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## Policy Conflicts and Inflation Targeting: The Role of Credit Markets

By Woon Gyu Choi and David Cook

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# Policy Conflicts and Inflation Targeting: The Role of Credit Markets*

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## Abstract

This paper shows that stabilizing volatility in credit growth often conflicts with price stability: unusual credit expansions often occur when inflation is low relative to goals, and credit slumps often appear when inflation is overshooting. We find that central banks with inflation targeting (IT) are responsive to credit conditions in both advanced economies and emerging-market economies (EMEs). However, EMEs are more sensitive to inflation conditions, responding to credit growth only when consistent with IT. Macroprudential measures are also deployed to address credit growth volatility when orthodox policy moves would be inconsistent with IT, complementing monetary policy.

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**CONTENTS** **PAGE**

## I. INTRODUCTION

Over the last twenty years, a wide range of central banks in advanced economies and emerging-market economies (EMEs) have adopted inflation targeting (IT) monetary policies (Hammond, 2012). Among the extensive set of elements of a full-fledged IT regime, key aspects include the use of the policy rate to achieve price stability as both the ultimate goal and the nominal anchor for the currency. Price stability is one among many possible goals for a central bank. Given a liberalized money market, the central bank with a limited number of instruments may be unable to achieve other potentially important goals including business cycle stability, exchange rate stability, and financial stability.

To achieve each independent goal, policymakers must have access to an independent instrument, as implied by Tinbergen's rule. For example, New Keynesian theory suggests that implementing price stability does not conflict with business cycle stability and indeed can achieve first best outcomes, if the economy is subject to standard demand shocks (see Woodford, 2002). Conversely if independent shocks shift inflation and the output gap in opposite directions, policymakers would face a trade-off between alternative goals unless they have an additional independent instrument. As White (2006) noted, policymakers would be mindful of exchange rate movements, external debt and capital flows, and financial overreach (including accelerating credit growth and mounting leverage) as well as price stability to ensure high, sustained growth.

This paper is meant to tabulate potential conflicts between price stabilization and alternative monetary policy goals. While many central banks have price stability as an ultimate objective, IT regimes present clear numerical targets for inflation. Most IT regimes will also allow target ranges for inflation as a target is considered to be missed. We identify periods when a central bank with IT faces constraints on monetary policy by comparing actual inflation with the target range.[1] During periods when inflation lies outside of its target range, the central bank's policy space to address conflicting goals is likely reduced. For example, if inflation rates exceed the target range, monetary policy responses to a business cycle recession or currency appreciation could raise credibility issues regarding the central bank's commitment to its inflation target.

We examine the frequency at which the price stability goal might conflict with other goals associated with the output gap, exchange rates, and credit growth. These conflicts can be particularly pronounced for IT central banks which are explicit about their numerical goals and acceptable range for inflation outcomes. Periods when inflation is out of the target range require policy actions or justifications. We find cases where inflation below the target range suggests looser policy at the cost of excessive credit and opposite cases where inflation above the target range calls for tighter policy at the cost of posing financial stress with lower credit growth.

Stabilizing the output gap and exchange rates sometimes conflict with movements in inflation, but such conflicts are not as frequent as potential conflicts between credit growth and inflation. We find that credit growth is at least as frequently high when inflation is below target as when it is high. This conflict may echo a policy challenge as follows. Persistent downward pressures, stemming from low energy and commodity prices, on inflation led to persistent low

[1] The forward-looking monetary policy would respond to inflation forecast (Clinton et al., 2015). Inflation forecast could be based on surveys, models, or markets (Faust and Wright, 2013; Bauer and Rudebusch, 2015; and Bauer and McCarty, 2015), while it could also be the central bank's forecast taking into account all available information (Svensson, 1997 and 2017b).

inflation in open economies including most IT countries. The confluence of low global interest rates and low inflation rendered policy rates persistently low, and further loosening monetary policy to meet inflation target may run the risk of credit bubbles, mounting debt, or hitting the "effective" lower bound of interest rates.

Against this backdrop, an ongoing debate considers whether an exclusive focus on price stability is appropriate with a financial system out of sync with inflationary conditions. Estimating a monetary policy reaction function with panel data, we find that central banks are responsive to credit growth in setting their monetary policy rates (in addition to inflation and the output gap), suggesting the mindfulness of financial imbalance buildups. In EMEs, however, central bank responses to credit conditions are limited to periods when policy responses to inflation condition are required. In advanced economies, the sensitivity of monetary policy to credit growth is more consistent across inflation conditions.

Recent research using DSGE models with financial frictions have examined how the collaboration of monetary policy and macroprudential policy affects macroeconomic stabilization or welfare: for example, if macroprudential policy is deployed to shore up collateral liquidity or require liquidity buffers in response to financial shocks (Choi and Cook, 2012); if monetary and capital requirements policies collaborate (Angelini et al., 2014); if macroprudential policy responds to financial imbalance (Bailliu et al., 2015); or if monetary policy interacts with macroprudential policy (Mendoza, 2016; and Carrillo et al., 2017).

Macroprudential actions are an additional tool that can help achieve an additional goal (Crowe et al., 2011; Kannan et al., 2012; Tovar et al., 2012; Smets, 2014; Gaspar et al., 2016; and Kim and Mehrotra, 2017). We find that macroprudential actions are used for financial stability when the traditional monetary policy instruments are constrained by the inflation target. Specifically, when inflation falls below (rises above) the target range with tight (easy) monetary policy, which might constrain further policy rate hikes (cuts) to lean against financial risks, central banks are more likely to implement macroprudential actions that tighten (ease) credit.

The remainder of the paper proceeds as follows. Section II describes the characteristics of the country panel data used for our empirical analysis, and Section III examines policy conflicts between price stability with business cycle stabilization, exchange rate stability, or financial stability. Section IV assesses monetary policy responsiveness to credit growth and to interactions between credit markets and inflation status by estimating a Taylor-type rule extended to country-panel regressions. Section V explores how macroprudential measures have been deployed to lean against the wind in harmonization with inflation targeting. Section VI concludes.

## II. DATA

We examine quarterly data from 23 countries identified as implementing IT in Hammond (2012) including Australia, Brazil, Canada, Chile, Colombia, the Czech Republic, Hungary, Iceland, Indonesia, Israel, Korea, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Romania, South Africa, Sweden, Thailand, Turkey, and the United Kingdom. We do not include Armenia, Ghana, Guatemala or Serbia for reasons of data availability. Data on the inflation target on an annual basis are taken from central bank publications, web sites, and IMF Article IV reports. We use point targets or the midpoint of the range as a proxy for the target for countries that operate a target range without a particular numerical target. Where possible we use ex ante targets, ignoring changes that occur within a year.

Table 1. Inflation Outcome by Region

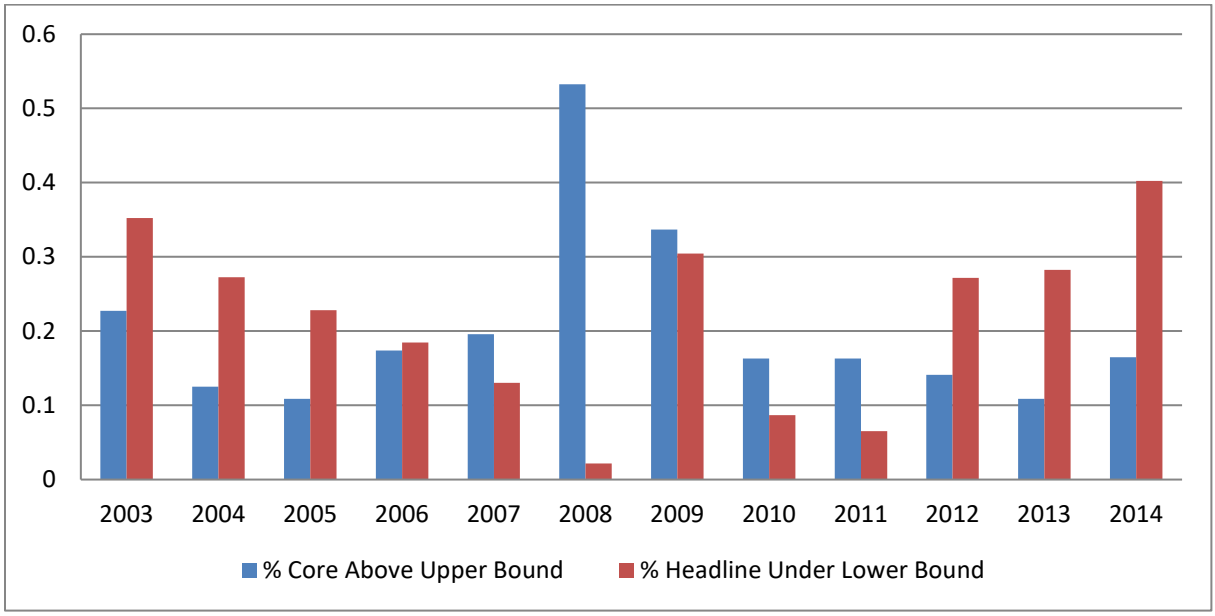
| Region | Average Y-o-Y Inflation | | Gap from Target | | Headline: % of Quarters | | Core: % of Quarters | |
|---|---|---|---|---|---|---|---|---|
| | (A) Headline | (B) Core | (C) Headline | (D) Core | (E) Above Upper Bound | (F) Below Lower Bound | (G) Above Upper Bound | (H) Below Lower Bound |
| Anglophone | 2.25 | 1.95 | 0.09 | -0.25 | 22.4% | 13.0% | 8.4% | 8.9% |
| East Asia | 3.61 | 2.87 | 0.30 | -0.60 | 32.3% | 25.5% | 12.8% | 33.3% |
| Eastern Europe | 3.50 | 2.46 | 0.37 | -0.51 | 41.3% | 30.4% | 18.9% | 39.5% |
| Latin America | 3.97 | 3.41 | 0.69 | 0.22 | 33.8% | 9.2% | 9.2% | 18.9% |
| Scandinavia | 2.00 | 1.10 | -0.32 | -1.22 | 25.7% | 32.6% | 5.52% | 55.2% |
| Others | 5.28 | 5.67 | 0.93 | 1.31 | 37.5% | 26.4% | 50.0% | 17.8% |
| World | 3.22 | 2.66 | 0.32 | -0.24 | 32.2% | 21.6% | 20.6% | 27.8% |

Note: This table shows the average inflation outcomes for inflation target countries and compositions of departures from inflation target levels in various regions using quarterly data for 2003−2014.

