Commentary: Riders on the Storm

Kristin J. Forbes

I.   Introduction

The paper by Òscar Jordà and Alan Taylor (hereafter referred to as JT) is very timely. As some countries have recovered more quickly from the global financial crisis, can they begin to normalize interest rates while rates are still around zero—or even negative—in other countries? As the European Central Bank shifts toward easing monetary policy further, can nearby countries with tight labor markets avoid following their lead? As countries have become more tightly linked through trade and capital flows, how much autonomy does any individual central bank have to set monetary policy to address domestic imbalances? These questions are not new for "small open" economies and countries with fixed exchange rates, but the experience over the last decade suggests that monetary policy in even the world's largest economies may be increasingly constrained by the currents of monetary policy abroad.[1] The most recent U.S. rate hiking cycle may have been at an unprecedented, slow pace because it was going against the tide of monetary policy in other major economies. When the Federal Reserve cut its key interest rate by 25 basis points on July 31, 2019, some argued that a key factor was that the Federal Reserve "cannot permit U.S. rates to deviate too far from their foreign counterparts."[2]

This paper studies the divergence in monetary policy and business cycles in four major economic areas (the euro area, Japan, U.K. and the United States) since 1960 in order to put recent experiences in a historic context. A key argument is that focusing on interest rates in different countries is insufficient to capture the "stance" of monetary policy—which should also control for the deviation in each country's interest rate from its natural interest rate. Each country's natural interest rate can also be decomposed into the world natural rate and domestic factors—all of which can move over time. Much of the paper focuses on estimating these world and country-specific natural rates, before exploring a number of patterns over time and correlations with other variables (such as output gaps and inflation). Most of the resulting patterns and correlations are logical and agree with other research—such as the fall in the various "stars" over time and a large global component in each country's natural rates and potential growth. A key result is that monetary policy has been predominantly driven by the "stars"—the slow-moving world and country-specific natural rates—with a smaller role for local developments in output gaps and inflation. The paper concludes that as inflation, output gaps, and the monetary policy stances of the four economies have become more synchronized since 1980, central banks are increasingly "riders on the storm" of global developments.

The paper documents a rich array of interesting patterns and trends, many over a longer time period than previous work. It also uses a plethora of fun and creative terms to describe many key themes. For example, policymakers set interest rates based on either terrestrial factors (i.e., local economic conditions) or celestial factors (i.e., the stars). The latter is a direct link to Chairman Powell's speech at this Jackson Hole symposium last year.[3] The paper is filled with references to "stormy waters," "reading of local currents" and central banks that "tack" to avoid the "drift of economic currents" and avoid going "off course." This makes for much more entertaining reading than many economic papers.

My comments will continue these nautical analogies and focus on two themes central for monetary policy. First is how to measure monetary policy divergence—where I have several suggestions for

the paper. There are a number of technical issues that arise from focusing on the *policy stance*, and thereby estimates of the imprecise stars. Different approaches can have first order implications for the conclusions. Second, I link the key results to the U.K. experience in 2014-15 to delve into why we care about divergence and whether it has changed over time. Increased monetary policy convergence does not necessarily undermine the ability of central banks to use monetary policy to achieve their domestic mandates. Developments in the global economy over the last decade, however, may have shifted how monetary policy works, with more adjustment occurring through guidance and exchange rates and less through changes to policy rates. More research is needed to understand these channels, and especially if they reflect longer-term shifts in the global economy or temporary challenges around monetary policy divergence. Is this a temporary storm or more permanent climate change?

II. Measuring the Policy Stance: Harder than Predicting the Weather

The analysis in this paper builds on a key insight: policy interest rates are not an accurate measure of a country's monetary policy stance. Instead, analysis should focus on the difference between the country's prevailing policy interest rate (r) and the country's short-term "natural" interest rate (r^*), where r^* is the Wicksellian natural real rate. The key equation that captures this relationship in the paper is:

$$\underbrace{r_t}_{\text{Policy rate}} = \underbrace{\left(r_t - r_t^*\right)}_{\text{Policy stance}} + \underbrace{\left(r_t^* - r_{w,t}^*\right)}_{\text{Domestic minus World natural rate}} + \underbrace{r_{W,t}^*}_{\text{World natural rate}} . \tag{1}$$

This focus on the *policy stance*, instead of the *policy rate*, is logical to answer certain questions related to monetary policy, such as how the degree of monetary stimulus has changed over time, given the well-documented fall in the natural interest rate. This framework is also useful for understanding how changes in interest rates reflect a mix of central banks reacting to local conditions and exogenous developments in the domestic and global "stars."

