	.03	.00	.44	.02	.00	.01	.16	.09	.00	.03	.01	.00	.00	.12

Note: F-test is the value of the maximum F-statistic for the null of no-threshold effect with the corresponding bootstrapped p-values as in Hansen (1997, 2000).

the test.[10] Second, we further examine the countries for which the threshold model is not rejected to determine whether the switch of the slopes from one regime to the other is consistent with the predictions of the inflation globalization hypothesis.

In the first stage of the analysis, we focus on the estimated thresholds; the results of the F-test for the significance of the threshold model are reported in Table 3. We find a quite large support for using a non-linear approach to examine the inflation globalization relation for the countries we study. The F-test and corresponding bootstrapped p-values indicate that openness is indeed a statistically significant threshold variable for all countries in the sample except for Australia, France, Japan, and the U.S. Table 1 shows that Australia, Japan, and the U.S. are the three countries that display the lowest average levels of openness in our sample, while France has the sixth lowest. This evidence suggests that low degrees of openness might not be sufficient even to trigger non-linear effects in Phillips Curve model.[11] Thus we can classify these four countries as having no globalization effect on inflation.

Table 4 illustrates the results of the estimated threshold models for the countries that see a significant threshold effect from openness. Like the linear model, the non-linear specification of (2) also uses one lagged value of inflation and the average of the subsequent four lags. Additionally, Figure 1 relates the estimated threshold of each country to its respective trade openness index. The estimated thresholds show some level of heterogeneity with the median estimated threshold for openness at 49% and an inter-quartile range of 20%. This is not entirely unexpected as there are clear differences in the structural characteristics of these countries, especially in terms of the relative degree of integration in the global economy as has been documented in Table 1. Similarly, the magnitudes of the estimated effects of the two output gaps are characterized by good variability across countries, with more open economies having in general larger estimated thresholds as well as experiencing stronger effects of the foreign output gap. In this paper, our main purpose

[10] Note that a nonrejection of the H_0 in the F-test implies that a linear analysis of the inflation dynamics is appropriate.

[11] This interpretation may not apply to France, whose inflation is not affected by openness in a clear manner. While the domestic output gap loses significance in France's more open regime, we also observe quite high bootstrapped p-values. Using a state space framework, López-Villavicencio and Saglio (2014) have also shown that openness is not responsible for the decline in the response of France's inflation to its domestic output gap.

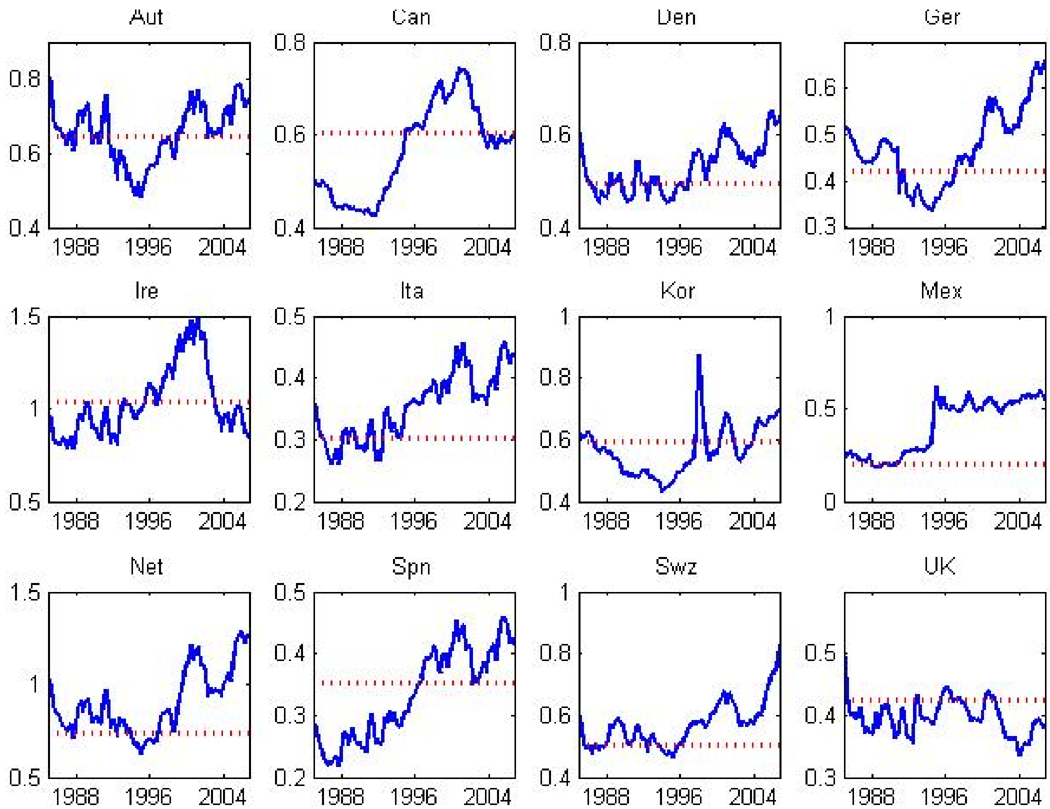

Figure 1: Evolution of trade openness and estimated thresholds.

is documenting that countries experience similar threshold effects from openness in their domestic inflation dynamics rather than accounting for specific differences in the individual threshold estimates. Once the existence and importance of the non-linear effects are assessed, one could think of estimating an average effect of globalization on inflation in a panel framework, for instance, after imposing some restriction on the cross-sectional structure of the model.[12]

We turn next to the second stage of our empirical analysis. Table 3 showed that countries with low levels of openness did not experience a significant threshold effect on their inflation dynamics. While this is conceptually consistent with the non-linear role globalization can have in the inflation process, we still need to assess the main predictions of the inflation globalization hypothesis for all the remaining countries in our sample.

[12]In a companion paper, we exploit the cross-sectional dimension of a similar dataset and the rich variation in openness across countries to generalize our result by estimating the threshold effects in a dynamic panel model.

These predictions for the slopes of domestic and foreign output gaps across the two regimes can be stated as:

1. As we move to the more open regime, the responsiveness of inflation to the domestic output gap, β, is expected to decline, becoming less significant.
2. In the more open regime, the foreign output gap should replace the domestic output gap, indicating a more significant and larger estimate of γ.

Based on these estimated output gap coefficients, we can sort the countries in Table 4 into those displaying a full, a partial, or no globalization effect. A full globalization effect is said to occur for a country in which, going from the less to the more open regime, the foreign and domestic output gap coefficients respectively turn from insignificant to significant and from significant to insignificant (at 10% level of confidence, at least). On the other hand, a partial effect is when we observe this change for only one of the two output gaps. Finally, we treat all the remaining cases as having no globalization effect on inflation, along with the countries for which the non-linear model is rejected.[13]

Figure 2 helps us classify the countries for which a significant threshold is found. Solid bars correspond to the estimated domestic output gap coefficients, while the criss-cross patterns identify the coefficients for the foreign gap. The blue color is used to indicate switches in the parameter's magnitude and significance consistent with the globalization hypothesis predictions; gray indicates cases which are not in line with the globalization hypothesis. Given this information, it is easy to recognize that Austria, Canada, Denmark, Italy, and Mexico all experience a full globalization effect as they move toward the more open regime. The inflation dynamics for these nations are fully affected by an increase in globalization. In addition to them, Germany, Ireland, Korea, Netherlands, and Spain display a partial effect from openness that is reflected by a switch only in the foreign output gap. The estimates of the Y^f coefficients are large for all of them, and strongly significant for Germany and Ireland in particular; at the same time, the Y^d coefficient remains insignificant across regimes.[14] The UK and Switzerland, on the the other hand, display a partial globalization effect due to the domestic gap response, which loses significance in the more open regime. Overall, the observed non-linear relation between inflation and the output gaps is broadly consistent with the inflation globalization hypothesis for all the countries that pass the test of significance of openness as a threshold in the Phillips Curve model.

[13] Note that these classifications are quite conservative since the inflation globalization hypothesis also would be formally valid when both gaps are significant in the more open regime but the foreign gap is larger than the domestic gap. Thus, our findings in favor of the inflation globalization hypothesis can be viewed with even greater confidence.

[14] It is important to note that Ireland's foreign output gap was significant in the linear case as well. Accounting for non-linearity, we find inflation has an even larger response to the external factors.