We obtain measures of headline CPI inflation from the IMF International Financial Statistics. Data on Core Inflation comes from the OECD Main Economic Indicators and a variety of national statistical agencies and central banks. To measure core inflation for Australia, Canada, Chile, Czech Republic, Hungary, Israel, Iceland, Korea, Mexico, New Zealand, Norway, Poland, Sweden, Switzerland, Turkey, UK, and South Africa, we use *CPI: All Items: Non-Food Non-Energy* from OECD Main Economic Indicators (base 2010). Core inflation for other countries is based on CPI: Lima: Core (Central Reserve Bank of Peru, base 2009=100) for Peru, Core CPI (Philippine Statistics Authority, base 2006=100) for the Philippines, HICP: All Items excluding Energy, Food, Alcohol & Tobacco (Eurostat, base 2005=100) for Romania, CPI: NFB excluding Food and Energy (Bureau of Trade and Economic Indices, base 2011=100) for Thailand, National CPI: IPCA: Core: Exclusion (ex2) (Central Bank of Brazil) for Brazil, and CPI: Core (Central Bureau of Statistics, linking base 2002, 2007, and 2012 successively) for Indonesia.

Table 1 reports statistics for each region (specifying Turkey, Israel and South Africa as "Others"). We show the median level of year-on-year inflation, both headline and core for the period 2003-2014. We see that inflation tends toward the low single digits in the regions of the world. Due to the commodity cycle during this period, headline inflation has tended to be above core inflation by somewhat more than 50 basis points in all the regions of the world except "Others." In Columns C and D, we show the median deviation of inflation from the inflation target (which varies from country to country and over time). The median gap overall is near zero with headline inflation above target and core inflation typically below target. Within each region, the typical deviation from target also tends to be small, less than 1% point in all cases except Scandinavia where core inflation has generally run more than 1% point below target and Others where core inflation has generally been more than 1% point above target.

Figure 1. Inflation Departures from the Target Range




Note: This figure depicts the fraction of country quarters in which IT countries saw core (headline) inflation above (below) the target range for 2003–2014.

Despite this overall good performance, there have been periods when inflation has deviated from its target range. Columns E–H show the percentage of country quarters in which (year-on-year) inflation is outside the target range for the countries relative to the total number of country quarters for 2003–2014 for each region. Headline inflation has more often been above the upper bound of the target range (Column E) than below the lower bound (Column F) in most regions except Scandinavia. In contrast, core inflation has less often been above the upper bound of the target range (Column G) than below the lower bound (Column H) in most regions except Latin America and Others. Also notable is that, in contrast to the Other countries, the Anglophone countries are more likely to shoot headline and core inflation within the target range.

While most IT countries apparently target headline inflation, underlying inflation pressures could weigh in core inflation as well as headline inflation. Figure 1 indicates that the fraction of country quarters in which IT countries saw core inflation above the target range escalated before the global financial crisis (GFC) and receded afterwards owing to weaker demand. It also mirrors that the fraction of country quarters in which IT countries saw headline inflation below the target range shrunk but surged shortly after the GFC and then, in tandem with slow recovery and pent-up disinflationary pressures, ramped up for 2012-14. Given that core inflation is prone to be under the inflation target (see Table 1), the overshooting by core inflation could offer a clear indicator of overheating. Given that headline inflation is prone to be above target, the undershooting by headline inflation might offer a clear indicator of disinflationary pressures.

Inflation performance varies over periods as shown in the figure, while during most of the previous decade inflation was largely held in check. The fraction of country quarters in which

year-on-year core inflation has been over the target range has been in 10-20% except for 2008 and 2009. In 2008, over half of the time core inflation was above the target range, and headline inflation exceeded the target range in over 80% of country quarters, attributable to the commodity cycle. The occurrence of disinflationary episodes shows more volatility. We can observe that in more than half of the years, headline inflation has been below the lower the bound in more than 20% of country quarters, while in 2008 and 2010-11 only 10% of country quarters display disinflationary pressures. Notably, the crisis year of 2009 displays the greatest dispersion of inflationary and disinflationary conditions. In more than 30% of country quarters in 2009, core inflation was overshooting the target range, possibly owing to pass-through effects of depreciation. Conversely in another more than 30%, headline inflation was undershooting the range, possibly dominated by the reduced aggregate demand upon the GFC. Interestingly, the most recent year, 2014, displays the greatest frequency of disinflationary outcomes with more than 40% of country quarters, heralding the emergence of disinflationary pressures in many advanced economies and EMEs.

## III. Inflation Targeting Policy Conflicts

We examine conflicts between price stability and other goals through IT country experiences. To assess more comprehensively the relationship between inflation stabilization and other goals allowing for threshold or asymmetric effects on policy actions, we construct a discrete variable *Headline* (*Core*) *Inflation Status* which equals -2 when headline (core) inflation is below the target lower bound, -1 when headline inflation is below target but within the target range, 1 when headline inflation is above target but within the range, and 2 when inflation is above the target upper bound. We also construct a continuous variable, *Headline* (*Core*) *Inflation Gap*: the gap between headline (core) inflation and the inflation target (or midpoint of the target range when a point target is unavailable).

Other goals we consider are trifold. First, business cycle stabilization on the real front may exacerbate inflation or be conducive to price stability, depending on the nature of driving shocks. Second, central banks could be concerned about the stable value of domestic currency or exchange rate stability because of pass-through effects of exchange rates on prices. Third, central banks are keen on credit growth and short-term capital flows for financial stability.

### A. Business Cycle Stabilization

To explore the traditional Phillips curve tradeoff between inflation and growth, one can compare periods when inflation is outside of the target range with business cycle outcomes. We measure the output gap as the percentage deviation of seasonally-adjusted real GDP (using the X12 method) from the Hodrick-Prescott (HP) trend using data for 1990-2014. For each country, we construct the standard deviation of the output gap over the period from the inception of the IT regime to the second quarter of 2008 (onset of the Lehman Brothers crisis).[2] If a country's output gap in a given quarter is above (below the negative of) the pre-crisis standard deviation, we characterize the corresponding country quarter as a boom (recession).

[2] We use pre-GFC sample distributions to sort out effectively repercussions and follow-ups from the GFC that could have changed trends and variations in the output gap, exchange rates, real credit growth, or hot money flows.

Table 2. Business Cycle Conflicts with Inflation

| Panel A | Headline Inflation | | | | |
|---|---|---|---|---|---|
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Output Gap in: | | | | | |
| Recession | 45 | 32 | 29 | 42 | 148 |
| Neither | 161 | 188 | 197 | 216 | 762 |
| Expansion | 15 | 20 | 37 | 94 | 166 |
| Total (Obs.) | 221 | 240 | 263 | 352 | 1,076 |

| Panel B | Core Inflation | | | | |
|---|---|---|---|---|---|
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Output Gap in: | | | | | |
| Recession | 42 | 35 | 30 | 41 | 148 |
| Neither | 223 | 245 | 162 | 133 | 763 |
| Expansion | 30 | 55 | 36 | 45 | 166 |
| Total | 295 | 335 | 228 | 219 | 1,077 |

| Panel C | Independent Variable | | | |
|---|---|---|---|---|
| | *Headline Status* | *Core Status* | *Inflation Gap* | *Core Inflation Gap* |
| | Without Fixed Effects | | | |
| Output Gap (Dependent Variable) | $0.26^{***}$ | $0.07^{*}$ | $0.23^{***}$ | $0.08^{***}$ |
| | (0.03) | (0.04) | (0.02) | (0.03) |
| | With Country-Fixed Effects | | | |
| | $0.23^{***}$ | $0.08^{***}$ | $0.27^{***}$ | $0.12^{***}$ |
| | (0.02) | (0.03) | (0.03) | (0.04) |

Notes: This table displays how outcomes for the output gap (measured by HP-filtered and seasonally-adjusted real GDP) over business cycles are associated with the achievement of the inflation target for the entire sample 2003-2014 with 23 countries. Panel A compares periods (for 2003–2014) for which the economy is in recession (more than one s.d. below zero) or expansion (more than one s.d. above zero) coincides with periods in which headline inflation is above, within, or below the target range. Panel B makes a similar comparison with core inflation. Panel C shows coefficient estimates from the simple regression of the inflation gap (inflation minus its target value) on the status index of inflation relative to target. It also includes regression results with country-fixed effects. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

We find little evidence of conflicts between inflation stabilization and business cycle stabilization. Table 2 shows the frequency of periods in which headline (Panel A) and core inflation (Panel B), respectively, are outside of the target range for the periods of expansion and recession as defined above. We see that when headline inflation is below the target range, the economy is three times as likely to be in a recession as in an expansion; and when headline

inflation is above the target range, the economy is more than twice as likely to be in an expansion as in a recession. This finding is consistent with the idea that business cycles are primarily driven by demand forces which shift the output gap and inflation in the same direction. Core inflation nonetheless has less clear positive links with the output gap. We do see that when core inflation is below the target range, the economy is substantially more likely to be in a recession than in an expansion. However, when core inflation is above the target range, the economy is only slightly more likely to be in expansion than in recession.

Table 2, Panel C shows coefficient estimates from the simple regression of the output gap on each of these variables. The results—broadly consistent with those in Panels A and B—offer little evidence on conflicts between headline inflation and the output gap, especially for headline inflation. In each case, the relationship between headline inflation relative to target and the output gap is positive in the range of 0.2 and 0.3 and significant at the 1% level. Controlling for country-fixed effects provided similar results. The coefficient on the output gap in core inflation regressions is less than a half of that in headline inflation equation. Specifically, the *Core Inflation Status* coefficient is 0.07 and only significant at the 10% level; and the *Core Inflation Gap* coefficient is around 0.1 but significant at the 1% level.

## B. Exchange Rate Stability

A floating exchange rate is integral for implementing IT to allow for a focus on internal price stability. Price stability is inherently linked to exchange rate changes which feed into inflation. Beyond its role in determining domestic prices however, exchange rate stability can offer independent benefits in stabilizing external goods and financial markets (e.g., Nordstrom et al., 2009).