Any empirical analysis using this framework, however, hinges on whether the estimated *policy stance* (and corresponding estimate of

r^*) is accurate. My main concern with the paper is this focus on the "stars," and whether they can be estimated accurately enough to justify being used as the focal point for analyzing monetary policy divergence across countries or as a driver of a central bank decision on any specific date. In the context of this paper, I have three specific concerns about how the *policy stance* is currently measured: only incorporating adjustments to the short-term real interest rate for r (which could miss important effects of unconventional monetary policy); only incorporating developments in four advanced economies for the world r^* (which could miss important effects from emerging markets); and focusing on an imprecisely measured r^* when an observable variable (the policy interest rate, r) may be a more accurate signal of the underlying stance relative to other countries at a given time. These concerns are not just minor measurement issues—but could have first order implications for how to interpret some of the results. (I will leave more theoretical questions about whether this is even the right concept on which to focus to the next section.)

First, to measure the *policy rate* set by the four central banks in the sample, JT uses the ex-ante real rate on short-term government bills $\left(r_t = i_t - \pi^*_{t|t-1}\right)$. This makes sense for the earlier part of the sample, and is undoubtedly the only measure readily available over the historic period since 1960. Over the last decade, however, the four countries in the sample have often adjusted monetary policy through tools other than adjustments to their short-term policy interest rates, such as: purchasing a range of assets, forward guidance, reducing longer-term rates relative to short rates (i.e., "yield-curve control" in Japan and "Operation Twist" in the United States), and subsidized lending programs to support the pass-through of lower policy rates to bank lending rates (i.e., the Term Funding Scheme in the U.K.). These different monetary policy tools loosened financial conditions and provided substantial stimulus, with at least some of their impact through mechanisms other than short-term interest rates. As a result, the measure of r used in this paper could miss meaningful changes in monetary policy stances in individual countries over the last decade when certain countries used these "unconventional" tools more aggressively. This should be straightforward to address in the paper by using one of the existing measures of the "shadow" policy rate that

incorporates the effects of unconventional policy.[4] This research has shown that there can be a large difference between these estimated shadow rates and policy rates or short-term interest rates.

Second, another key variable used in parts of JT's analysis is the "world" natural rate (r_w^*). This is calculated as the average of the natural rates of what I will call the G-4 (the euro area, Japan, U.K. and the United States). This definition of the "world" may have made sense at certain periods when the G-4 dominated global gross domestic product (GDP), but Chart 1 shows that faster growth in emerging markets has corresponded to a meaningful reduction in the weight of the G-4 in global GDP. For example, over just the window from 1991 to 2019, the share of global GDP represented by the G-4 has shrunk from 70% to 49%.[5] Papers attempting to explain changes in the world natural interest rate regularly cite developments in the emerging world as important, such as their capital flows, reserve accumulation, savings and investment, growth, and demographics. Now that the emerging and developing economies constitute nearly 40% of global GDP (almost as much as for the G-4), it is harder to justify excluding them from a calculation of the "world" natural rate.

Moreover, as originally shown in Rachel and Smith (2015) and updated in Chart 2, the real interest rate in these emerging countries appears to have been fairly stable—not declined as in the advanced economies (documented in JT and Rachel and Smith, 2015, among others). This suggests that incorporating emerging economies in a calculation of the "world" r^* could lead to meaningful changes in the estimated world natural rate used in the paper—including a less marked decline over time. Moreover, developments in these emerging economies could have different effects on each of the G-4 (such as a greater impact of developments in China on Japan's r^*). As a result, a more representative world r^* could not simply be dismissed as a level effect on all countries, but have different implications for the role of the "stars" in different countries.

Finally, and perhaps most important, given the imposing challenges in measuring r^* for each country (and the world), would it make more sense to simply focus on the country's observable real interest rate as a measure of the *policy stance* rather than try to back out