Table 4: Threshold Phillips Curve

	(1) Aut	(2) Can	(3) Den	(4) Ger	(5) Ire	(6) Ita	(7) Kor	(8) Mex	(9) Net	(10) Spn	(11) Swz	(12) UK
Constant	0.489***	0.340*	0.313**	0.422***	0.686***	0.116*	0.574**	1.120*	0.227**	0.355*	0.117*	0.574***
	(0.13)	(0.17)	(0.12)	(0.12)	(0.15)	(0.07)	(0.22)	(0.60)	(0.10)	(0.17)	(0.07)	(0.17)
Lag Inf	0.873***	0.876***	0.810***	0.780***	0.866***	1.075***	0.933***	1.174***	1.023***	0.868***	1.067***	0.987***
	(0.08)	(0.08)	(0.13)	(0.08)	(0.06)	(0.06)	(0.06)	(0.08)	(0.06)	(0.08)	(0.06)	(0.05)
Avg Lag Inf	-0.076	0.001	0.0476	-0.075	-0.080	-0.111**	-0.069	-0.212***	-0.132**	0.047	-0.132**	-0.129*
	(0.07)	(0.08)	(0.11)	(0.10)	(0.05)	(0.05)	(0.07)	(0.07)	(0.06)	(0.07)	(0.05)	(0.06)
						Regime 1 (Open $\leq \theta_0$ ***)***						
Dom Gap	0.211***	0.120*	0.162**	0.302	-0.020	0.237*	0.101	2.933*	0.121	0.043	0.370**	0.117**
	(0.08)	(0.06)	(0.08)	(0.39)	(0.04)	(0.14)	(0.09)	(1.46)	(0.25)	(0.11)	(0.16)	(0.04)
For Gap	0.060	-0.092	-0.085	-0.540	0.061*	-0.223	0.121	0.457	-0.191	0.102	0.301*	0.126
	(0.08)	(0.13)	(0.09)	(0.42)	(0.06)	(0.22)	(0.13)	(1.39)	(0.19)	(0.15)	(0.15)	(0.09)
						Regime 2 (Open $> \theta_0$***)***						
Dom Gap	-0.159	-0.331	-0.106	-0.09*	0.026	-0.031	-0.110	-0.432	-0.020	-0.136	0.067	0.045
	(0.11)	(0.19)	(0.07)	(0.05)	(0.09)	(0.04)	(0.16)	(0.28)	(0.07)	(0.22)	(0.05)	(0.24)
For Gap	0.242**	0.695*	0.184**	0.262***	0.456**	0.102*	0.565*	0.444*	0.175*	0.257*	-0.006	-0.099
	(0.10)	(0.39)	(0.08)	(0.09)	(0.17)	(0.06)	(0.34)	(0.25)	(0.09)	(0.14)	(0.06)	(0.22)
Threshold	0.648	0.604	0.497	0.423	1.041	0.303	0.595	0.305	0.734	0.354	0.502	0.425
Regime 1(%)	47	62	37	27	66	24	66	17	17	56	19	74
RMSE	0.37	0.61	0.40	0.62	0.48	0.34	0.99	4.44	0.38	0.54	0.41	0.59

Note: Threshold are estimated so that each regime has at least 15% of observations in either Regime.

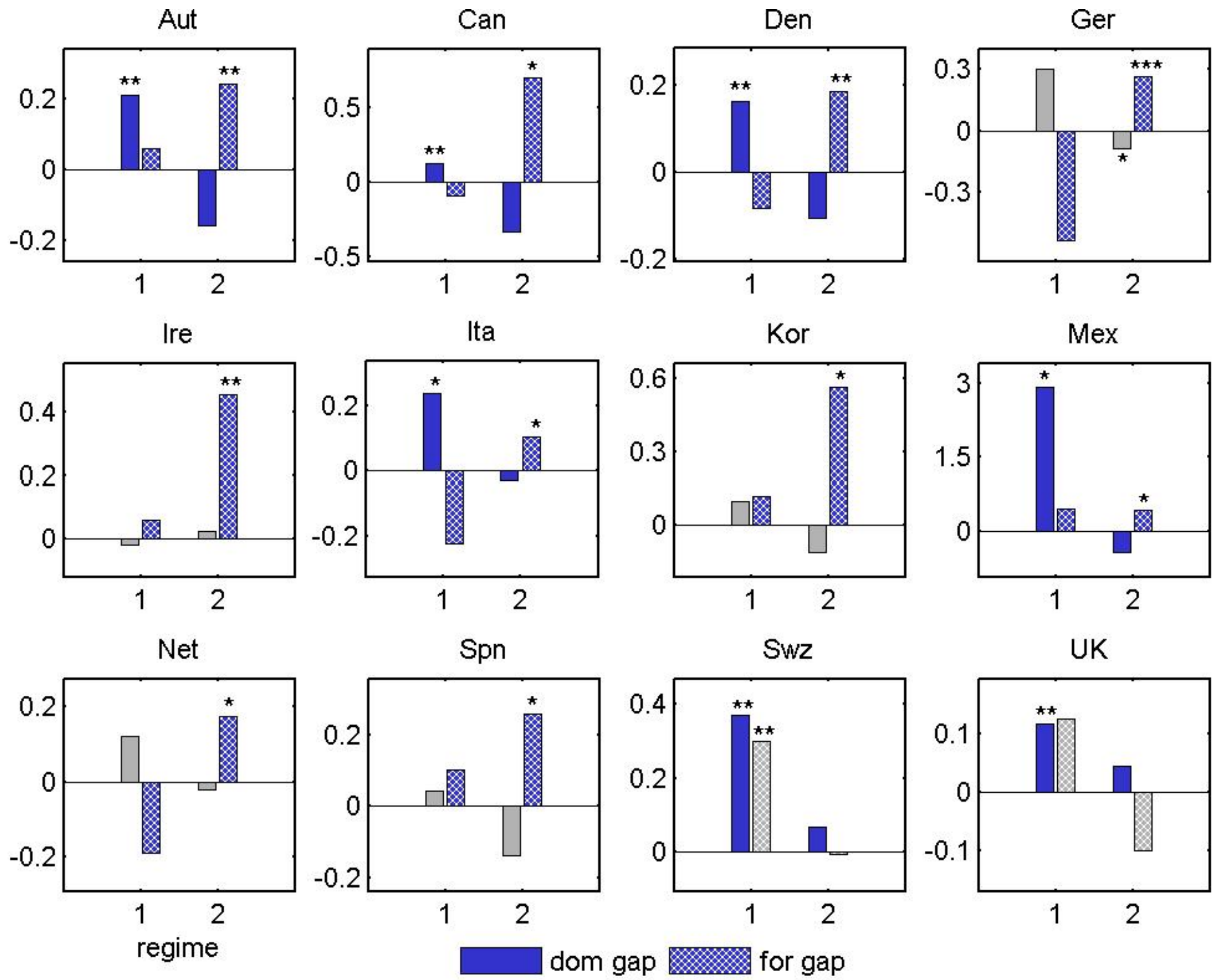

Figure 2: Blue (gray) bars indicate output gap responses to the regime switch consistent (not consistent) with the globalization hypothesis. */**/*** denotes significance at the 10/5/1 level. **Full globalization effect:** Aut, Can, Den, Ita, and Mex. **Partial effect** (Y^d only): UK and Swz. **Partial effect (**Y^f only**):** Ger, Ire, Kor, Net, and Spn;

5.2 Out-of-Sample Performance

We next consider a simple out-of-sample forecasting exercise to evaluate the performance of the linear and non-linear Phillips Curve models. The evidence on the effectiveness of traditional Phillips Curve models for forecasting inflation against univariate ones is generally mixed and it is quite sensitive to the choice of sample horizon (Stock and Watson, 2008). Faust and Wright (2013) have also shown that simple autoregressive models that account for time-varying mean inflation perform much better than models that have a number of estimated parameters. Thus, our goal in this section is to look mainly at the relative performance of our various Phillips Curve models, and in particular to assess whether there are gains from incorporating non-linearity due to openness in the Phillips Curve framework.

Following Stock and Watson (2008), pseudo out-of-sample forecasts were generated using the recursive method where we first estimate a given Phillips Curve model for the initial period 1985:Q1 to 2001:Q4, and then use these coefficient estimates to obtain the $h = 1$, 2, 3, and 4 quarter-ahead forecasts. The $h > 1$ step-ahead forecasts were determined iteratively by substituting the $h - 1$ step-ahead forecast for π_t in the subsequent forecast determination. Furthermore, the $h-$step ahead forecasts also require $E_tY^d_{t+h}$ and $E_tY^f_{t+h}$ as inputs. Since we are only interested in comparing the forecast performance of these Phillips Curve models, as in Qin and Enders (2008), we simply replace them with the actual values for our out-of-sample forecasts. We then re-estimate each model from 1985:Q1 to 2002:Q1 (so adding one more observation) and obtain the next set of out-of-sample forecasts. For the case of the Threshold Phillips model, the threshold value is also estimated in each sample window along the regime coefficients. Continuing in this manner up till 2006:Q3, we get a series of 1 to 4 step-ahead forecasts for each model and we can compare their forecasting accuracy using the actual inflation rate for the same period.