We define periods of exchange rate appreciation or depreciation for a subset of IT countries in terms of the behavior of their exchange rates against the U.S. dollar. We restrict our analysis to countries in Latin America or Asia in addition to Anglophone countries. Exchange rate stability versus the euro might be more important for countries in Scandinavia, Eastern Europe or the Near East. For each of the remaining countries, we measure depreciation (appreciation) quarters when the year-on-year growth of the exchange rate against the U.S. dollar is higher (lower) than the rate measured as one-standard deviation above (below) the average for the period between the inception of an IT regime and the second quarter of 2008.

Table 3 tabulates appreciation and depreciation quarters versus *Inflation Status* (Panel A) and *Core Inflation Status* (Panel B). In both cases, when inflation is above the upper target bound, the economy is much more likely to be in a period of depreciation. In contrast, when the inflation rate is below the lower bound, the exchange rate is roughly equally likely to be in a period of depreciation as appreciation. Within the target range, however, appreciation is more likely to be associated with low inflation: for example, in a period of appreciation, the core inflation rate is much more likely to be below target than above target. These results are largely consistent with a floating exchange rate under IT as a shock absorber and exchange rate passthrough on inflation.

Table 3. Exchange Rate Conflicts

| Panel A | Headline Inflation | | | | |
|---|---|---|---|---|---|
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Exchange Rate: | | | | | |
| Appreciation | 10 | 34 | 31 | 19 | 94 |
| Neither | 73 | 96 | 145 | 131 | 445 |
| Depreciation | 13 | 18 | 17 | 36 | 84 |
| Total | 96 | 148 | 193 | 186 | 623 |
| Panel B | Core Inflation | | | | |
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Exchange Rate: | | | | | |
| Appreciation | 16 | 50 | 15 | 14 | 95 |
| Neither | 96 | 175 | 110 | 63 | 444 |
| Depreciation | 15 | 22 | 16 | 31 | 84 |
| Total | 127 | 247 | 141 | 108 | 623 |
| | Independent Variable | | | | |
| Panel C | *Headline Status* | *Core Status* | *Inflation Gap* | *Core Inflation Gap* | |
| Exchange Rate Growth (Dependent Variable) | Without Country-Fixed Effects | | | | |
| | $0.82^{***}$ | $1.62^{***}$ | $0.84^{***}$ | $1.38^{***}$ | |
| | (0.29) | (0.30) | (0.24) | (0.31) | |
| | With Country-Fixed Effects | | | | |
| | $0.67^{**}$ | $1.72^{***}$ | $0.74^{***}$ | $1.59^{***}$ | |
| | (0.31) | (0.33) | (0.25) | (0.35) | |

Notes: This table tabulates outcomes for a measure of exchange rate depreciation (the growth rate of the exchange rate against the U.S. dollar) in comparison with the achievement of the inflation target for the sample period 2003-2014 with 13 countries from Latin America, Asia, and Anglophone groups. Panel A compares periods (from 2003-2014) for which the exchange rate is in appreciation (more than one s.d. below mean) or depreciation (more than one s.d. above mean) with periods in which headline inflation is above, within or below the target range. Panel B makes a similar comparison with core inflation. Panel C shows coefficient estimates from the simple regression of exchange rate growth on the status index of inflation relative to target. It also includes regression results with country-fixed effects. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

We again regress the exchange rate growth rate on *Inflation Status* or *Inflation Gap* (Panel C). Simple regressions or regressions with country-fixed effects indicate a uniformly positive relationship with highly significant coefficient estimates. It is perhaps not surprising that nominal exchange rate movements are positively associated with inflation movements. These results, if not sufficient to minimize the possibility of conflicts between inflation targeting and exchange rate stability, lead us to turn to conflicts between potential goals on the financial front.

## C. Financial Stability

### C.1. Credit Growth

To examine credit growth (relative to output growth), we use credit to the non-financial private sector from domestic banks as measured by the BIS Long-term Private Credit database.[3] This database has quarterly data for Australia, Brazil, Canada, Czech Republic, Hungary, Indonesia, Korea, Mexico, Norway, Poland, Sweden, Thailand, Turkey, South Africa, and United Kingdom. We augment it with quarterly data on Bank Claims on the Private Sector for Chile, Colombia, Iceland, Philippines, and Romania from IMF IFS. Each of these series is deflated by CPI. The year-on-year percentage increase in these series we call credit growth.

Table 4 measures and compares periods of credit contraction and expansion with inflation conditions in terms of the distance from inflation target. A period of credit loosening (tightening) is one in which real credit growth expands at a level higher (lower) than the average level plus (minus) one-standard deviation measured over the pre-crisis IT period for each country. In country quarters where inflation is above the target range, credit conditions are prone to be tightening. This is possibly because credit expansions which are prone to precede inflation will call for policy rate hikes to ward off future inflation. The association of credit conditions with inflation conditions is mixed when inflation is below the target range. When headline inflation is considerably below the target range, credit conditions are more likely to be contractionary (possibly owing to reduced demand for credit). When core inflation is below the target range, however, measured credit conditions are more likely to be loose (possibly owing to credit provisions to counteract undershooting inflation with persistence).

We also find some evidence on a policy conflict between price stability and financial stability from the regression of real credit growth on *Inflation Status* or *Inflation Gap* (Panel C). The *Core Status*, *Headline Inflation Gap*, and *Core Inflation Gap*, controlling for country-fixed effects, are strongly negatively associated with real credit growth, while their estimated coefficients are insignificant without country-fixed effects. We could view this as evidence of a conflict because the deployment of policy rates improves one objective at the cost of another, as opposed to no policy conflicts if policy rate hikes (cuts) to temper (spur) credit growth would lower inflation (reduce disinflationary pressures).

[3] While there is no consensus on what variable to target for financial stability, we look at real credit growth as a metric of financial imbalance, along with the output gap as a metric of real imbalance (to see whether credit to support fundamentals is well-aligned with output). While an alternative metric could be the detrended credit-GDP ratio, we focus on year-on-year real credit growth to isolate cumulative real credit changes from real output changes because we include the output gap as a separate variable in all regression equations.

Table 4. Credit Growth Conflicts

| Panel A | Headline Inflation | | | | |
|---|---|---|---|---|---|
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Credit Growth: | | | | | |
| Tightening | 41 | 35 | 43 | 81 | 200 |
| Neither | 122 | 121 | 152 | 173 | 568 |
| Loosening | 28 | 43 | 42 | 51 | 164 |
| Total | 191 | 199 | 237 | 305 | 932 |
| | | | | | |
| Panel B | Core Inflation | | | | |
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Credit Growth: | | | | | |
| Tightening | 33 | 67 | 59 | 41 | 200 |
| Neither | 185 | 188 | 105 | 90 | 568 |
| Loosening | 53 | 54 | 33 | 24 | 164 |
| Total | 33 | 67 | 59 | 41 | 932 |
| | | | | | |
| Panel C | *Headline Status* | *Core Status* | *Inflation Gap* | *Core Inflation Gap* | |
| | Independent Variable | | | | |
| Real Credit Growth (Dependent Variable) | Without Country-Fixed Effects | | | | |
| | 0.35 | 0.01 | -0.26 | -0.12 | |
| | (0.24) | (0.26) | (0.16) | (0.22) | |
| | With Country-Fixed Effects | | | | |
| | -0.09 | -1.10*** | -0.77*** | -1.33*** | |
| | (0.25) | (0.27) | (0.16) | (0.23) | |

Notes: This table tabulates outcomes for a measure of real credit growth (year-on-year growth in claims on the private sector deflated by the CPI) in comparison with the achievement of the inflation target for the sample period 2003-2014 with 20 countries (excluding Israel, New Zealand, and Peru owing to data unavailability on credit growth). Panel A compares periods (from 2003-2014) for which the credit is tightening (less than one s.d. below mean) or loosening (more than one s.d. above mean) with periods in which headline inflation is above, within or below the target range. Panel B makes a similar comparison with core inflation. Panel C shows coefficient estimates from the simple regression of real credit growth on the status index of inflation relative to target. It also includes regression results with country-fixed effects. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 5. Hot Money Flow Conflicts

| Panel A | Headline Inflation | | | | |
|---|---|---|---|---|---|
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Hot Money: | | | | | |
| Outflows | 52 | 53 | 38 | 88 | 231 |
| Neither | 124 | 152 | 170 | 180 | 626 |
| Inflows | 25 | 22 | 48 | 74 | 169 |
| Total | 201 | 227 | 256 | 342 | 1,026 |
| | | | | | |
| Panel B | Core Inflation | | | | |
| | Below Target Range | Within Target Range | | Above Target Range | Total (Obs.) |
| | | Below Target | Above Target | | |
| Hot Money: | | | | | |
| Outflows | 51 | 64 | 60 | 56 | 231 |
| Neither | 197 | 197 | 118 | 115 | 627 |
| Inflows | 33 | 58 | 38 | 40 | 169 |
| Total | 281 | 319 | 216 | 211 | 1,027 |
| | | | | | |
| Panel C | *Headline Status* | *Core Status* | *Inflation Gap* | *Core Inflation Gap* | |
| | Independent Variable | | | | |
| Hot Money Flow (Dependent Variable) | Without Country-Fixed Effects | | | | |
| | -0.17 | -1.20*** | -0.03 | -0.79*** | |
| | (0.28) | (0.29) | (0.19) | (0.22) | |
| | With Country-Fixed Effects | | | | |
| | -0.06 | -1.65*** | 0.09 | -1.14*** | |
| | (0.32) | (0.35) | (0.21) | (0.28) | |

Notes: This table tabulates outcomes for a measure of international capital flows (increases in short term debt as a percentage of nominal GDP) in comparison with the achievement of the inflation target for the entire sample 2003-2014 with 23 countries. Panel A compares periods (from 2003 to 2014) when short-term flows are more (less) than pre-crisis mean plus (minus) one pre-crisis standard deviation with periods in which headline inflation is above, within or below the target range. Panel B makes a similar comparison with core inflation. Panel C shows coefficient estimates from the simple regression of hot money flows on the status index of inflation relative to target. It also includes regression results with country-fixed effects. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

### C.2. Hot Money Flows

A more ambiguous form of financial stability in small open economies is associated with the volatility of short-term liabilities. A country experiencing a wave of capital inflows might raise interest rates to slow the expansion of domestic credit, in line with addressing inflationary pressures. Policymakers, being mindful of cross-border financial linkages, might allow for interest rate cuts to reduce incentives to participate in the carry trade (and fend off appreciation pressures stemming from hot money flows), as opposed to a need for tighter policy to fight inflation (alongside appreciation effects on inflation).[4] Recently, Corsetti et al. (2018) suggest that such policy responses depend on the degree of exchange rate passthrough. They show using a New Keynesian open economy monetary model that, facing capital inflows, low passthrough economies raise policy rates to curb excess demand with credit expansions whereas high passthrough economies reduce policy rates to fend off exchange rate appreciation at the cost of a higher inflation. Given this ambiguity, it may be interesting to outline whether strong capital flows conflict with inflation targeting at any period.