Chart 1
G-4 and EM Share of Global GDP (in U.S.$)
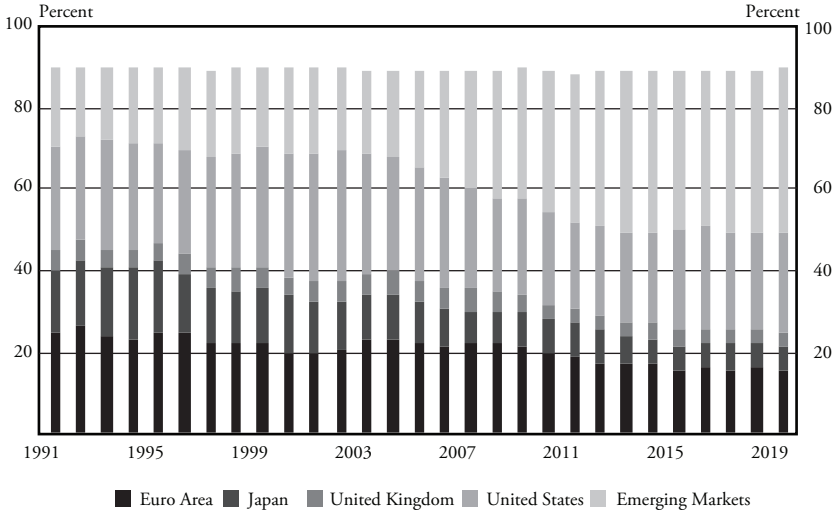
Notes: Emerging markets includes emerging markets and developing economies. GDP calculated based on U.S. dollar. Data for euro area GDP starts in 1991.
Source: Underlying data from the IMF Data Mapper, accessed Aug. 16, 2019.

Chart 2
Real Interest Rates for Advanced
Economies vs. Emerging Markets
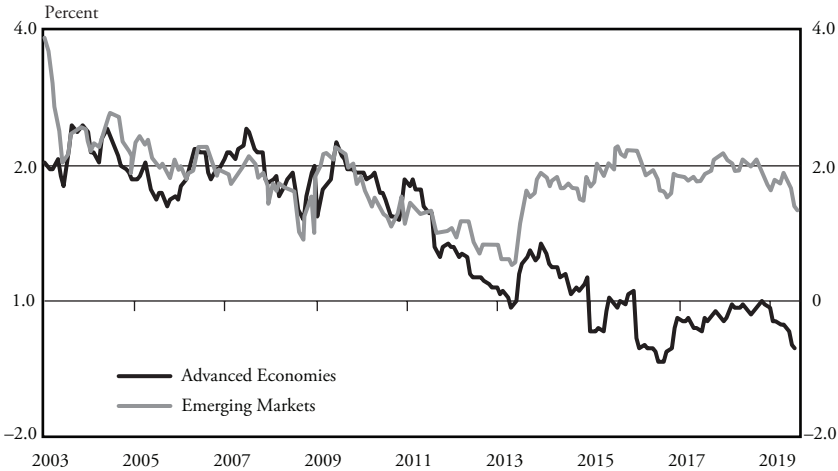
Notes: Real interest rates are GDP-weighted for each country group. Based on Rachel and Smith (2015), with updated data.

a highly imprecise estimate? Although adjusting for each country's natural interest rate makes sense in theory, do the practical challenges in measuring r^* mean that it makes little sense in practice—especially when focusing on cross-sectional divergence in monetary policy instead of changes over time?
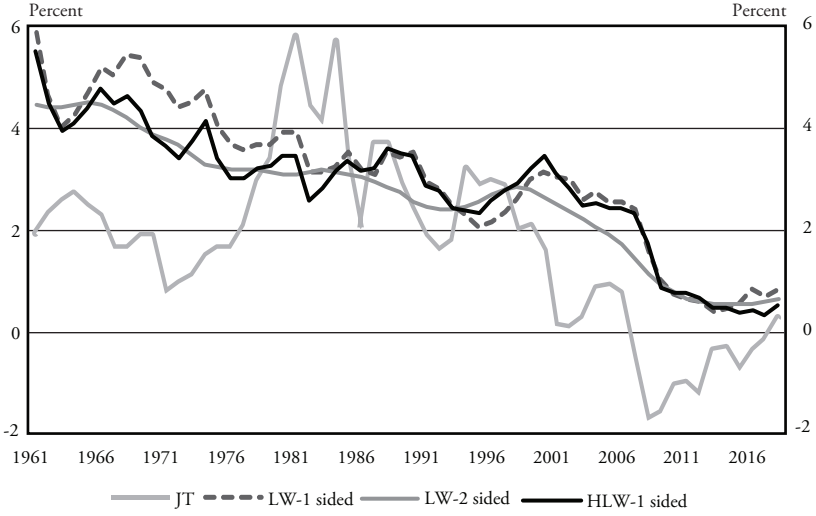
There is an extensive literature attempting to measure r^*—and I am not alone in worrying that it is extremely difficult to calculate. For example, Holston, Laubach and Williams (2017) estimate that the standard error of their estimated natural interest rate for the United States is 1.1 percentage points (pp), for the U.K. is 3.4 pp, and for the euro area is 3.9 pp. The standard error for their one-sided estimates that correspond more closely to "real-time" estimates (by only using past and current data) are even more imprecise—at 1.5 pp, 4.8 pp and 6.0 pp for the United States, U.K. and euro area, respectively.