This procedure is also valid for obtaining the forecasts from the Threshold Phillips Curve model. Since trade openness is the threshold variable in our non-linear model, we do not, as is the case with traditional Self-Exciting Threshold (SETAR) models, have to deal with the issue of out-of-sample forecasts not having analytical solutions (Clements and Smith, 1999). However, we still require trade openness as an input in order to determine the regime to use in generating the out-of-sample forecasts. To obtain this input we use an AR2 model to forecast openness in the out-of-sample periods for each country and then apply the Monte Carlo method (MC), where an error term drawn from a normal distribution is added to this forecast and this value determines the regime for the Phillips Threshold model. The procedure is repeated a 1000 times for each horizon, and averaging gives the MC out-of-sample inflation forecast for the non-linear Phillips Curve model. Clements and Smith (1997) have shown that the MC method performs well in comparison to other possible methods in obtaining the multi-period forecasts from the SETAR model, and so is a suitable choice to obtain the out-of-sample forecasts for our purposes as well.[15]

Table 5 reports the out-of-sample forecast performance of all the OECD countries that exhibit non-linearity in the F-tests in Table 3. In our analysis we compare the linear domestic Phillips Curve (DPC), the linear open-economy Phillips Curve (OPC), and the Threshold Phillips Curve (TPC) models along with an AR2 model of inflation, taken as usual as benchmark univariate model. As in

[15] Alternatively, we could have used the actual values of openness in determining the regime for the out-of-sample forecasts. By using forecasts of openness, instead, we ensure that the comparison between linear and non-linear Phillips Curves is solely due to the non-linearity and not to the extra information given by the knowledge of the openness variable in the out-of-sample period.

Faust and Wright (2013), we use the modified Diebold-Mariano (DM) test to evaluate the relative performance of a model against another baseline model for the forecast horizons h = 1, 2, 3, and 4. This approach is valid as long as the null hypothesis of interest is equal finite-sample forecast accuracy (and not in population) of two models (Clark and McCracken, 2013). As required by this method, we apply an heteroskedasticity and autocorrelation consistent estimator of the variance of the test statistic with the small-sample correction given by Harvey, Leybourne, and Newbold (1997), and then compare it with critical values from the standard normal distribution. Using the modified DM test, we compare the DPC, OPC, and TPC models against the AR2 model, then the OPC and TPC against the DPC as the baseline, and finally the TPC against the OPC. Table 5 also presents each model's MSFE relative to the given baseline model, with a value less than one indicating that the alternative model outperforms the baseline.

Table 5 confirms the efficacy of univariate models in forecasting inflation, as for most countries neither the linear nor the non-linear Phillips Curve models perform better that the benchmark AR2 model. As discussed in Clark and McCracken (2006), one possible reason for this finding is that, in finite samples, forecast comparison tests have limited power and so might fail to detect improvements in inflation forecasts using Phillips Curve models.[16] In terms of including openness as a threshold variable in the open-economy Phillips Curve, the results generally vary with Austria, Canada, Denmark, Ireland, Netherlands, and Switzerland seeing little improvements from the alternate TPC model against the baseline DPC and OPC models. However, for the remaining countries like Germany, Italy, Korea, Mexico, Spain, and UK we do find evidence of gains from incorporating the non-linearity in the Phillips Curve due to openness: we are able to reject the null that the baseline model is as good as the alternate TPC model in these instances. The TPC is especially found to be better for the h =2, 3, and 4 quarters and strongly dominates the DPC and OPC models for these countries. Overall, our results suggest it is hard to distinguish between the alternate Phillips Curve models over the short horizons, but that over longer horizons the non-linear TPC has value, at least for a subset of our sample OECD countries.

[16] Indeed Inoue and Kilian (2004) recommends that we should discount results of out-of-sample tests if they fail to confirm in-sample findings.

Table 5: Forecast Evaluation

AUSTRIA

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	1.122	-1.00	1.120	-0.63	1.115	-0.44	1.126	-0.48
OPC	1.170	-0.94	1.218	-0.57	1.260	-0.46	1.292	-0.49
TPC	1.473	-1.16	1.785	-0.84	1.964	-0.73	1.998	-0.74
DPC vs OPC	1.042	-0.44	1.087	-0.42	1.130	-0.42	1.148	-0.44
TPC	1.313	-0.96	1.593	-0.82	1.761	-0.76	1.775	-0.77
OPC vs TPC	1.259	-1.15	1.465	-0.98	1.559	-0.90	1.546	-0.93

CANADA

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	0.881	0.94	0.912	0.85	0.903	0.49	0.855	0.69
OPC	0.932	0.52	1.040	-0.23	1.084	-0.29	1.054	-0.18
TPC	1.138	-0.94	1.419	-2.15	1.987	-1.70	2.620	-1.36
DPC vs OPC	1.059	-0.72	1.140	-1.08	1.200	-1.12	1.233	-1.15
TPC	1.292	-1.12	1.556	-2.29	2.199	-1.48	3.064	-1.27
OPC vs TPC	1.221	-1.04	1.365	-1.84	1.833	-1.27	2.485	-1.13

DENMARK

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	0.876	1.37*	0.847	0.82	0.798	0.76	0.745	0.83
OPC	0.879	1.42*	0.854	0.82	0.807	0.75	0.757	0.82
TPC	1.646	-2.18	1.545	-1.27	1.552	-1.08	1.554	-0.95
DPC vs OPC	1.003	-0.39	1.007	-0.65	1.012	-0.79	1.017	-0.93
TPC	1.878	-2.42	1.823	-1.44	1.945	-1.48	2.087	-1.91
OPC vs TPC	1.873	-2.41	1.810	-1.43	1.922	-1.46	2.052	-1.85

GERMANY

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	0.867	2.21**	0.937	1.23	1.003	-0.02	1.014	-0.12
OPC	0.858	2.10**	0.965	0.24	1.024	-0.06	1.029	-0.07
TPC	0.691	2.42***	0.625	2.63***	0.652	1.09	0.695	0.80
DPC vs OPC	0.989	0.19	1.031	-0.20	1.021	-0.07	1.014	-0.04
TPC	0.796	1.88**	0.668	2.38**	0.650	1.52*	0.685	1.09
OPC vs TPC	0.805	1.90**	0.648	2.78***	0.637	2.25**	0.675	2.75**

IRELAND

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	1.213	-1.75	1.086	-0.73	1.055	-0.67	1.013	-0.24
OPC	1.146	-1.26	1.010	-0.11	0.974	0.41	0.938	1.15
TPC	1.542	-1.89	1.318	-0.99	1.248	-0.65	1.166	-0.37
DPC vs OPC	0.945	0.96	0.930	0.99	0.923	1.06	0.926	1.09
TPC	1.271	-1.19	1.214	-0.62	1.182	-0.45	1.151	-0.34
OPC vs TPC	1.345	-1.74	1.305	-0.99	1.281	-0.74	1.243	-0.53

ITALY

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	0.895	-0.63	0.781	-1.17	0.768	-0.81	0.667	-1.51*
OPC	1.059	0.22	0.972	-0.12	1.000	0.00	0.850	-0.38
TPC	1.540	1.18	1.686	1.21	2.141	1.12	1.986	0.92
DPC vs OPC	1.183	0.98	1.244	0.73	1.301	0.66	1.274	0.63
TPC	1.721	1.69**	2.158	1.44*	2.786	1.38*	2.977	1.34*
OPC vs TPC	1.455	2.21**	1.735	1.89**	2.142	1.75**	2.337	1.64**

Table 5 – Continued

KOREA

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	1.033	-0.43	1.020	-0.32	1.093	-1.24	1.116	-2.18
OPC	1.000	0.00	0.954	0.31	0.985	0.10	0.983	0.09
TPC	0.979	0.07	0.789	0.79	0.697	1.07*	0.666	1.24*
DPC vs OPC	0.968	0.26	0.936	0.35	0.901	0.55	0.881	0.59
TPC	0.948	0.20	0.774	0.79	0.638	1.38*	0.596	1.80*
OPC vs TPC	0.979	0.12	0.827	1.04*	0.707	1.40*	0.677	1.23**