We measure hot money stocks as the sum of short-term liabilities and short-term international debt securities. Hot money flows are measured as the year-on-year incremental increase in outstanding hot money stocks relative to the previous four-quarter GDP. We categorize the economy as experiencing hot money inflows (outflows) when hot money flows are more (less) than pre-crisis mean plus (minus) one pre-crisis standard deviation. Table 5 tabulates periods of hot money flows relative to periods of inflation vs. disinflation. Overall, there are more periods of hot money outflows, perhaps attributable to post-crisis financial disintermediation. When inflation (either core or headline) is below the target range, outflow quarters are disproportionately more than inflow quarters; but when inflation is above the target range, the difference is small.

We also report regressions of hot money flows on *Inflation Status* or *Inflation Gap*. Despite no significant relationship between hot money flows and headline inflation, we do find a significant negative relationship between hot money flows and core inflation (with and without country-fixed effects), suggesting some possible conflicts. Whether that relationship indicates a conflict with price stability goals may depend on the transmission mechanism of capital flows and the nature of hot money flows.

## IV. Credit Conflicts and Monetary Policy

Knut Wicksell (1936), the proponent of interest rate policy for price stabilization, predicates that interest rate policy should also reflect credit risk stemming from financial innovations. A simple interest rate policy rule proposed by Taylor (1993)—the standard Taylor rule—suggests that the policy rate should react to inflation and the output gap. Along the lines of Wicksell's interest rate policy, central banks may be mindful of credit-driven imbalances as well.

[4] Capital inflows could call for currency appreciation pressures. For example, Bruno and Shin (2015) find evidence that a change in cross-border bank capital flows stemming from U.S. monetary policy shocks is associated with a change in the exchange rate against the U.S. dollar.

To assess the impact of credit markets on monetary policy, we estimate a modified Taylor-type rule. We define "the interest rate gap" as the interest rate minus the inflation target. We think of the interest rate gap as a quasi-real interest rate that can largely be controlled by the central bank. If inflation expectations were well grounded at the target, the interest rate gap would be equivalent to the real interest rate.

We estimate a modified Taylor rule for IT countries using a panel regression:

$$Y_{i,t} = \beta_1 Y_{i,t-1} + \beta_2\left(\pi_{i,t} - \pi^*_{i,t}\right) + \beta_3 \Delta\left(\pi^{core}_{i,t} - \pi^*_{i,t}\right) + \beta_4 (Output\ Gap)_{i,t} + \alpha^{FE}_i + \varepsilon_{i,t}\ , \quad (1)$$

where $Y_{i,t}$ equals $R_{i,t} - \pi^*_{i,t}$: the *Interest Rate Gap* for country *i* in period *t*, defined as the policy rate $(R_{i,t})$ minus inflation target $(\pi^*_{i,t})$. The *Interest Rate Gap* is regressed on the *Inflation Gap* $(\pi_{i,t} - \pi^*_{i,t})$. and *Output Gap* as well as a lagged term to reflect a policy-rate inertia. We find that policy rates respond to surges in core inflation $(\pi^{core}_{i,t})$, so we also include the first difference in the *Core Inflation Gap*. All regressions include year dummies, seasonal dummies, a GFC dummy (for the four quarters spanning the third quarter of 2008 to the second quarter of 2009), and country-fixed effects $(\alpha^{FE}_i)$ to control for heterogeneity among IT countries.[5] We restrict our examination to countries that have brought the inflation target into single digits.

To examine whether IT central banks respond to risks associated with domestic or cross-border credit, we extend the Taylor rule as follows:

$$Y_{i,t} = \beta_1 Y_{i,t-1} + \beta_2\left(\pi_{i,t} - \pi^*_{i,t}\right) + \beta_3 \Delta\left(\pi^{core}_{i,t} - \pi^*_{i,t}\right) + \beta_4 (Output\ Gap)_{i,t} + \beta_5 X_{i,t} + \beta_6 X_{i,t} \times (Core\ Above\ Average)_{i,t} + \beta_7 X_{i,t} \times (Headline\ Below\ Average)_{i,t} + \alpha^{FE}_i + \varepsilon_{i,t}, \quad (2)$$

where $X_{i,t}$ is a credit variable to allow for leaning against credit-driven asset bubbles (e.g., Carrillo et al., 2017; and Allen et al., 2017).[6] The credit variable's interactive terms are associated with two dummies of inflation status, which represent times when an IT central bank is conservatively expected to be constrained by the price stability goal. The first (second) dummy equals one if core (headline) inflation is over the target range and zero otherwise.

While IT central banks currently target headline inflation, core inflation also plays important roles. Headline inflation signal promptly emerging changes and are susceptible to supply shocks, whereas core inflation is often trend-driven and persistent. Policymakers would be responsive to headline inflation falling below the target range to ward off deflation risks, while fending off

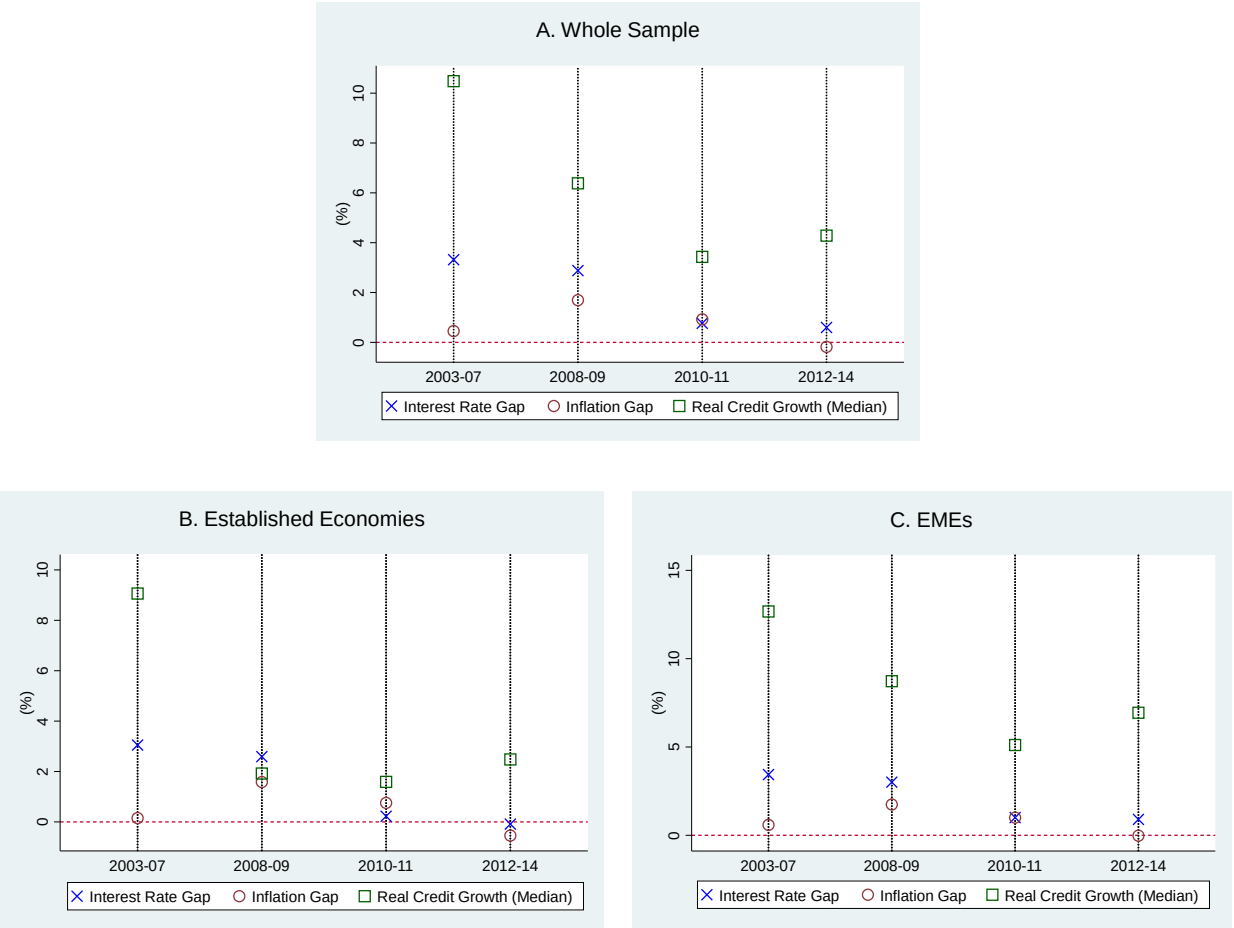
[5] We assume that the time dimension of the panel is sufficient to allow for the consistent estimation of regression coefficients in the presence of both the lagged dependent variable and country-fixed effects. IT countries are floaters, but remaining heterogeneity in the floating regime are largely controlled for by country-fixed effects. The results of the relevant regressions without country-fixed effects are quantitatively very similar to the reported results.

[6] As regards policy effectiveness, monetary policy aiming at leaning against credit-driven bubbles is likely to be effective, as Allen et al. (2017) suggest. In contrast, a policy rate hike against a bubble which already exists but not necessarily driven by credit excesses may call for an unexpected consequence: reduced consumption and more savings in assets (with increased debt services), possibly exacerbating the credit bubble risk à la Galí (2014). Svensson (2017a) suggests that tighter monetary policy for financial stability could entail the cost of a weaker economy (with lower output and employment) that outweighs the benefit of reducing the probability of a crisis.

entrenching inflation when core inflation rises above the target range. In this vein, we introduce credit growth interacting with policy-status dummies to attest that facing higher credit growth IT central banks strengthen policy tightening to ward off entrenching inflation whereas they could keep monetary policy accommodative when headline inflation falling below the target range.