Moreover, moderate changes to the underlying framework used to calculate these natural rates can have meaningful changes on the estimates—further aggravating concerns about their accuracy. For example, Chart 3 graphs up to three estimates of r^* from different models: JT is from Jordà and Taylor (2019), HLW is from Holston, Laubach and Williams (2019) and LW is from an earlier version of this model in Laubach and Williams (2003).[6] All use similar modeling frameworks and assumptions, so any differences in results cannot be explained by the general approach (with other papers using dynamic stochastic general equilibrium (DSGE) models incorporating very different assumptions). Nonetheless, the estimates vary meaningfully. For the United States, the average difference between the largest and smallest estimate of r^* in these three papers in any given year is 1.88 pp; in the U.K. it is 1.70 pp and in the euro area is 1.15 pp. This deviation is particularly worrisome when assessed relative to the level of rates. For example, in the United States the average r^* in JT is 1.68 over the sample from 1960-2018—less than the average difference between the estimates from the three models!
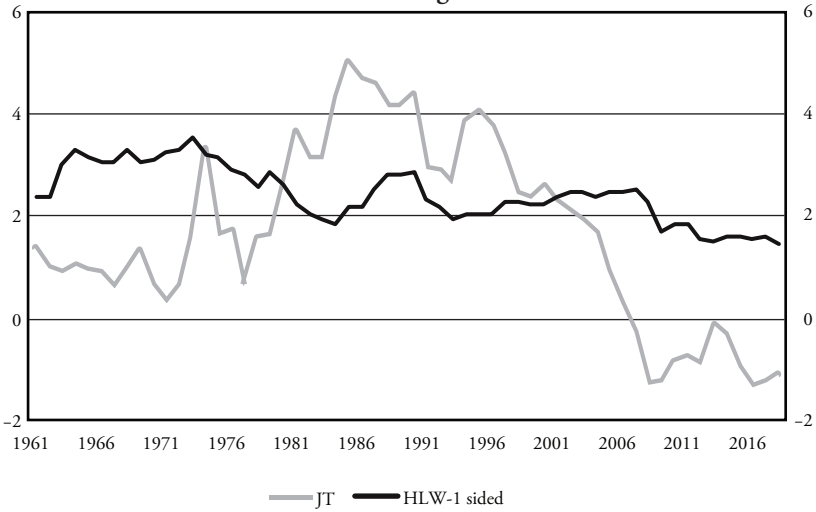
Given these challenges in estimating r^*, how much is gained by controlling for r^* when assessing a country's relative *policy stance* instead of simply focusing on the relative *policy rate*? In other words, does it make more sense to focus on differences in r, rather than in

Chart 3
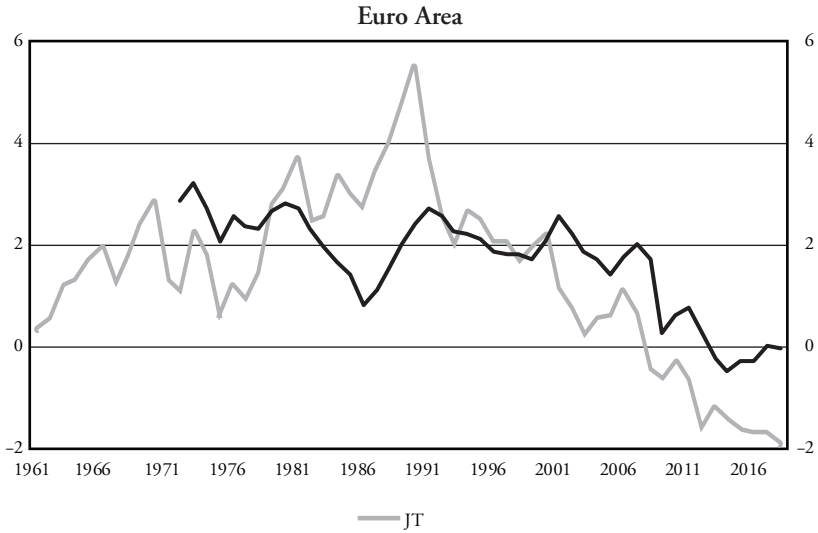**Estimates of r* from Different Papers**

United States

JT   ▪▪▪▪ LW-1 sided   LW-2 sided   HLW-1 sided

United Kingdom

JT   HLW-1 sided

Chart 3 continued

Euro Area

Notes: JT is Jorda and Taylor (2019). LW is Laubach and Williams (2003). HLW is Holston, Laubach and Williams (2017). 1-sided are estimates and are closer to real-time estimates as they only use current and past data instead of the full distribution.