MEXICO

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	2.521	-4.74	1.965	-2.95	1.682	-2.26	1.574	-1.96
OPC	2.531	-4.77	1.979	-3.05	1.701	-2.39	1.599	-2.14
TPC	0.856	0.95	0.543	3.32 ***	0.435	3.32***	0.399	2.96***
DPC vs OPC	1.004	-0.52	1.007	-0.66	1.012	-0.86	1.016	-1.05
TPC	0.340	5.32***	0.277	3.38***	0.259	2.76***	0.254	2.39***
OPC vs TPC	0.338	5.46***	0.275	3.49***	0.256	2.87***	0.250	2.51***

NETHERLANDS

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	0.882	1.10	0.777	1.19	0.656	0.76	0.672	0.59
OPC	0.863	1.32*	0.770	1.42*	0.675	0.82	0.676	0.72
TPC	0.968	0.18	1.068	-0.21	0.965	0.06	0.861	0.23
DPC vs OPC	0.978	0.54	0.991	0.11	1.030	-0.18	1.005	-0.03
TPC	1.097	-0.71	1.374	-1.42	1.472	-0.66	1.281	-0.54
OPC vs TPC	1.122	-0.90	1.386	-1.34	1.429	-0.71	1.275	-0.61

SPAIN

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	1.005	-0.14	1.014	-0.19	1.046	-0.32	1.054	-0.32
OPC	1.013	-0.14	1.046	-0.24	1.168	-0.49	1.213	-0.46
TPC	0.985	0.19	0.971	0.19	1.049	-0.19	1.008	-0.02
DPC vs OPC	1.009	-0.13	1.031	-0.25	1.117	-0.60	1.151	-0.52
TPC	0.981	0.36	0.957	0.47	1.004	-0.03	0.957	0.23
OPC vs TPC	0.972	0.50	0.928	1.16*	0.899	1.04*	0.831	1.54**

SWITZERLAND

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	0.902	1.02	0.943	0.54	1.215	-1.75	1.230	-3.15
OPC	0.898	1.07	0.902	1.03	1.103	-1.37	1.064	-0.91
TPC	1.028	-0.15	1.112	-0.37	1.583	-0.84	1.642	-0.82
DPC vs OPC	0.996	0.09	0.956	0.612	0.907	0.81	0.87	1.52*
TPC	1.140	-0.93	1.180	-0.67	1.302	-0.55	1.34	-0.52
OPC vs TPC	1.145	-0.87	1.234	-0.75	1.436	-0.67	1.543	-0.68

UK

	1 step MSPE	1 step DM	2 step MSPE	2 step DM	3 step MSPE	3 step DM	4 step MSPE	4 step DM
AR2 vs DPC	1.412	-2.12	1.267	-1.15	1.186	-1.39	1.108	-2.06
OPC	1.373	-1.98	1.237	-1.04	1.161	-1.06	1.088	-1.22
TPC	1.238	-0.94	0.991	0.04	0.731	1.58*	0.500	6.42***
DPC vs OPC	0.973	2.31**	0.976	1.31*	0.979	0.96	0.982	0.58
TPC	0.877	0.65	0.782	0.80	0.616	1.88 *	0.449	5.84***
OPC vs TPC	0.902	0.51	0.801	0.73	0.629	1.81*	0.457	5.95***

Note: Forecast comparison based on recursive estimates across h-quarter ahead forecast horizons. A model's Mean Square Prediction Error(MSPE) is expressed relative to the given baseline model. The modified Diebold-Mariano (DM) statistic is used to evaluate the fit of the different models with the null hypothesis that Model i's performance is not superior to that of the baseline Model j at the 1%, 5% and 10% significance level (denoted by ***, **, *).

6 Robustness Checks

In this Section, we conduct a series of robustness exercises to check the validity of the main results based on our preferred specification of the non-linear model discussed in Section 5. Numerous interesting points are explored next, including the role of other possible competing international factors in the inflation dynamics to the econometric robustness of the specification of model (2).

6.1 Trend Inflation Issues

Generally models of inflation that take into account a slowly evolving local mean perform better than purely stationary specifications (Faust and Wright, 2013). One way we account for this possibility is to have regime-specific intercepts in our threshold model and so allow for different means of inflation in the open and closed regimes. For most countries the open regime is associated with the later years of the sample, so a regime-specific intercept can account for the lower mean of inflation that has been observed in these OECD countries. As shown in Table A2, having regime-specific intercepts does not impact our threshold estimates and for most countries we see a similar switch in the output gap coefficients as in Table 4.

We further address the possibility of a persistent downward trend in the individual inflation series by demeaning the inflation series from a slow moving trend. In order to capture this trend component accurately, we employ an exponential smoothing method on each country's inflation series with a weighting scheme similar to Cogley (2002). Cogley (2002) shows that exponential smoothing filters out transient elements of CPI based inflation more effectively than other traditional detrending methods, while Rich and Steindel (2005) find that the exponentially smoothed series is able to track the underlying trend of inflation more closely than core inflation measures created by excluding food and energy prices from the CPI.

Table A3 in the Appendix shows the individual-country threshold estimates for inflation in deviation from its exponentially smoothed trend component. Again the estimates for most countries do not undergo much change from the baseline results in Table 4. We continue to see Austria, Denmark, Italy, and Mexico exhibiting a full globalization effect; Germany, Ireland and Netherlands exhibiting a partial effect due to the foreign output gap only; and Korea and the UK seeing an effect from the domestic output gap only. We no longer observe any globalization effect for Canada, Spain, and Switzerland when using the detrended inflation series. Our results in support of the inflation globalization are still quite robust even after accounting for the downward trend of inflation in recent years.

6.2 External Controls

We now consider specifications of the Phillips Curve in which we also allow traditional external factors, such as real exchange rate depreciation, import prices inflation, and oil prices, to have a role in determining domestic inflation.[17] From a theoretical perspective, Engel (2013) and Zaniboni (2008) have shown that besides the foreign output gap, the exchange rate depreciation (under producer currency pricing) or the term of trade (under local currency pricing) has a direct effect on inflation in the New Keynesian Phillips framework. Also empirically, Mihailov, Rumler, and Scharler (2011) have found with a GMM methodology that the relative change in the terms of trade is a more important factor in driving inflation than the current domestic output gap for a sample of OECD countries. We hence first consider the impact changes in the real exchange rate has on our baseline threshold model given in (2).

Table A4 reports the results when the annual depreciation rate of the real exchange rate is used as an additional control variable (constructed as the log difference of the trade-weighted real exchange rate between one quarter and the same quarter of the previous year). As with the output gaps, we allow the impact of the real exchange rate to vary across the two regimes. All in all, these results are consistent with our earlier findings, with most countries continuing to have the same estimated thresholds and similar bootstrapped p-values from the F-test of threshold significance. Trade openness as a threshold variable for the inflation dynamics is still rejected for Australia, France, Japan, and the U.S. The remaining countries still have a statistically significant threshold effect, and display similar changes in their output gap slopes as before from the close to open regime. For most of the countries, the real exchange rate depreciation coefficient also does not switch in a consistent manner between the regimes. Exceptions are Ireland, Korea, and Switzerland, for which the real exchange rate gains significance with the expected negative sign in the more open regime.[18] In the case of Switzerland, however, we no longer see a clear switch in the significance of the domestic output gap slope; for this country, the effect of trade openness on inflation seems to be better captured by the exchange rate channel.

We next turn to specifications that include oil and import prices as external controls in (2). Following Ihrig, Kamin, Lindner, and Marquez (2010), we include both import prices inflation and oil price inflation as deviations from lagged core inflation so that an increase in these prices relative

[17] In our analysis we examine these external controls as separate cases since including them altogether in a single model can lead to issues of over-fitting and inaccurate inference, especially in the threshold case we are studying, where there might not be sufficient observations in each regime to get consistent estimates for a large number of parameters. This was also the strategy employed in Borio and Filardo (2007) to test for the impact of traditional controls on their open-economy Phillips Curve estimates.

[18] The real exchange rate is defined so that an increase of it corresponds to an appreciation of the domestic currency and a loss of competitiveness of domestic goods. A negative sign of its coefficient is expected in the Phillips Curve, and an increase in significance of this coefficient in the more open regime is consistent with the implications of the globalization hypothesis.