Data on short-term nominal interest rates are from IMF International Financial Statistics. We use "Monetary Policy-Related Interest Rate" for Australia, Brazil, Canada, Chile, Colombia, Indonesia, Israel, Korea, Mexico, New Zealand, Norway, Peru, Philippines, South Africa, Sweden, Thailand, Turkey, and United Kingdom. We use Repurchase Agreement Rates for Czech Republic and Romania, and Treasury Bill Rates for Hungary.

Figure 2. Evolution of the Interest Rate Gap, Inflation Gap, and Real Credit Growth




Notes: This figure depicts the group means (medians) of the interest rate gap and inflation gap (real credit growth) for four sub-periods: the pre-GFC (2003-07), GFC (2008-09), post-GFC and pre-European Debt Crisis (2010-11), and post-European Debt Crisis (2012-14) periods. The median values are used for real credit growth to sort out outliers owing to very large negative values for Iceland.

Figure 2 shows how the interest rate gap, (headline) inflation gap, and (real) credit growth have evolved over sub-periods. The interest rate gap slides, especially in Established countries near to zero after the GFC, and the inflation gap follows a hump-shape trail reaching zero in EMEs and a negative territory in Established countries after the 2012 European Debt Crisis. Real credit growth sees a smile-shape rebound but with different curves between Established and EMEs. A strong pickup in credit growth amid low inflation gaps challenges the accommodative policy stance at the cost of escalating credit bubble risk.

The baseline result of regression (1) is reported in Table 6, Column A. The positive significant response of the quasi-real rate to the (headline) inflation gap ($\beta_2 > 0$) is consistent with the condition for stabilizing the economy and the idea that business cycles and inflation are primarily driven by demand forces and stabilizing the economy: see Choi and Wen (2010) for discussions on policy responses and the source of shocks to inflation. The quasi-real rate also rises with the inflation gap and an increase in the core inflation gap, while involving a substantive inertia with an auto-regressive coefficient above 0.8.[7]

Column B tests whether IT central banks respond to credit growth with concerns over financial stability. We find that the coefficient on year-on-year real credit growth is, if quantitatively small, positive and significant. This finding, along with the inflation gap coefficient in the range of 0.09-0.20, lends credence on the central bank mandate of financial stability or cooperation between monetary and financial authorities (Carrillo et al., 2017). A 1% point rise in credit growth would be associated with slightly more than a basis point immediate policy rate increase. Given the persistence of policy rates, however, a permanent one-standard-deviation rise in credit growth would be associated with a long-term rise in policy rates of nearly 100 basis points. This motivates us to delve into whether the potential conflicts between credit growth and inflation targeting affect the central bank response to credit conditions.

We examine cross-country variations in the response of central banks to credit growth. Table 7, Column A shows the coefficients on interactions between real credit growth and country dummies (conditioning on the output gap, lagged interest gaps, the inflation gap and surges in the core inflation rate). We find that the monetary policy rate is positively associated with credit growth in most countries (Brazil is the only country for which the coefficient is negative and significant). The coefficient on real credit growth differs across countries: the hypothesis of equal coefficients is rejected at a high significance level.

Larger domestic credit markets are strongly associated with higher credit growth sensitivity of monetary policy, as shown in Figure 3. Central bank responses to credit growth may depend on whether credit growth would undermine financial stability. The figure also suggests the possibility that countries with very high credit exposures relative to GDP have a disproportionately high sensitivity of monetary policy to credit growth.

[7] We tested a second-order specification. The coefficient on the second-order term was small and negative, and its inclusion had little impact on the other coefficients.

Table 6. Taylor Rules & Credit Conflicts

| | Dependent Variable: *Interest Rate Gap*$_t = i_t - \pi_t^*$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | (A) | (B) | (C) | (D) | (E) | (F) | (G) |
| Independent Variables | Whole Sample | | | Established | EME | Resilient EME | Fragile EME |
| *Interest Rate Gap*$_{t-1}$ | 0.85*** | 0.86*** | 0.86*** | 0.83*** | 0.86*** | 0.82*** | 0.86*** |
| | (0.01) | (0.01) | (0.01) | (0.03) | (0.02) | (0.03) | (0.03) |
| *Output Gap* | 0.11*** | 0.09*** | 0.08*** | 0.07** | 0.09*** | 0.07** | 0.18*** |
| | (0.02) | (0.02) | (0.02) | (0.03) | (0.02) | (0.03) | (0.05) |
| *Inflation Gap* | 0.09*** | 0.10*** | 0.09*** | 0.20*** | 0.06*** | 0.03 | 0.08** |
| | (0.01) | (0.01) | (0.02) | (0.03) | (0.02) | (0.04) | (0.03) |
| Δ*Core Inflation Gap* | 0.21*** | 0.26*** | 0.26*** | 0.05 | 0.32*** | 0.20** | 0.39*** |
| | (0.03) | (0.03) | (0.03) | (0.06) | (0.04) | (0.08) | (0.07) |
| *Real Credit Growth* | | 0.012*** | 0.006* | 0.014*** | -0.001 | -0.004 | -0.005 |
| | | (0.003) | (0.003) | (0.004) | (0.004) | (0.005) | (0.011) |
| *Real Credit Growth* × *Core Above Range* | | | 0.023*** | 0.011 | 0.031*** | 0.042*** | 0.022* |
| | | | (0.004) | (0.008) | (0.006) | (0.008) | (0.011) |
| *Real Credit Growth* × *Headline Below Range* | | | -0.005 | 0.013 | -0.006 | 0.005 | -0.031** |
| | | | (0.006) | (0.011) | (0.007) | (0.010) | (0.014) |
| N | 1016 | 916 | 916 | 281 | 635 | 269 | 227 |
| Countries | 23 | 20 | 20 | 6 | 14 | 6 | 5 |
| $R^2$ | 0.95 | 0.95 | 0.95 | 0.97 | 0.95 | 0.92 | 0.96 |

Notes: This table shows coefficient estimates from panel regressions (1)-(2) of the quarterly monetary policy reaction function (with country-fixed effects) using the gap between the interest rate and the inflation target. The interest rate gap is allowed to respond to real credit growth and interaction between real credit growth and dummy variables for periods when core inflation is above the target range and periods when headline inflation is below the range. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively. All regressions include year dummies, seasonal dummies, and a global financial crisis dummy (for 2008Q3-2009Q2).

Table 7. Country-Specific Leaning Against the Wind

| | A. Credit Growth | | B. Hot Money | |
|---|---|---|---|---|
| Country | Coefficient | *t-Statistics* | Coefficient | *t-Statistics* |
| Australia | 0.011 | 0.49 | 0.050 | 1.56 |
| Brazil | -0.029** | -2.42 | -0.312*** | -3.42 |
| Canada | 0.021 | 1.43 | -0.014 | -0.26 |
| Chile | 0.019 | 0.90 | -0.010 | -0.19 |
| Colombia | 0.018 | 1.37 | 0.059 | 0.73 |
| Czech Republic | -0.001 | -0.11 | -0.087* | -1.65 |
| Hungary | 0.024** | 2.54 | -0.018 | -0.58 |
| Iceland | 0.017*** | 4.62 | 0.007*** | 3.71 |
| Indonesia | 0.021 | 1.01 | -0.246 | -1.48 |
| Israel | n/a | n/a | 0.092 | 0.79 |
| Korea | 0.004 | 0.23 | -0.044 | -0.85 |
| Mexico | -0.002 | -0.19 | -0.247* | -1.72 |
| New Zealand | n/a | n/a | 0.027 | 1.09 |
| Norway | 0.019 | 1.38 | 0.022 | 1.46 |
| Peru | n/a | n/a | 0.091 | 1.50 |
| Philippines | -0.001 | -0.08 | 0.006 | 0.10 |
| Poland | -0.004 | -0.45 | -0.032 | -0.38 |
| Romania | 0.016*** | 2.85 | -0.007 | -0.44 |
| South Africa | 0.035** | 2.60 | -0.061 | -0.49 |
| Sweden | 0.003 | 0.10 | -0.011 | -0.59 |
| Thailand | 0.015 | 0.83 | 0.069 | 0.82 |
| Turkey | 0.003 | 0.20 | -0.030 | -0.26 |
| UK | 0.048*** | 2.68 | 0.015* | 1.83 |

Notes: This table shows the country-specific responses (coefficients along with their *t*-statistics) of monetary policy rates to real credit growth and hot money flows. The coefficient estimates are obtained from an extended form of panel regression (B) of Table 6 to allow for cross-country variation in the response of central banks to credit growth. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 6, Column C shows a regression including the interactions of (real) credit growth with inflation status. The estimated coefficient of credit growth interacting with core inflation above the target range is positive and statistically significant. The estimated impact of credit growth on the policy rate is about five times as large when core inflation is above its upper bound as otherwise.[8] In contrast, the estimated impact of credit growth interacting with headline inflation below the lower bound is negative but near zero and insignificant. Given a standard deviation of credit growth of 8.4% within this sample, a one-standard deviation rise in credit growth would be associated with a long-term rise in the policy rate by nearly 200 basis point when core inflation is above the target range, in contrast with a long-term rise by only 40 basis point otherwise.

[8] The total effect of credit growth during a period when core inflation is above the target range can be measured by $\beta_5 + \beta_6$ in equation (2), and its standard error can be calculated using the delta method. For example, the total effect based on Table 6 in Column C is 0.029*** (0.005) where the standard error is in the parenthesis.

Figure 3. Central Bank Credit Sensitivity to Credit Growth and Credit Share in GDP


Notes: This figure depicts the country-specific coefficients on real credit growth in Table 7 on y-axis and the credit to GDP (of year 2000) ratio of respective countries in x-axis. A simple regression of the monetary policy sensitivity of credit growth on the credit- GDP ratio gives R-square of 0.28.

We divide our sample of countries into groups. The first comprises Scandinavian countries and the English-speaking countries of Australia, Canada, New Zealand, and the United Kingdom. The rules of the game in financial markets in this group could be considered to be more long-established. We estimate the policy rule for pooled data from six of these seven countries (dictated by the data availability of credit growth for New Zealand).