$(r-r^*)$, to assess policy divergence given the potential error introduced by subtracting out estimates of r*? The potential benefits from this approach become clearer when the key decomposition used in JT (in equation 1 above) is rewritten to focus on the divergence in monetary policy across countries. More specifically, denote $r_{(i-W)}^*$ as the difference in the natural rates for country *i* relative to that for the world:

$$r_{(i-W)}^* = r_i^* - r_W^* \ . \tag{2}$$

Then the policy stance for country *i* can be expressed as:

$$(r_i - r_i^*) = r_i - r_{(i-W)}^* - r_W^* \ , \tag{3}$$

and the difference in the policy stance between two countries *i* and *j* is:

$$\underbrace{(r_i - r_i^*) - (r_j - r_j^*)}_{\text{difference in policy stances}} = \underbrace{(r_i - r_j)}_{\text{difference in policy rates}} - \underbrace{\left(r_{(i-W)}^* - r_{(j-W)}^*\right)}_{\text{difference in relative } r^*} \ . \tag{4}$$

If the final term in braces (the difference in the relative r* of each country relative to the world r*) is very noisy, as suggested in the

discussion above, using the observable difference in the *policy rates* (r_i-r_j) could be a better approximation of the actual difference in *policy stances*. This is even more likely to be true if there is a strong global component in r^* (as shown in JT) and movements in r^* are predominantly determined by movements in the world natural rate (as JT shows is the case since 1994). In this case, since the larger movements in r_W^* in each country basically cancel out in equation 4, the final term in braces (measuring the difference in the difference of each countries r^* relative to the world r^*) would generally be small and likely be overwhelmed by noise instead of providing an accurate signal.

Although these measurement issues may sound minor, Chart 4 provides examples of how they could have important implications for analyzing policy divergence today. The top panel shows the dispersion in policy stances over time based on the JT and HLW estimates of r^*.[7] The dispersion in both measures was high during parts of the 1970s and 1980s as countries exited the Bretton Woods arrangement, faced periods of high inflation and "groped for a new nominal anchor" (as discussed in JT). Since 1990, however, the estimated dispersion in policy stances has often been meaningfully higher according to the HLW measure, and even increased since 2016 instead of decreased (as implied by the JT measure). In fact, the HLW measure suggests that the dispersion in policy stances in 2018 is currently above the average since 1980, and just below the average since 1960, instead of being well below that of the historic windows as indicated by the JT measure.[8]

The bottom panel takes a different approach to showing how measurement error in r^* could influence results, reporting the dispersion in the observable *policy rates* as well as in the noisy estimated *policy stances*. Once again, monetary policy dispersion evolves in different patterns since the 1990s when assessed using the different metrics. Dispersion measured using the observable differences in *policy rates* was higher during most of the 1990s and increased sharply since 2014 (instead of decreasing). In fact, dispersion based on observable policy rates has almost tripled since 2014—quite different than the apparent decrease in dispersion indicated by the noisy *policy stance* measures.

Chart 4
Dispersion in Policy Stances and Policy Rates

Different Estimates of *r**(Euro Area, U.K. and U.S.)

HLW Policy Stance (r-r*) — — JT Policy Stance (r-r*)
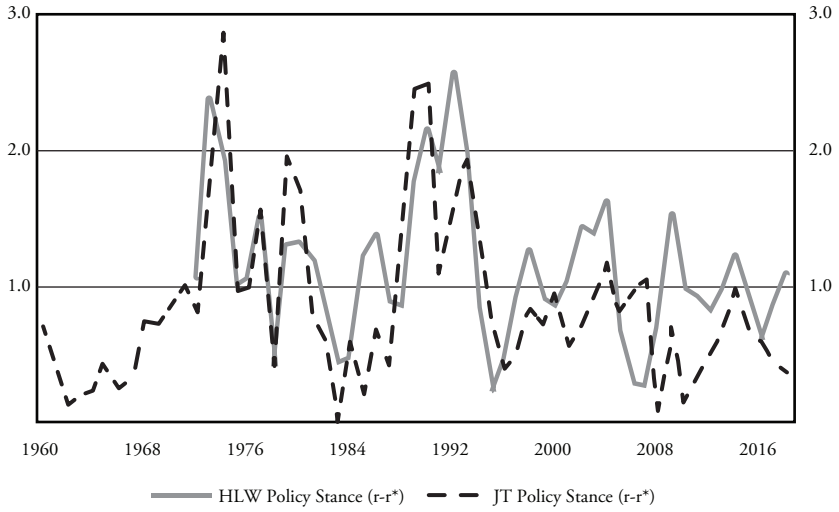
Policy Rates vs. Stances (Euro Area, U.K., U.S. and Japan)