Table 6: Globalization Effects with External Controls

Controls	Full Effect	Partial Effect (For)	Partial Effect (Dom)	No Effect
None	AUT, CAN, DEN, ITA, MEX	GER, IRE, KOR, NET, SPN	UK, SWZ	
Real Exch	AUT, DEN, MEX	CAN, GER, IRE, KOR, NET, SPN	ITA, UK	SWZ
Import Prices	AUT, DEN, SPN, MEX	GER, IRE, NET, KOR	UK	CAN, SWZ, ITA
Oil Prices	AUT, DEN, MEX	CAN, GER, IRE, KOR, NET, ITA	SPN, UK	SWZ

to domestic prices implies higher domestic inflation. Using the relative deviations of these supply shock variables is also consistent with the triangle model approach to capture inflation dynamics (Gordon, 2011). The estimates for the models with imports and oil prices are respectively illustrated by Tables A5 and A6 of the Appendix. The results are generally robust to the use of oil prices as a supply shock, while the regime switch is less clear for some of the countries once import prices are included. In particular, we do not find a significant change in the output gap coefficients from the closed to open regime for Canada, Italy, and Switzerland. It is also important to stress that the effects of globalization related to the foreign output gap channel might in many ways overlap with those determined by import prices, since a positive foreign output gap would cause prices of foreign goods to increase and could be reflected in higher import prices for the domestic economy. So including import prices as a separate regressor can make it harder to empirically disentangle the effect of the foreign output gap from that of import prices, and can potentially mask a switch between the regimes, at least for some of the countries in our sample. Table 6 summarizes the results for all the external controls used in our analysis; we continue to see the same degree of support for the inflation globalization hypothesis as for our baseline model from most of our sample countries.

6.3 Core Inflation

We now turn to the role of the energy and food components in the dynamics of domestic prices. It is important to understand whether the impact of globalization on inflation is a general phenomenon or more simply reflects the growing influence of global food and energy prices. We thus repeat the analysis of Section 5.1 using core inflation instead of CPI inflation in the threshold estimation. This substitution basically strips the more volatile food and energy prices from the CPI and allows us to focus on a narrower and more policy-oriented definition of inflation. For parsimony, we focus on the estimates without the external controls and just allow the output gaps to switch between regimes.[19]

Table A7 shows that the threshold Phillips Curve estimates are quite similar to those observed in Table 4, which is not surprising given that the two inflation series are highly correlated for most

[19]In general these results with core inflation do not change much with the addition of the external controls.

of the countries in our sample. Austria, Denmark, Mexico, and Korea exhibit a full globalization effect; Canada, Germany, Ireland, Netherlands, and Spain see a partial effect due to the foreign gap only; and Italy and the UK find a partial effect for the domestic output gap only. Notably, with core inflation both Australia and the U.S. also see a statistically significant non-linear effect from openness, with the domestic output gap coefficient losing significance in their more open regimes. Thus using core inflation actually corroborates our main findings and the role of openness in changing a country's inflation dynamics.

7 Conclusions

There are strong implications for the conduct of monetary policy if indeed it is the case that inflation is more influenced by global rather than domestic conditions. For one, a diminishing response to domestic factors implies an increase in the sacrifice ratio so that it becomes more costly to stabilize inflation through conventional policy actions (Calza, 2009). Alternatively, policy makers may feel that globalization adequately anchors inflationary tendencies through external competition and so are freer to concentrate on domestic output (López-Villavicencio and Saglio, 2014). Given these important policy consequences, it becomes imperative to identify the exact role globalization plays in the inflation process.

Our paper makes an interesting contribution to this debate by applying a threshold methodology to account for potential non-linear effects of trade openness on inflation dynamics. We find evidence that trade openness is not rejected as threshold variable for the Phillips Curve model for most of the countries in our sample, and this non-linear component must be explicitly modeled and included in the analysis of the inflation globalization hypothesis. We find that as countries reach a certain level of openness, their domestic inflation starts to respond to external influences as captured by the foreign output gap. At the same time, relatively closed economies that do not reach sufficient levels of openness, such as the U.S., do not exhibit such non-linearity in the relation between inflation and globalization. Accounting for non-linearities in the Phillips Curve reveals new evidence that contrary to the previous literature, which often ignores these effects, helps to corroborate the inflation globalization hypothesis. Nevertheless, the threshold Phillips Curve model also leads to improvements in out-of-sample forecast over the linear Phillips models only for some countries, and especially at longer horizons. Our threshold approach is robust to many alternative specifications, and provides a suitable tool to inform the policy making process with respect to the influence of relevant external forces.

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Appendix: Additional Tables

Table A1: SUR Phillips Estimates

	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Constant	0.505***	0.526***	0.500***	0.310**	0.290***	0.296**	0.625***	0.252*	0.091	0.603**	1.798**	0.187**	0.524***	0.180***	0.525***	0.850***
	(0.16)	(0.09)	(0.13)	(0.12)	(0.07)	(0.12)	(0.14)	(0.07)	(0.06)	(0.24)	(0.77)	(0.08)	(0.14)	(0.07)	(0.15)	(0.14)
Lag Inf	0.945***	0.820***	0.856***	0.853***	0.867***	0.840***	0.993***	1.10***	0.820***	0.972***	1.201***	1.095***	0.788***	1.042***	0.948***	0.851***
	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.08)	(0.06)	(0.04)	(0.06)	(0.07)	(0.04)	(0.05)	(0.05)
Avg Inf	-0.042	-0.055	-0.041	0.004	-0.014	0.012	-0.189***	-0.177***	0.046	-0.097	-0.283***	-0.180***	0.087	-0.143***	-0.079	-0.124*
	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.07)	(0.05)	(0.04)	(0.08)	(0.07)	(0.04)	(0.07)	(0.06)	(0.04)	(0.06)	(0.05)
Dom Gap	0.113**	0.062	0.036	0.110**	0.008	0.015	0.026	-0.032	0.100*	0.022	-0.239	0.018	0.027	0.034	0.110***	0.085*
	(0.04)	(0.05)	(0.04)	(0.04)	(0.03)	(0.05)	(0.03)	(0.03)	(0.05)	(0.04)	(0.22)	(0.06)	(0.07)	(0.04)	(0.04)	(0.04)
For Gap	-0.039	0.110*	0.037	-0.034	0.014	0.101	0.06	0.098	0.077	0.234	0.035	0.078	0.143	0.047	0.055	0.042
	(0.11)	(0.05)	(0.08)	(0.05)	(0.06)	(0.08)	(0.06)	(0.06)	(0.06)	(0.13)	(0.48)	(0.08)	(0.10)	(0.06)	(0.09)	(0.06)
RMSE	0.82	0.38	0.64	0.43	0.38	0.64	0.52	0.35	0.52	1.00	4.74	0.39	0.56	0.43	0.62	0.48

Notes: Sample 1985-2006. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A2: Threshold Estimates with Regime Specific Intercepts