The Taylor-rule parameters of this "Established" group are quite similar to those of the whole sample (see Column D). Amongst the Established countries, we find that central banks put more emphasis on the headline inflation gap and relatively less on surges in core inflation. Also, central banks increase interest rates with real credit growth to a slightly greater degree than in the whole sample, as implied by the credit growth coefficient estimate being significant at the 1% level. We do not find evidence that central bank sensitivity to credit conditions is dependent on whether inflation is outside the target range: the corresponding coefficient estimates are positive but not significant at the 10% level.

The estimated result of the remaining countries comprising 14 EMEs[9] (Column E) shows significant coefficients for the lagged dependent, output gap, inflation gap, and surges in core inflation. While the coefficient on credit growth is essentially zero, that on the interaction term is positive and highly significant, meaning that EME central banks adjust policy rates in response to credit growth only when core inflation is above the target range. When inflation is below the target range, we find a negative but insignificant link between policy rates and credit growth.

[9] Peru and Israel are excluded owing to the unavailability of credit data.

Choi and others (2017) argue that EMEs have diverse responses to shocks depending on the strength of fundamentals. We estimate the monetary policy response for resilient EMEs (the Czech Republic, Korea, Mexico, Poland, Romania, and Thailand) and fragile EMEs (Brazil, Chile, Hungary, Indonesia, and Turkey). Columns F and G report estimates for these two groups. In general, the policy rates in the resilient EMEs are more sensitive to the output gap. We also find that the response of interest rates to credit expansion is significantly positive in both groups only when core inflation is above the target range. When headline inflation is below the target range, however, policy rates are negatively associated with credit growth. This might suggest that these countries accommodate credit expansions when inflation undershoots its target.

Table 8 focuses on whether the policy rates of IT central banks respond to hot money flows in light of capital flow management. Short-term-external borrowings or debt issuance can be used as an alternative to domestic credit as a channel for financing the credit cycle. Column A reports the whole sample estimate of the Taylor rule that includes a measure of hot money flows as defined in Section III.C.ii. The inclusion of a possible policy response to hot money flows has no substantial impact on the estimate of the coefficients on the lagged interest rate, output gap, or inflation gap. We find that, conditioning on inflation and the output gap, hot money flows relative to GDP are associated positively and significantly with the policy rate. The coefficient is relatively small. Given the interest rate inertia and the sample standard deviation of hot money flows being above 14%, the long-term adjustment of interest rates to a one-standard-deviation shocks would be around 70 basis points. One interpretation is that in response to rising foreign borrowing, the central bank raises interest rates to tame its impact on the financial sector.

To show how policy responses are affected by the inflation status, Column B adds hot money flows interacting with dummy variables for periods when core inflation is above the inflation target and when headline inflation is below the target. In addition to a positive response to hot money flows, the coefficient on the interaction with periods when core inflation is above the upper bound is positive and significant at the 1% level. Effectively, the response of the policy rate when inflation is above the target range is more than double that seen otherwise. The coefficient on the interaction term with the dummy for periods when headline inflation is below the lower bound is nil. These findings may suggest a policy reconciliation between hot money flow management and inflation targeting.

Returning to Table 7 (Column B), we find considerable country variations in the policy response to hot money flows that is allowed to vary across countries in estimation. Five of seven established countries raise policy rates upon hot money flows, possibly mindful of spillovers on total credit. While five of sixteen EMEs raise insignificantly interest rates, eleven tend to cut interest rates to temper hot money inflows on the external front: especially, Brazil, Indonesia, and Mexico display sharply negative responses.

Table 8. Taylor Rules & Hot Money Conflicts: Country Panel Regressions

| | Dependent Variable: *Interest Rate Gap*$_t = i_t - \pi_t^*$ | | | | | |
|---|---|---|---|---|---|---|
| | (A) | (B) | (C) | (D) | (E) | (F) |
| Independent Variables | Whole Sample | Whole Sample | Established | EME | Resilient EME | Fragile EME |
| *Interest Rate Gap*$_{t-1}$ | 0.86*** | 0.85*** | 0.85*** | 0.86*** | 0.83*** | 0.86*** |
| | (0.01) | (0.01) | (0.03) | (0.01) | (0.03) | (0.03) |
| *Output Gap* | 0.10*** | 0.11*** | 0.04* | 0.13*** | 0.11*** | 0.18*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.03) | (0.05) |
| *Inflation Gap* | 0.10*** | 0.10*** | 0.17*** | 0.08*** | 0.06** | 0.11*** |
| | (0.01) | (0.01) | (0.03) | (0.02) | (0.03) | (0.03) |
| Δ*Core Inflation Gap* | 0.22*** | 0.22*** | 0.05 | 0.26*** | 0.09* | 0.40*** |
| | (0.03) | (0.03) | (0.05) | (0.04) | (0.05) | (0.07) |
| *Hot Money Flows* | 0.007*** | 0.005** | 0.005** | -0.012 | -0.013 | -0.013 |
| | (0.002) | (0.002) | (0.002) | (0.014) | (0.014) | (0.050) |
| *Hot Money Flows* × *Core Above Range* | | 0.008** | 0.009** | 0.016 | -0.022 | 0.007 |
| | | (0.004) | (0.004) | (0.029) | (0.046) | (0.064) |
| *Hot Money Flows* × *Headline Below Range* | | -0.005 | 0.001 | -0.005 | 0.006 | -0.218* |
| | | (0.011) | (0.01) | (0.027) | (0.026) | (0.116) |
| N | 1016 | 1016 | 315 | 701 | 305 | 217 |
| Countries | 23 | 23 | 7 | 16 | 7 | 5 |
| $R^2$ | 0.95 | 0.95 | 0.97 | 0.94 | 0.91 | 0.95 |

Notes: This table shows coefficient estimates from panel regressions (1)-(2) of the quarterly monetary policy reaction function (with country-fixed effects) using the gap between the interest rate and inflation target. The policy reaction function allows for reactions to hot money flows and interactions between hot money flows and dummy variables for periods when core inflation is above the target range and for periods when headline inflation is below the range. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively. All regressions include year dummies, seasonal dummies, and a global financial crisis dummy (for 2008Q3-2009Q2).

Table 8 also reports estimated policy responses separately for different country groups to examine divergent policy responses to hot money flows. The estimates from seven Established economies amongst the Anglophone and Scandinavian countries (Column C) are quite similar to those from the broad set of countries except that they are less responsive to changes in the core inflation gap. The significant positive response of Established economies to hot money flows may reflect that policymakers could be more mindful of impacts of hot money flows on credit growth as low inflation tends to be associated with low (exchange rate) passthrough in Established economies. In contrast, the coefficient on hot money inflows is essentially negative, if insignificant, for EMEs (Column D). EMEs, on average, tend to cut their interest rates on average when faced with inflows. Since short-term external liabilities for EMEs prone to be dominated in foreign currencies, cutting policy rates might discourage the carry trade. This policy divergence associated with the degree of passthrough is also consistent with Corsetti et al. (2018). The coefficients on the interaction terms, if statistically insignificant, perhaps enunciate that fragile EMEs, weighing on external funding, react to capital inflows during inflationary (deflationary) periods by raising (cutting) rates to defend the currency value.

There may be divergence among EMEs in policy responses to capital inflows.[10] Among seven resilient countries (the six mentioned above plus Israel), we again find no statistically significant response to hot money inflows (Column E). Among the five fragile countries, we do find that EMEs experiencing capital inflows in deflationary times are likely to cut sharply interest rates (possibly fending off appreciation pressures from capital inflows on domestic inflation as well) even though this outcome is significant only at the 10% level (Column F).

We also consider how central banks respond to exogenous financial market shocks. The spread between Moody's Seasoned Baa Corporate Bond Rate and the Federal Funds Rate from FRED—we call this “Risk Spread”—includes both the bond risk premium and the yield curve slope in the U.S. We can think of innovations in this indicator as the global risk premium that is relatively exogenous to domestic conditions in smaller open economies with IT regimes.

Table 9 summarizes the estimated results of policy reaction functions including quarterly changes in the Risk Spread. In general, when global bond market risk increases, central banks would respond by cutting interest rates and easing domestic liquidity. This prediction is supported by the estimated coefficient of the Risk Spread that is negative and significant at the 1% level for the whole sample (Column A). Nonetheless the policy reaction to such exogenous shocks will be influenced by the constraints imposed by the inflation target, as shown for the whole sample (Column B). When inflation is largely in the target range (normal times), the negative coefficient estimate (-0.10, significant at the 10% level) suggests that IT central banks lowers policy rates upon global risk shocks. When the core inflation above the target range, however, the positive coefficient estimate on the interaction with the risk shock (0.12, significant at the 10% level) suggests that the net effect of the shock on policy rates is muted. In contrast, when headline inflation is below the target range, the interest rate response is much more substantial than at normal times, as indicated by a significantly negative coefficient (-0.16) on the related interactive term.

[10] E.g., Choi and others (2017) find from the factor-augmented panel vector auto-regression analysis that, upon a U.S. funds rate hike accompanying capital outflows from EMEs, high-inflation EMEs raise initially and then cut policy rates whereas low-inflation EMEs raise policy rates with a lag.