Policy Rate (r) — — JT Policy Stance (r-r*)
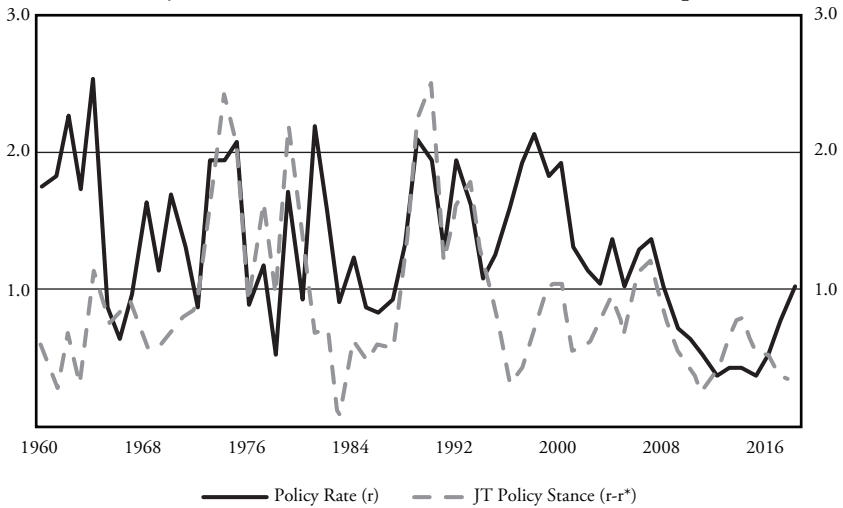
*Dispersion measured as standard deviation of policy stance or policy rate each year for the countries in the sample.

To summarize, although JT makes an important point that the stance of monetary policy depends on the natural interest rate, I am cautious about using this impossible-to-measure concept to estimate the degree of policy divergence around the world (or even just the G-4). Simple tweaks to the model used to calculate this measure, or focusing on the directly observable component of monetary policy that excludes this noisy component, can yield different conclusions about how divergence has evolved over the last few years. Just as a compass that is off by a small amount could cause a ship to miss its harbor, relying on noisy and mismeasured proxies for r^* could lead to conclusions that are off course.

III.   Policy Divergence: Implications for How Monetary Policy Works

Shifting gears from measurement, it is useful to take a step back and consider why issues around monetary policy divergence can be important. Why do we care if interest rates (as well as other variables) have converged around the world? What does JT teach us about the challenges to running a divergent monetary policy today? If a country can effectively use monetary policy to address domestic goals (such as inflation and unemployment), does it matter if its monetary policy stance is more in sync with that in the rest of the world now than in the past? Using JT's terms, does it matter if the ship is guided more by "celestial" than "terrestrial" navigation if it ends up in the right harbor?

To think through these important questions and use the insights from the paper to better understand why monetary policy convergence can in some cases be benign, and in others create challenges, it is useful to start with a concrete example: monetary policy in the U.K. in 2014-15 (before the economy became meaningfully affected by risks around Brexit). In the spring of 2014, the Bank of England (BOE) provided guidance that it was likely to increase its policy interest rate (Bank Rate) soon—the first increase since 2009.[9] Chart 5 shows market expectations for U.K., the United States and euro area interest rates in the summer of 2014. Investors expected an increase in U.K. rates to occur within the next six months, just before the U.S. "liftoff."[10] But the U.K.'s "liftoff' never occurred. Instead,