Inflation	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Lag Inf	0.992***	0.868***	0.796***	0.810***	0.881***	0.816***	0.860***	1.071***	0.797***	0.909***	1.180***	1.037***	0.802***	1.067***	1.002***	0.851***
	(0.06)	(0.08)	(0.08)	(0.13)	(0.08)	(0.07)	(0.07)	(0.06)	(0.08)	(0.05)	(0.08)	(0.06)	(0.08)	(0.05)	(0.05)	(0.06)
Avg Lag	-0.098	-0.078	-0.272 **	0.046	0.006	-0.075	-0.071	-0.101*	0.083	-0.202**	-0.204**	-0.141**	0.023	-0.177***	-0.170***	-0.274**
	(0.08)	(0.07)	(0.11)	(0.11)	(0.07)	(0.10)	(0.05)	(0.06)	(0.08)	(0.08)	(0.08)	(0.05)	(0.07)	(0.05)	(0.06)	(0.10)
	Regime 1 (Open$\leq \theta_0$)															
Constant	0.766**	0.543***	1.932***	0.322**	-0.189	0.534*	0.657***	0.041	-0.008	2.161***	-0.934	-0.549***	1.027***	0.315***	0.792***	1.608***
	(0.33)	(0.16)	(0.47)	(0.14)	(0.23)	(0.27)	(0.15)	(0.14)	(0.11)	(0.44)	(2.36)	(0.12)	(0.33)	(0.08)	(0.20)	(0.37)
Dom Gap	0.171**	0.216**	0.042	0.161**	-0.013	0.172	-0.020	0.227*	-0.108	-0.109	3.286**	-0.367***	-0.069	-0.012	0.120**	-0.035
	(0.07)	(0.09)	(0.10)	(0.08)	(0.08)	(0.23)	(0.04)	(0.13)	(0.09)	(0.07)	(1.58)	(0.09)	(0.11)	(0.05)	(0.06)	(0.09)
For Gap	-0.164	0.077	0.151	-0.082	-0.424	-0.224	0.057	-0.204	0.107	0.449	1.567	-0.500***	0.269*	0.190*	0.415**	0.332
	(0.17)	(0.07)	(0.21)	(0.10)	(0.30)	(0.20)	(0.06)	(0.22)	(0.09)	(0.16)	(1.59)	(0.08)	(0.15)	(0.09)	(0.15)	(0.15)
	Regime 2 (Open$> \theta_0$)															
Constant	0.310**	0.471***	0.889***	0.311**	0.276***	0.353***	0.740***	0.109*	0.056	1.060***	0.965	0.248**	0.476**	-0.367*	0.632***	1.072***
	(0.15)	(0.13)	(0.22)	(0.13)	(0.10)	(0.12)	(0.18)	(0.06)	(0.06)	(0.26)	(0.66)	(0.10)	(0.18)	(0.18)	(0.19)	(0.22)
Dom Gap	0.183*	-0.136	0.172 **	-0.105	0.075*	-0.096*	0.011	-0.022	0.171**	0.014	-0.391	-0.039	0.016	0.597**	0.161**	-0.002
	(0.11)	(0.12)	(0.07)	(0.07)	(0.04)	(0.05)	(0.10)	(0.04)	(0.07)	(0.09)	(0.29)	(0.07)	(0.20)	(0.27)	(0.07)	(0.06)
For Gap	0.135	0.221**	-0.123	0.182**	-0.035	0.265***	0.493***	0.101*	0.078	0.263*	0.399*	0.191**	0.125	-0.450	-0.199	0.090
	(0.16)	(0.10)	(0.12)	(0.08)	(0.07)	(0.09)	(0.18)	(0.06)	(0.10)	(0.15)	(0.23)	(0.09)	(0.14)	(0.19)	(0.12)	(0.07)
Threshold	0.300	0.648	0.501	0.497	0.329	0.446	1.041	0.303	0.150	0.500	0.216	0.749	0.354	0.636	0.394	0.163
N1	43	53	61	63	81	61	34	76	76	70	84	82	44	16	59	56
RMSE	0.80	0.37	0.58	0.40	0.38	0.62	0.48	0.34	0.51	0.94	4.45	0.36	0.54	0.40	0.59	0.45
F-Stat	2.32	2.74	5.39	4.21	2.45	2.10	4.89	2.43	1.88	4.17	4.64	5.37	2.73	3.84	4.02	2.00
p-value	0.15	0.06	0.00	0.00	0.11	0.18	0.00	0.01	0.29	0.01	0.00	0.03	0.06	0.01	0.00	0.12

Note: See also Table 4.

Table A3: Threshold Estimates for De-Trended Inflation

Inflation	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Constant	0.048	-0.047	-0.109	-0.143***	-0.150*	-0.101	-0.140*	-0.188***	-0.080	0.053	0.347	0.004	-0.189**	0.002	-0.030	0.001
	(0.10)	(0.05)	(0.07)	(0.05)	(0.08)	(0.07)	(0.07)	(0.07)	(0.08)	(0.10)	(0.49)	(0.05)	(0.10)	(0.05)	(0.07)	(0.06)
Lag Inf	0.920***	0.860***	0.720***	0.822***	0.652***	0.795***	0.915***	1.020***	0.771***	0.959***	1.125***	0.993***	0.723***	1.007***	0.932***	0.816***
	(0.06)	(0.08)	(0.08)	(0.12)	(0.1)	(0.07)	(0.06)	(0.05)	(0.08)	(0.06)	(0.07)	(0.06)	(0.07)	(0.05)	(0.05)	(0.08)
Avg Lag	-0.129*	-0.136*	-0.166**	-0.032	0.160*	-0.072	-0.129**	-0.175***	0.037	-0.168**	-0.204***	-0.137**	0.075	-0.198***	-0.181***	-0.140
	(0.07)	(0.07)	(0.08)	(0.11)	(0.09)	(0.1)	(0.05)	(0.06)	(0.08)	(0.08)	(0.07)	(0.06)	(0.07)	(0.05)	(0.06)	(0.09)
								Regime 1 (Open $\leq \theta_0$ ***)***								
Dom Gap	0.168***	0.240***	-0.138	0.125*	0.007	0.206	-0.002	0.224*	-0.052	0.092**	4.343***	0.142	-0.692*	-0.026	0.153***	0.307**
	(0.05)	(0.09)	(0.15)	(0.08)	(0.04)	(0.3)	(0.04)	(0.13)	(0.09)	(0.04)	(1.56)	(0.25)	(0.30)	(0.05)	(0.04)	(0.13)
For Gap	-0.125	0.084	0.457	-0.090	-0.012	-0.220	0.042	-0.153	0.133	0.253	-0.679	-0.191	1.260*	0.278***	0.102	-0.250
	(0.13)	(0.07)	(0.35)	(0.10)	(0.07)	(0.30)	(0.07)	(0.20)	(0.09)	(0.16)	(1.77)	(0.19)	(0.33)	(0.09)	(0.08)	(0.27)
								Regime 2 (Open $> \theta_0$***)***								
Dom Gap	0.365*	-0.062	0.220***	-0.086	-0.251***	-0.123***	-0.095	-0.052	0.167**	0.102	-0.532	-0.026	0.122	0.055	0.062	0.095*
	(0.19)	(0.10)	(0.07)	(0.08)	(0.09)	(0.04)	(0.12)	(0.04)	(0.07)	(0.12)	(0.29)	(0.07)	(0.08)	(0.09)	(0.27)	(0.05)
For Gap	0.221	0.163*	-0.048	0.146*	0.395***	0.291***	0.787***	0.110*	0.060	0.160	0.834**	0.202**	0.040	-0.139	0.039	0.042
	(0.19)	(0.09)	(0.12)	(0.09)	(0.14)	(0.09)	(0.31)	(0.06)	(0.10)	(0.17)	(0.34)	(0.09)	(0.08)	(0.09)	(0.25)	(0.07)
Threshold	0.312	0.646	0.447	0.497	0.446	0.439	1.241	0.303	0.15	0.535	0.201	0.734	0.236	0.592	0.429	0.153
Regime 1(%)	70	45	20	37	82	34	84	23	25	39	16	17	19	72	88	21
SSE	0.77	0.37	0.58	0.42	0.35	0.63	0.51	0.32	0.52	0.99	3.95	0.38	0.52	0.4	0.6	0.44
F-Stat	1.69	3.37	3.53	5.39	3.28	2.25	5.19	5.19	1.99	1.76	11.06	2.66	5.86	5.51	4.91	3.63
p-value	0.18	0.00	0.00	0.01	0.14	0.08	0.00	0.00	0.11	0.12	0.00	0.03	0.01	0.00	0.02	0.10

Note: Inflation is determined as CPI inflation minus its exponentially smoothed trend component.