Table 9. Taylor Rules and Global Risk Shocks: Panel Regressions

| | Dependent Variable: *Interest Rate Gap*$_t = i_t - \pi_t^*$ | | | | | |
|---|---|---|---|---|---|---|
| | (A) | (B) | (C) | (D) | (E) | (F) |
| Independent Variables | Whole Sample | Whole Sample | Established | EME | Resilient EME | Fragile EME |
| *Interest Rate Gap*$_{t-1}$ | 0.83*** | 0.83*** | 0.76*** | 0.86*** | 0.83*** | 0.85*** |
| | (0.01) | (0.01) | (0.02) | (0.01) | (0.02) | (0.03) |
| *Output Gap* | 0.08*** | 0.08*** | 0.06** | 0.10*** | 0.05*** | 0.16*** |
| | (0.02) | (0.02) | (0.03) | (0.02) | (0.02) | (0.05) |
| *Inflation Gap* | 0.14*** | 0.14*** | 0.19*** | 0.12*** | 0.17*** | 0.16*** |
| | (0.01) | (0.01) | (0.03) | (0.02) | (0.02) | (0.04) |
| Δ*Core Inflation Gap* | 0.22*** | 0.21*** | 0.06 | 0.28*** | 0.20*** | 0.35*** |
| | (0.03) | (0.03) | (0.05) | (0.03) | (0.05) | (0.08) |
| Δ*U.S. BAA-Fed Funds Spread* | -0.12*** | -0.10* | -0.14** | -0.01 | 0.00 | -0.18 |
| | (0.04) | (0.05) | (0.07) | (0.08) | (0.10) | (0.18) |
| Δ*U.S. BAA-Fed Funds Spread* × *Core Above Range* | | 0.13* | 0.38*** | -0.06 | -0.04 | -0.03 |
| | | (0.07) | (0.13) | (0.09) | (0.11) | (0.22) |
| Δ*U.S. BAA-Fed Funds Spread* × *Headline Below Range* | | -0.16** | -0.05 | -0.28** | -0.27** | -0.31 |
| | | (0.08) | (0.10) | (0.11) | (0.12) | (0.46) |
| N | 1360 | 1360 | 529 | 831 | 400 | 236 |
| Countries | 23 | 23 | 7 | 16 | 7 | 5 |
| $R^2$ | 0.95 | 0.95 | 0.93 | 0.95 | 0.95 | 0.95 |

Notes: This table shows coefficient estimates from panel regressions (1)-(2) of the quarterly monetary policy reaction function (with country-fixed effects) using the gap between the interest rate and inflation target as the dependent variable. The policy reaction function allows for a reaction to global risk shocks (represented as the spread between Moody's BAA spread and the Fed Funds rate) and interactions between global risk shocks and dummy variables for periods when core inflation is above the target range and periods when headline inflation is below the range. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively. All regressions include year dummies, seasonal dummies, and a global financial crisis dummy (for 2008Q3-2009Q2).

Are policy responses to the global risk premium different across country groups? In the subgroup of seven established economies (Column C), the response to a rise in the global risk premium is to cut interest rates in normal times (significant at the 5% level). However, the coefficient on the interactive term with core inflation above the target range is large and significantly positive (at the 1% level). Thus, the net effect of heightened global risk when inflation is above the target range is thus to raise policy rates, possibly reflecting proactive responses to potential financial risk amid inflationary pressures. In contrast, the coefficient on global risk premium shocks is nil for sixteen EMEs (Column D), while the coefficient on its interaction with headline inflation below the target range is large and significantly negative (at the 5% level) for these EMEs except fragile EMEs (Columns E and F). This result suggests that, upon heightened global risk, resilient EMEs ease monetary policy only when inflation target is undershot whereas Fragile EMEs do not change policy rates.

## V. MACROPRUDENTIAL MEASURES

When confronted with credit conditions which are inconsistent with inflationary conditions, policy authorities constrained by anchoring to inflation target may use alternative policy instruments.[11] The drivers of macroprudential policy could include systemic risks stemming from financial imbalance buildups over time and spillovers at a time, especially credit growth, macro-real factors such as growth and inflation, and liquidity risk—for economic impacts of financial imbalances and roles for macroprudential policy, see Choi and Cook, 2012; Jordà et al., 2015; Korinek and Simsek, 2016; and Buch et al., 2017. A variety of administrative and regulatory tools might be adjusted to the economic environment under the rubric of macroprudential measures. Lim (2011) show that 40 out of 49 countries surveyed have undertaken macroprudential actions. Macroprudential measures could affect other goals as well as financial stability (Bayoumi et al., 2014). Kim and Mehrotra (2017) find from Indonesia, Australia, Korea, and Thailand using structural VARs that macroprudential policy shocks have impacts on credit growth and inflation. Schularick and Shim (2017) from 12 Asian panel data analysis find the effect of macroprudential policy pronounced on credit growth but not on output and inflation.

We examine macroprudential actions to manage bank-intermediated credit for financial stability.[12] To measure such official policy actions, we use the Shim et al. (2013) database of prudential measures that affect credit growth and housing markets for advanced and EM economies over the period to the middle of 2012.[13] The database divides prudential actions

[11] A conflict between price stability and financial stability (e.g., Borio and Lowe, 2002; and Smets, 2014) renders credibility difficult to establish unless interest rate policy is well-coordinated by macroprudential policy. Issues on coordination for monetary policy and prudential policy among authorities, which are beyond the scope of this paper, are discussed in Bayoumi et al. (2014).

[12] The macroprudential measures considered here do not cover capital flow measures to handle currency and maturity mismatches, while such capital flow measures can broadly be considered as macroprudential (IMF, 2014).

[13] Shim et al. (2013) construct a database of macroprudential measures implemented by a large number of central banks (including the IT countries we examine here). Using information from central bank publications to identify official actions, the database comprises monetary measures that affect funds available for lending (adjustments in reserve or liquidity requirements as well as credit growth ceilings) as well as direct regulations on mortgage lending (including adjustments in the loan-to-value or debt-to-income ratio).

affecting housing credit or house prices into regulatory tightening actions to restrain credit issuance and regulatory easing actions to advance lending. We construct a dummy variable equal to one for each country quarter with one or more macroprudential actions to tighten credit; and zero for each country quarter with no such action. Another dummy variable equals one for each country quarter with at least one macroprudential action to ease credit conditions; and zero with no such action. For a small number of country quarters, there may be both tightening and easing actions. In those cases, we classify the country quarter as being either tightening or easing depending on whether the corresponding quarter entails more tightening or easing actions or on the general tendency of the country's policymakers in adjacent quarters.

For our sample of IT countries with credit growth data, we calculate the percentage of country quarters in which macroprudential actions were undertaken during IT periods. We find that some sort of macroprudential tightening (easing) actions were undertaken in 7.8% (5.8%) of the country quarters in our sample. The evolving percentage of country quarters depicted by Figure 4 suggests that IT countries have undertaken more prudential easing measures after the 1997 Asian crisis and GFC and more prudential tightening measures in 2010-2011 following continued monetary easing after the GFC.

Figure 4. Fraction of IT Country Quarters with Macroprudential Measures Taken


Notes: This figure shows the percentage of country quarters in which macroprudential actions were taken in our sample of IT countries with credit data (20 countries) for 2003-2013 (annual average).

We examine how policymakers in IT countries deploy macroprudential tools to complement monetary policy in the face of a tradeoff between price stability and financial stability as well as to reinforce monetary policy in response to business cycle, inflation, and credit growth. To do this, we estimate panel regressions for a macroprudential policy rule as follows:

$$Prob(MaP_{i,t=1} = 1) = \Lambda(\boldsymbol{\tau}'\boldsymbol{X}) \tag{3}$$

$$\boldsymbol{\tau}'\boldsymbol{X} = \tau_1(Output\ Gap)_{i,t} + \tau_2\left(\pi_{i,t} - \pi^*_{i,t}\right) + \tau_3(Credit\ Growth)_{i,t} + \tau_4(Indicator\ of\ Constrained\ Monetary\ Policy)_{i,t} + \eta_{i,t},$$

where whether policy authorities in country *i* period *t* deploy macroprudential policy in a certain direction ($MaP_{i,t}$ =1) or does not ($MaP_{i,t}$ =0) to temper macro-financial imbalances is explained a set of variables (vector $\boldsymbol{X}$), and $\boldsymbol{\Lambda}$ is the logistic cumulative distribution: i.e., $\Lambda(\boldsymbol{\tau}'\boldsymbol{X}) = \frac{e^{\boldsymbol{\beta}'\boldsymbol{X}}}{1+e^{\boldsymbol{\beta}'\boldsymbol{X}}}$. Vector $\boldsymbol{X}$ includes business cycle conditions, real credit growth, and an indicator of constrained monetary policy under IT. The credit growth measures financial imbalances stemming from both external flows (e.g., hot money flows) and domestic credit flows (e.g., loans). The logit regression also includes year dummies, a dummy covering the GFC, and seasonal dummies.

Macroprudential actions to check financial imbalances can supplement monetary policy by curbing credit growth. Table 10 reports the results of logit regression (3) for macroprudential tightening and macroprudential easing, respectively.[14] The data include those periods after Hammond (2012) identifies the central bank as implementing an IT regime.

The key findings of estimated macroprudential actions are as follows. (i) Macroprudential actions to the output and inflation gaps are less pronounced than monetary policy actions are. (ii) The likelihood of macroprudential tightening rises with credit growth. (iii) Macroprudential tightening (easing) is deployed when inflation is persistently below (above) a target range, implying asymmetric policy reactions between tightening and easing.

Table 10 reports a logit regression with a dummy variable indicating that headline inflation is below the target range. Macroprudential tightening could be viewed as complementary to raising interest rates to temper inflation pressures or slow credit growth (especially stemming from capital inflows). Macroprudential tightening is more likely when the economy is booming because the estimated coefficients on the output gap, inflation gap, and real credit growth are all positive. While the coefficient on the output gap is significant at the 5% level in columns B and D and the coefficient on the inflation gap is significant at the 5 or 10% level only for the whole sample, real credit growth is significant at the 1% level.

Macroprudential tightening is also likely to occur to check credit expansions when inflation is below the target range, while monetary policy space is limited in achieving price stability goals. Column A shows that the coefficient on the dummy for inflation being below the target range is positive (significant at the 5% level).

[14] While we estimate reaction functions of monetary and macroprudential policies for most IT countries, Shim and Schularick (2017) estimate the impact of those policies on household credit growth for 12 Asian countries.