Chart 5
Market Expectations for Interest Rates in 2014
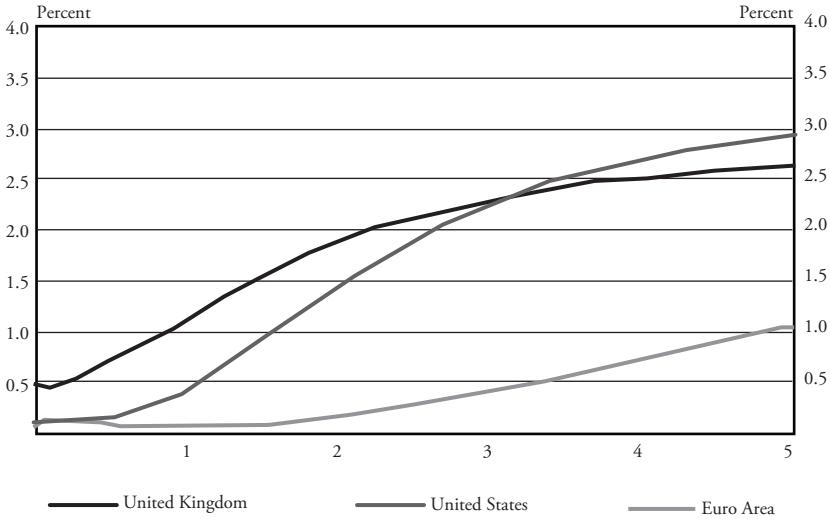
Notes: Curves of market expectations for interest rates are estimated using instantaneous forward overnight index swap rates in the 15 working days to Aug. 6, 2014. Based on data from Bank of England, Inflation Report, August 2014.

the next move in Bank Rate was down (in August 2016 after the Brexit vote). It was almost four years later—not until August 2018—that the BOE raised interest rates for the first time since the global financial crisis.

What explains this delay in the U.K.'s liftoff? Is this an example of how it has become more difficult for a country to adjust monetary policy if its adjustment is out of sync with other major economies? And if so, did this imply that the BOE was constrained in its ability to use monetary policy to achieve its mandate? Understanding why the BOE decided to stay "in sync" helps clarify when and why monetary policy divergence can—and cannot—be a cause of concern, and how the channels central to making this assessment may have changed over time. This experience yields a number of important insights, and I will focus on five that relate to the results in JT.

First, If the U.K. did not lift off primarily because some type of shock unrelated to U.K. monetary policy led to a deterioration in the economic forecast (or even if it just increased the downside risks around this forecast), then the resulting delay in liftoff is not a cause

for concern. Instead, this scenario would simply reflect a central bank adjusting monetary policy appropriately in response to changes in the inflation (or growth) outlook. And there is some evidence this was at least part of the explanation for the delayed U.K. liftoff. A series of events starting in mid-2014 negatively impacted U.K. forecasts for inflation and growth: the Scottish vote on staying in the U.K.; sharp falls in oil and then broader commodity prices; weaker growth in China and concerns about the global economy; increased risks around Greece defaulting, and then Brexit. Changes in the economic forecast related to these events could have weakened the case for raising interest rates. Moreover, the U.K. was not the only country affected by many of these events—especially the fall in commodity prices and weaker growth in China. If these types of global shocks have had a larger impact on growth and inflation in multiple countries over the past decade (from more integration or a larger role for emerging markets), this could have caused the increased synchronization in growth, inflation, and the corresponding monetary policy stances around the world as documented in JT.[11] The resulting convergence in policy interest rates does not necessarily imply less monetary policy autonomy, and is not necessarily a cause of concern. Instead, it simply reflects monetary policy responding to common global shocks.

Second, if the delay in liftoff instead reflected a feedback effect related to monetary policy divergence, the situation may still be benign, but merits more careful evaluation. And there is some evidence that feedback effects related to divergence were also important for the U.K.—especially in the latter half of 2014. As investors began to expect a U.K. liftoff to occur soon (Chart 5), sterling appreciated sharply, strengthening about 12% by October 2014 (relative to its recent low in March 2013). This tightened financial conditions and was expected to reduce import prices by about 11% and consumer price index (CPI) inflation by about 3% over the next three years (using the BOE's rough rule of thumb at the time).[12] These effects had first-order importance for monetary policy. Chart 6 shows the results of a simulation from that time using the BOE DSGE model, combined with data that existed in October 2014.[13] The black line shows the official MPC inflation forecast for inflation to remain below the 2% target over the