Table A4: Threshold Estimates with Real Exchange Rates

Inflation	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Constant	0.508***	0.492***	0.389**	0.225*	0.208**	0.525***	0.520***	0.050	0.010	0.635***	0.444	0.227**	0.393**	0.052	0.516***	0.674***
	(0.17)	(0.17)	(0.18)	(0.13)	(0.11)	(0.15)	(0.18)	(0.06)	(0.05)	(0.23)	(0.46)	(0.11)	(0.18)	(0.07)	(0.17)	(0.17)
Lag Inf	0.938***	0.871***	0.909***	0.794***	0.911***	0.678***	0.881***	1.054***	0.781***	0.948***	1.209***	1.025***	0.857***	1.097***	1.012***	0.908***
	(0.06)	(0.08)	(0.07)	(0.12)	(0.08)	(0.09)	(0.08)	(0.06)	(0.08)	(0.06)	(0.07)	(0.06)	(0.08)	(0.05)	(0.05)	(0.07)
Avg Lag	-0.021	-0.076	-0.038	0.093	-0.009	-0.055	-0.062	-0.073	0.127	-0.072	-0.203***	-0.120*	0.053	-0.148***	-0.140**	-0.136
	(0.08)	(0.08)	(0.08)	(0.11)	(0.07)	(0.09)	(0.05)	(0.06)	(0.09)	(0.07)	(0.07)	(0.06)	(0.08)	(0.05)	(0.06)	(0.09)
Regime 1 (Open$\leq \theta_0$)																
Dom Gap	0.151***	0.213**	0.147**	0.216***	0.011	0.235	-0.014	0.216*	-0.024	-0.064	0.944*	0.204	0.034	-0.159**	0.124***	0.607***
	(0.05)	(0.09)	(0.06)	(0.07)	(0.08)	(0.36)	(0.04)	(0.14)	(0.09)	(0.04)	(0.49)	(0.19)	(0.11)	(0.07)	(0.05)	(0.21)
For Gap	0.005	0.056	-0.071	-0.102	-0.097	-0.652	0.086	-0.202	0.190**	0.198	0.786	-0.103	0.119	0.234**	0.133	-0.457
	(0.15)	(0.09)	(0.12)	(0.08)	(0.31)	(0.41)	(0.07)	(0.22)	(0.09)	(0.18)	(1.00)	(0.16)	(0.19)	(0.10)	(0.09)	(0.27)
Real Exch	-0.041***	0.002	-0.025*	-0.033***	-0.017	0.099**	0.006	-0.027	0.021	-0.004	-0.343***	-0.078***	-0.001	0.017*	-0.014	0.032**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.05)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)	(0.07)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Regime 2 (Open$> \theta_0$)																
Dom Gap	0.361**	-0.158	-0.329	-0.110	0.090**	-0.073	-0.117	0.022	0.149*	0.186**	-0.145	-0.043	-0.173	0.095*	-0.024	0.048
	(0.18)	(0.11)	(0.17)	(0.06)	(0.04)	(0.05)	(0.12)	(0.04)	(0.09)	(0.09)	(0.24)	(0.07)	(0.21)	(0.06)	(0.22)	(0.05)
For Gap	0.204	0.241**	0.656*	0.161**	-0.072	0.275***	0.727***	0.063	0.074	0.333**	0.510***	0.182**	0.290**	-0.074	-0.033	0.054
	(0.18)	(0.10)	(0.35)	(0.08)	(0.06)	(0.10)	(0.23)	(0.06)	(0.10)	(0.17)	(0.2)	(0.09)	(0.15)	(0.06)	(0.22)	(0.06)
Real Exch	0.032	0.000	0.051*	-0.016	-0.016	-0.023**	-0.050**	-0.018***	-0.008	-0.053***	-0.105***	-0.001	0.021	-0.017*	0.026	-0.019
	(0.03)	(0.02)	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)	(0.01)	(0.03)	(0.01)	(0.02)	(0.01)
Threshold	0.312	0.648	0.696	0.497	0.321	0.397	1.224	0.302	0.150	0.535	0.252	0.749	0.354	0.530	0.423	0.151
Regime 1(%)	71	47	89	37	15	25	83	23	25	39	26	19	56	39	83	21
RMSE	0.75	0.37	0.61	0.39	0.38	0.57	0.48	0.33	0.51	0.88	3.72	0.37	0.57	0.41	0.61	0.46
F-Stat	2.98	2.45	2.85	5.71	0.96	7.56	4.54	6.50	2.41	3.57	6.02	3.58	2.52	3.33	5.11	1.40
p-value	0.13	0.05	0.01	0.00	0.68	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.04	0.01	0.01	0.29

Note: The four quarter change in the trade-weighted real exchange rate is used as external control.

Table A5: Threshold Estimates with Import Prices

Inflation	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Constant	0.209	0.318**	0.13	0.187	0.266***	0.214	0.384***	0.034	0.027	0.409*	-0.067	0.204*	0.62***	0.079	0.591***	0.165
	(0.15)	(0.15)	(0.17)	(0.11)	(0.09)	(0.17)	(0.14)	(0.07)	(0.06)	(0.25)	(0.37)	(0.11)	(0.21)	(0.07)	(0.21)	(0.14)
Lag Inf	0.988***	0.872***	0.853***	0.759***	0.604***	0.773***	0.962***	1.029***	0.805***	0.964***	1.174***	1.02***	0.902***	0.998***	0.986***	0.694***
	(0.06)	(0.08)	(0.08)	(0.12)	(0.09)	(0.13)	(0.06)	(0.05)	(0.09)	(0.06)	(0.04)	(0.06)	(0.08)	(0.06)	(0.05)	(0.06)
Avg Lag	-0.027	-0.019	0.071	0.126	0.278***	0.053	-0.088*	-0.041	0.089	-0.079	-0.145***	-0.119*	-0.072	-0.038	-0.13**	0.213***
	(0.07)	(0.07)	(0.09)	(0.1)	(0.08)	(0.16)	(0.05)	(0.05)	(0.08)	(0.07)	(0.04)	(0.06)	(0.07)	(0.06)	(0.06)	(0.08)
							Regime 1 (Open $\leq \theta_0$ ***)***									
Dom Gap	0.107**	0.248***	0.064	0.153**	-0.002	0.115	-0.021	0.024	-0.098	0.098	-18.039***	0.169	0.294***	-0.127	0.116***	0.653***
	(0.05)	(0.10)	(0.10)	(0.08)	(0.04)	(0.70)	(0.05)	(0.06)	(0.09)	(0.07)	(6.97)	(0.23)	(0.09)	(0.14)	(0.04)	(0.13)
For Gap	-0.211	0.011	0.011	-0.127	-0.037	0.098	-0.141	-0.034	0.108	0.083	-5.449***	-0.224	-0.119	0.169	0.096	-0.454***
	(0.15)	(0.10)	(0.20)	(0.10)	(0.07)	(0.84)	(0.12)	(0.10)	(0.10)	(0.14)	(2.16)	(0.18)	(0.11)	(0.12)	(0.11)	(0.17)
Import Price	0.000	0.005	0.005*	-0.001	0.015***	-0.027	0.006*	0.012***	0.002	0.004	0.496***	0.007**	0.003	0.011**	0.001	0.02***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.03)	(0.003)	(0.002)	(0.01)	(0.003)	(0.15)	(0.003)	(0.005)	(0.004)	(0.002)	(0.004)
							Regime 2 (Open $> \theta_0$***)***									
Dom Gap	0.237	-0.176*	0.060	-0.109	0.135***	-0.086*	-0.022	0.039	0.157*	-0.131	-0.334	-0.026	-0.306	0.055	-0.276	0.065
	(0.2)	(0.09)	(0.07)	(0.06)	(0.05)	(0.05)	(0.05)	(0.04)	(0.09)	(0.15)	(0.23)	(0.07)	(0.23)	(0.06)	(0.26)	(0.04)
For Gap	-0.030	0.239***	-0.154	0.119*	-0.083	0.146*	0.167***	0.049	0.062	0.907*	0.414*	0.173*	0.320**	-0.041	0.554	-0.125**
	(0.21)	(0.08)	(0.13)	(0.07)	(0.11)	(0.09)	(0.05)	(0.07)	(0.09)	(0.53)	(0.27)	(0.09)	(0.14)	(0.06)	(0.36)	(0.06)
Import Price	0.006*	0.003***	0.008***	0.003***	0.003***	0.004***	0.005***	0.001*	0.001	0.037**	0.011	0.000	0.002*	0.002***	-0.023**	0.009***
	(0.004)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.02)	(0.01)	(0.001)	(0.001)	(0.001)	(0.01)	(0.002)
Threshold	0.3124	0.6317	0.5766	0.4967	0.365	0.3769	0.9009	0.3544	0.1495	0.6698	0.1975	0.7491	0.3536	0.5064	0.4291	0.1508
Regime 1(%)	70	36	49	37	44	17	29	45	24	89	19	18	51	25	88	20
RMSE	0.81	0.35	0.61	0.39	0.33	0.61	0.46	0.29	0.52	0.96	3.14	0.38	0.47	0.39	0.61	0.36
F-Stat	1.12	3.83	5.02	6.30	6.31	3.05	2.59	8.43	1.74	2.76	15.46	3.34	9.87	6.40	3.90	7.46
p-value	0.49	0.00	0.01	0.00	0.00	0.02	0.02	0.00	0.21	0.03	0.00	0.13	0.00	0.00	0.06	0.00

Note: Import price inflation measured as the difference between the four quarter change in (log-)domestic import price deflator and lagged core CPI inflation.