Table 10. Macroprudential Actions: Panel Logit Regressions

| | Implement Macroprudential Tightening | | | | Implement Macroprudential Easing | | | |
|---|---|---|---|---|---|---|---|---|
| | (A) | (B) | (C) | (D) | (E) | (F) | (G) | (H) |
| Independent Variables | Whole Sample | Whole Sample | EME | Whole Sample | Whole Sample | Whole Sample | EME | Whole Sample |
| *Output Gap* | 0.16 | 0.17** | 0.15 | 0.17** | -0.12** | -0.12** | -0.08 | -0.12** |
| | (0.09) | (0.08) | (0.10) | (0.08) | (0.05) | (0.05) | (0.06) | (0.05) |
| *Inflation Gap* | 0.16* | 0.16* | 0.15 | 0.17** | -0.07 | -0.05 | -0.06 | -0.07 |
| | (0.09) | (0.09) | (0.10) | (0.09) | (0.08) | (0.06) | (0.08) | (0.07) |
| *Credit Growth* | 0.05*** | 0.06*** | 0.07*** | 0.06*** | -0.01 | -0.01 | -0.03 | -0.01 |
| | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) |
| *Headline Below Range* | 0.84** | | | | | | | |
| | (0.38) | | | | | | | |
| *Headline Below Range for 1 Year* | | 1.70*** | 1 .50** | | | | | |
| | | (0.31) | (0.49) | | | | | |
| *# of Quarters Headline Below Range* | | | | 0.27*** | | | | |
| | | | | (0.05) | | | | |
| *Core Above Range* | | | | | 0.66*** | | | |
| | | | | | (0.26) | | | |
| *Core Above Range for 1 Year* | | | | | | 0.77 | 0.57 | |
| | | | | | | (0.51) | (0.56) | |
| *# of Quarters Core Above Range* | | | | | | | | 0.15* |
| | | | | | | | | (0.08) |
| N | 838 | 838 | 553 | 838 | 850 | 850 | 489 | 850 |
| Countries | 20 | 20 | 14 | 20 | 20 | 20 | 14 | 20 |
| Pseudo-$R^2$ | 0.133 | 0.148 | 0.155 | 0.150 | 0.104 | 0.108 | 0.110 | 0.113 |

Notes: This table shows coefficient estimates from quarterly panel logit regression (3) with random effects for 2003-2013 of indicators of the implementation of macroprudential actions from the Shim et al. (2013) database. (a) Israel, New Zealand, and Peru are excluded owing to the unavailability of credit growth. Regressors include indicators of constrained monetary policy. (b) ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively, based on the cluster-robust variance covariance matrix estimator allowing for intra-country correlation. (c) All regressions include year dummies, seasonal dummies, and a global financial crisis dummy (for 2008Q3-2009Q2). (d) The pseudo- $R^2$ statistics are calculated using logit regressions without country-fixed effects.

Since macroprudential adjustments may be less flexible than monetary policy changes, they may be likeliest when monetary policy has been constrained for a substantial period. When headline inflation is persistently undershot, monetary easing may exacerbate credit expansions as a side effect. To offset or prevent such a side effect, prudential tightening could be deployed. To examine this idea, we first estimate a regression where the dummy variable for headline inflation being below the target range for at least four quarters. The coefficient on this dummy variable is strongly positive at 1.70 (significant at the 1% level) for the whole sample (Column B) and similar for EMEs (Column C). We then replace the dummy variable with a measure of the number of consecutive periods in which headline inflation is below the target range (up to 3 years), representing the degree of prolonged target breach. We find that the number of periods in which headline inflation is below the target range is also associated positively with the likelihood of implementing macroprudential tightening for the whole sample (Column D). These findings reconcile well increasing needs for the mix of accommodative monetary policy and tighter macroprudential policy at low inflation and low growth as experienced in recent years.

We also report the logit regression results of macroprudential easing measures on macroeconomic conditions and indicators of constrained monetary policy (Columns E-H). We find that macroprudential easing is more likely when economic conditions are poor—as implied by negative coefficients on the output gap, inflation gap, and real credit growth—although the associated coefficients are significant only for the output gap in the whole sample. Prudential easing is less dependent on business or credit cycles than prudential tightening.

Macroprudential easing could be deployed to moderate the negative impact on credit growth of tighter monetary policy when inflation stays above the target range. There is somewhat weak evidence that macroprudential easing is more likely when monetary policy is otherwise constrained. The coefficient on a dummy variable for country quarters when core inflation is above the target range (thus posing constraints on cutting interest rates) is positive and significant at the 1% level (Column E). The coefficients on a dummy variable for periods when core inflation has been above the target range for at least one year is positive but statistically insignificant for the whole sample and EMEs (Columns F and G). Lastly, macroprudential easing is positively (significant at the 10% level) associated with the number of consecutive quarters that core inflation had been above the target range (Column H).

For robustness checks, we account for both sides of constrained monetary policy in each regression. Core inflation above the target range (by any metric) has insignificant explanatory power for the likelihood of macroprudential tightening, and headline inflation below the target range (by any metric) has little effect on the likelihood of macroprudential easing (see, e.g., Columns A and C in the appendix table). One may also consider the effect on policy actions of institutional arrangements for the mandate of financial stability. Lim et al. (2013) examine how *de facto* institutional arrangements affect the response time from the emergence of risk to the deployment of a policy instrument. We could not find any pronounced effects of institutional arrangements on undertaking macroprudential actions, and controlling for their proposed index leaves the main results largely unaffected (Columns B and D in the appendix table).[15]

[15] This finding from IT countries plausibly reflects that the central bank weighs in the *de facto* use of macroprudential measures: Cerutti et al. (2017) reported that the great majority (71%) of decisions on the use of the macroprudential tools in 2013 was the central bank.

## VI. CONCLUDING REMARKS

Credit-market or financial stability and price stability might be at odds as policy goals. We find that central banks lean against the wind to ward off credit-driven bubbles even in IT countries—as implied by 'flexible' IT. However, this behavior is sharply attenuated in EMEs when leaning against the wind conflicts with price stability.

This paper shed light on how central banks conduct monetary policy when inflation and credit growth are off the track. A natural question is whether the constraints of inflation targeting lead to financial instability when inflation is outside of the target range. We seek evidence on the complementarity between monetary policy and macroprudential policy to square inflation targeting with financial stability. Especially when inflation is off the target range but monetary policy space is constrained, policymakers could deploy macroprudential measures to offset the side effects of IT-focused monetary policy (such as excess credit or hot money flows).

Our findings on divergent policy responses to hot money flows and global risk shocks suggest that policy conflicts are not uniform among IT countries. Established economies weigh in IT by protecting monetary policy independence more than EMEs do in the face of hot money flows or global risk sentiments. First, Established economies reconcile hot money flows and inflation pressures through tighter monetary policy. In contrast, EMEs' responses to hot money flows are largely muted possibly because hot money flow transmission entails both an inflationary effect through credit expansion and a disinflationary effect through appreciation, offsetting each other. When inflation undershoots the target range, however, EMEs lower interest rates to boost inflation through funneling domestic liquidity and reversing the appreciation pressure of hot money flows. Second, Established economies lower interest rates to buffer global risk shocks while they raise them to fight inflation when core inflation is above the target range. In contrast, in the face of global risk shocks, EMEs deploy easy monetary policy only when headline inflation is below the target range without involving a conflict between IT and heightened global risk.

Also, our findings suggest monetary policy and macroprudential actions are intertwined to achieve multiple goals. Macroprudential actions are more likely to be undertaken during booms (output, inflation, and especially credit growth) or when monetary policy space is constrained by price stability concerns—as a complement for monetary policy. Macroprudential easing is more likely when tighter monetary policy to curb inflation is prone to overly constrain credit growth.

The well-woven policy mix of monetary and macroprudential policies will help address conflicts among goals including price stability and financial stability. The undershooting of inflation target could be prolonged if lower policy rates runs the risk of excess credit in some sectors. To prevent the deterioration of credit situations, tighter macroprudential measures (such as the loan-to-value and debt-to-income ratios) could be deployed depending on the scope and degree of financial spillovers. Our findings are consistent with the deployment of macroprudential policy when monetary policy is constrained, and somewhat supportive of cooperation between monetary and macroprudential policies for improving welfare.

As monetary and macroprudential policies are allowed to respond to credit growth to lean against asset bubble risks, they have some forward-looking nature. Policy rates nonetheless may respond to deviations from expected rather than actual inflation from the inflation target. Measuring expected inflation could be market-, survey-, or model-based, and using consistently such measures for IT countries will be challenging and left for future research. Also, future research could explore how macroprudential policy responds to systemic risks for financial stability.

## Appendix A: Robustness Checks for Macroprudential Action Regressions

This appendix summarizes the estimated results of regression (3) with extensions to account for the effects of: (i) monetary policy constraints from both sides of the target range and (ii) *de facto* institutional arrangement for the macroprudential policy mandate.

Table A1. Alternative Panel Logit Regressions

| | Implement Macroprudential Tightening | | Implement Macroprudential Easing | |
|---|---|---|---|---|
| | (A) | (B) | (C) | (D) |
| Independent Variables | Whole Sample | Whole Sample | Whole Sample | Whole Sample |
| *Output Gap* | 0.27*** | 0.18** | -0.14*** | -0.10* |
| | (0.10) | (0.08) | (0.06) | (0.06) |
| *Inflation Gap* | 0.17** | 0.14 | -0.03 | -0.09 |
| | (0.08) | (0.11) | (0.09) | (0.15) |
| *Credit Growth* | 0.05*** | 0.05*** | -0.01 | 0.01 |
| | (0.01) | (0.02) | (0.02) | (0.02) |
| *MAP Mandate Index* | | 0.11 | | 0.59 |
| | | (0.26) | | (0.39) |
| *# of Quarters Headline Below Range* | 0.28** | 0.23*** | 0.01 | |
| | (0.05) | (0.04) | (0.10) | |
| *# of Quarters Core Above Range* | 0.03 | | 0.18** | 0.21* |
| | (0.07) | | (0.09) | (0.12) |
| N | 834 | 561 | 850 | 521 |
| Countries | 20 | 14 | 20 | 14 |
| Pseudo-$R^2$ | 0.151 | 0.162 | 0.113 | 0.151 |

Notes: Columns (A) and (C) include indicators in both sides of constrained monetary policy in quarterly panel logit regression (3) with random effects for 2003-2013 of indicators of the implementation of macroprudential actions from the Shim et al. (2013) database. Israel, New Zealand, and Peru are excluded owing to the unavailability of credit growth. Columns (B) and (D) add the index of institutional arrangement for the macroprudential policy mandate from Lim et al. (2013) to regression (3). A higher score in the index indicates a more important role of the central bank in the macroprudential framework. The "MAP Mandate Index" assigns a score: 1 if the financial stability/macroprudential policy mandate is shared by multiple agencies including the central bank, but there is no coordination body; 2 if the mandate is shared by multiple agencies including the central bank as a member of a coordination body; 3 if the mandate is shared by multiple agencies including the central bank, and the central bank chairs the coordination body; and 4 if the central bank is the sole owner of the mandate. The whole sample ends up with 14 countries since the index is not available for Australia, Czech Republic, Iceland, the Philippines, South Africa, and the U.K. See notes (a)-(d) to Table 10.

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