Table A6: Threshold Estimates with Oil Prices

Inflation	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Constant	0.306*	0.500***	0.185	0.190*	0.343***	0.598***	0.552***	0.044	0.021	0.407	1.712**	0.387***	0.429***	0.132*	0.498***	0.400***
	(0.17)	(0.14)	(0.16)	(0.11)	(0.07)	(0.12)	(0.14)	(0.05)	(0.05)	(0.25)	(0.77)	(0.11)	(0.15)	(0.07)	(0.16)	(0.14)
Lag Inf	0.898***	0.861***	0.957***	0.758***	0.704***	0.587***	0.889***	0.908***	0.778***	0.962***	0.764***	0.955***	0.765***	1.085***	1.028***	0.789***
	(0.05)	(0.08)	(0.07)	(0.12)	(0.08)	(0.12)	(0.06)	(0.06)	(0.08)	(0.06)	(0.13)	(0.06)	(0.07)	(0.07)	(0.05)	(0.08)
Avg Lag	0.091	-0.064	0.027	0.125	0.199***	0.071	-0.038	0.078	0.165*	-0.080	-0.086	-0.115*	0.105	-0.143**	-0.122**	0.122
	(0.07)	(0.07)	(0.07)	(0.1)	(0.08)	(0.13)	(0.05)	(0.06)	(0.09)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.1)
Regime 1 (Open$\leq \theta_0$)																
Dom Gap	0.251***	0.204**	0.167***	0.158**	-0.113*	-0.012	-0.018	0.055	0.054	0.097	10.134**	0.060	0.156**	-0.182	0.108**	-0.494
	(0.08)	(0.08)	(0.06)	(0.08)	(0.07)	(0.52)	(0.04)	(0.08)	(0.13)	(0.07)	(4.09)	(0.11)	(0.08)	(0.14)	(0.04)	(0.36)
For Gap	0.140	0.087	-0.141	-0.128	0.037	0.339	0.032	0.081	0.139	0.079	-2.544	-0.081	0.446***	0.357***	0.132*	-0.169
	(0.17)	(0.07)	(0.11)	(0.1)	(0.29)	(0.53)	(0.06)	(0.16)	(0.09)	(0.14)	(3.3)	(0.14)	(0.13)	(0.12)	(0.08)	(0.26)
Oil Price	0.049***	-0.013	0.06***	-0.001	0.059***	-0.124***	0.033***	0.031***	-0.032	0.004	-0.298**	0.035***	0.018	-0.005	0.04***	0.12***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.04)	(0.01)	(0.01)	(0.02)	(0.01)	(0.12)	(0.01)	(0.01)	(0.02)	(0.01)	(0.04)
Regime 2 (Open$> \theta_0$)																
Dom Gap	0.108***	-0.215*	-0.426**	-0.11	0.157***	-0.072	0.01	0.146	0.082	-0.107	-0.578**	0.076	0.186	0.037	0.073	0.068
	(0.04)	(0.13)	(0.2)	(0.06)	(0.04)	(0.05)	(0.09)	(0.04)	(0.08)	(0.15)	(0.26)	(0.07)	(0.13)	(0.05)	(0.23)	(0.04)
For Gap	-0.079	0.280***	0.795*	0.122*	-0.166***	0.145*	0.430***	0.248**	0.122	0.853*	0.349*	0.154*	-0.098	-0.021	-0.104	-0.021
	(0.12)	(0.10)	(0.42)	(0.07)	(0.07)	(0.07)	(0.16)	(0.09)	(0.08)	(0.52)	(0.19)	(0.09)	(0.11)	(0.06)	(0.24)	(0.05)
Oil Price	0.058***	0.049**	-0.004	0.004***	0.046***	0.045***	0.016	0.006***	0.016***	0.033**	-0.232***	-0.017	0.04***	0.008	-0.026	0.062***
	(0.01)	(0.02)	(0.08)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)	(0.04)	(0.01)
Threshold	0.266	0.648	0.696	0.497	0.321	0.393	1.041	0.354	0.146	0.67	0.198	0.849	0.279	0.506	0.426	0.143
Regime 1(%)	22	47	89	38	15	22	66	45	18	89	23	49	26	25	85	15
RMSE	0.73	0.36	0.59	0.39	0.35	0.58	0.46	0.28	0.5	0.97	3.64	0.36	0.43	0.42	0.6	0.43
F-Stat	1.76	4.31	2.93	4.84	4.03	6.51	4.27	6.39	1.92	3.53	23.84	3.72	4.53	5.50	5.17	1.49
p-value	0.22	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.15	0.09	0.00	0.01	0.00	0.00	0.01	0.36

Note: Oil price inflation measured as the difference between the four quarter change in home currency oil prices and lagged core CPI inflation.

Table A7: Threshold Estimates for Core Inflation

Inflation	(1) Aus	(2) Aut	(3) Can	(4) Den	(5) Fra	(6) Ger	(7) Ire	(8) Ita	(9) Jpn	(10) Kor	(11) Mex	(12) Net	(13) Spn	(14) Swz	(15) UK	(16) USA
Constant	0.303^{**}	0.322^{***}	0.223^{*}	0.149^{**}	0.115^{*}	0.095	0.681^{***}	0.058	0.025	0.493^{***}	-0.345	0.194^{**}	0.516^{**}	0.117^{**}	0.109	0.109^{*}
	(0.14)	(0.10)	(0.12)	(0.06)	(0.07)	(0.11)	(0.17)	(0.07)	(0.04)	(0.17)	(0.70)	(0.09)	(0.21)	(0.06)	(0.11)	(0.07)
Lag Inf	1.054^{***}	0.788^{***}	0.929^{***}	0.941^{***}	0.978^{***}	0.951^{***}	0.883^{***}	0.953^{***}	1.010^{***}	0.991^{***}	1.19^{***}	1.093^{***}	0.653^{***}	1.101^{***}	0.957^{***}	0.969^{***}
	(0.07)	(0.08)	(0.06)	(0.1)	(0.09)	(0.08)	(0.07)	(0.08)	(0.06)	(0.07)	(0.06)	(0.06)	(0.13)	(0.06)	(0.06)	(0.07)
Avg Lag	-0.111	0.076	-0.011	-0.018	-0.033	0.004	-0.078	0.020	-0.070	-0.106	-0.112	-0.183^{**}	0.211^{**}	-0.140^{**}	-0.003	-0.009
	(0.07)	(0.08)	(0.05)	(0.09)	(0.07)	(0.11)	(0.05)	(0.08)	(0.06)	(0.09)	(0.07)	(0.08)	(0.09)	(0.06)	(0.07)	(0.07)
								Regime 1 (Open$\leq \theta_0$)								
Dom Gap	0.083^{**}	0.456^{***}	-0.018	0.121^{***}	-0.004	0.115	0.007	0.130^{*}	0.009	0.087^{*}	14.29^{***}	0.031	0.120	-0.114	0.163^{***}	0.103^{**}
	(0.04)	(0.08)	(0.09)	(0.05)	(0.03)	(0.15)	(0.04)	(0.08)	(0.03)	(0.06)	(2.73)	(0.05)	(0.1)	(0.09)	(0.06)	(0.04)
For Gap	-0.098	-0.023	0.211	-0.036	0.050	0.076	0.048	0.024	0.031	-0.067	-2.783	0.009	0.194	0.334^{***}	-0.098	0.016
	(0.12)	(0.07)	(0.15)	(0.06)	(0.05)	(0.29)	(0.06)	(0.11)	(0.05)	(0.21)	(3.22)	(0.06)	(0.11)	(0.11)	(0.10)	(0.06)
								Regime 2 (Open$> \theta_0$)								
Dom Gap	0.575	-0.160	0.098^{**}	-0.053	0.044	-0.028	0.002	0.032	0.156^{*}	0.014	-0.551	-0.124	-0.118	0.056	-0.078	0.012
	(0.44)	(0.11)	(0.04)	(0.04)	(0.05)	(0.03)	(0.10)	(0.04)	(0.09)	(0.07)	(0.37)	(0.13)	(0.16)	(0.04)	(0.28)	(0.02)
For Gap	-0.012	0.302^{***}	0.184^{**}	0.082^{*}	0.061	0.090^{*}	0.529^{***}	0.005	-0.002	0.295^{***}	0.815^{*}	0.349^{**}	0.278^{***}	0.001	0.29	0.041
	(0.29)	(0.10)	(0.09)	(0.04)	(0.08)	(0.05)	(0.21)	(0.06)	(0.08)	(0.10)	(0.42)	(0.14)	(0.11)	(0.05)	(0.23)	(0.03)
Threshold	0.336	0.629	0.604	0.497	0.365	0.423	1.041	0.313	0.173	0.497	0.198	1.036	0.354	0.506	0.423	0.154
Regime 1(%)	84	33	62	38	44	27	66	31	57	27	23	77	52	25	83	33
RMSE	0.85	0.34	0.59	0.28	0.24	0.47	0.51	0.31	0.36	0.8	6.55	0.3	0.47	0.34	0.72	0.19
F-Stat	3.98	12.52	2.15	4.93	1.56	5.51	7.03	2.97	1.65	4.71	7.39	2.20	3.37	4.58	3.54	2.94
p-value	0.06	0.00	0.09	0.00	0.24	0.00	0.00	0.01	0.23	0.02	0.00	0.08	0.12	0.00	0.10	0.02

Note: Inflation measured as the four quarter change in the CPI excluding food and energy prices.