Chart 6
U.K. Inflation Forecast and Simulated Inflation Path
Assuming no Sterling Appreciation
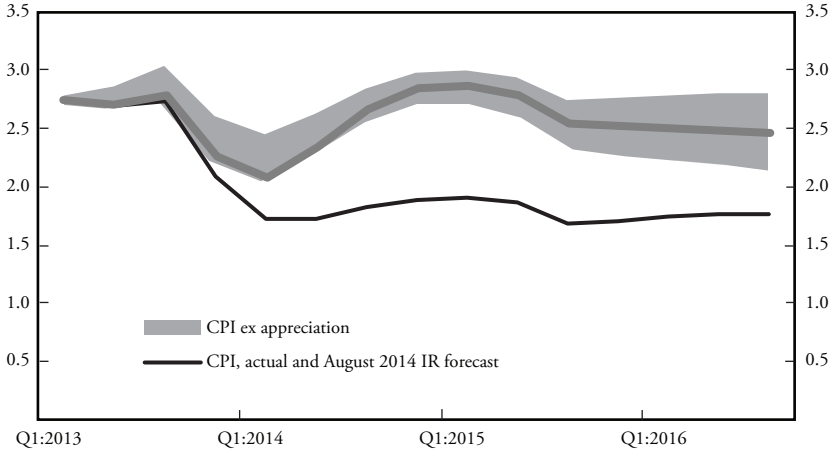
Notes: The gray swath is COMPASS' predictions of CPI inflation if the exchange rate remained at its Q1:2013 level, under different degrees of persistence of the appreciation. The appreciation is assumed to be exogenous, with no other changes in policy and no other shocks.
Source: Replicated from Forbes (2014).

next two years. This suggested that interest rates would not need to be tightened as much or as quickly as suggested by the market curve, and was a key factor contributing to the MPC decision not to raise interest rates. In contrast, the grey line shows my counterfactual simulation for inflation if sterling had not appreciated from its Q1:2013 level. In this case, inflation would have been well above the 2% target over the next two years, a forecast which might have caused the MPC to raise interest rates. This example does not suggest that the BOE lost monetary policy autonomy, or that monetary policy did not work in terms of achieving its mandate, but instead that the feedback effect through the exchange rate limited the ability of the U.K. to set interest rates that diverged from global levels.

Third, if U.K. inflation remained around its 2% target in 2014 primarily due to feedback effects from the expectation of U.K. interest rates being raised and out of sync with the rest of the world, monetary policy may have "worked" through different channels than when the policy interest rate is increased. These different channels would have implications for the broader economy. More specifically,

if the main reason why the U.K. did not lift off was because financial conditions tightened through an exchange rate appreciation, then the effects of monetary policy may not be fully captured in standard measures of short-term interest rates. In the extreme, monetary policy could work without changing the policy rate. This form of monetary policy adjustment would have different effects on the economy than would occur from traditional adjustments in the policy interest rate. For example, companies more sensitive to currency movements would be more affected, while companies with higher debt burdens and thereby more sensitive to borrowing costs would be less affected.

Fourth, although monetary policy has always worked partly through mechanisms other than just changes in the policy rate (including through the exchange rate), an interesting issue is whether the role of these nonrate mechanisms has increased. This could occur if more integrated financial markets (and/or larger capital flows) imply that smaller changes in relative interest rates lead to larger adjustments in capital flows and exchange rates. This could also occur if the pass-through from exchange rate movements to inflation is stronger than in the past. Or, this could occur if the first liftoff and/or raising interest rates from the effective lower bound (ELB) has a disproportionately larger effect on capital flows, exchange rates and/or the yield curve than adjustments to monetary policy from a higher starting point. More specifically, if changes in monetary policy around the ELB are more likely to involve "unconventional" tools, such as forward guidance about the near term, this could have an unusually large impact on the exchange rate. Or, if raising interest rates off the ELB after an extended period of monetary stimulus is seen as signaling a major shift in policy or a shift in confidence about the economic outlook (similar to the "Delphic effect" in Nakamura and Steinsson 2018), this could shift various yields across the whole market curve and have larger exchange rate effects. Also, the relative size of the change in interest rates may matter. More specifically, raising interest rates 25 basis points is a doubling of interest rates if moving from an ELB of 0.25%, but only about a 10% increase if moving from a level of 2.0%. The relative increase in carry costs or other prices related to the 25-basis-points increase in interest rates could cause disproportionate effects on currency trading and other pricing.

There has been little research on any of these questions, but the experience of the U.K. in 2014 suggests that these types of feedback mechanisms from a discussion of raising interest rates may have increased in 2014—albeit it is impossible to tell if this was because of a "divergent" monetary policy or challenges related to liftoff. A rough comparison with historic episodes suggests that sterling was more sensitive to the discussion of an increase in interest rates than normally occurred. A 25-basis-points increase in interest rates is usually assumed to correspond to a sterling appreciation of about 0.25% to 1%.[14] Even if the liftoff expected in 2014 was viewed as the first in a series of several rate increases, this does not even begin to correspond to the resulting 12% appreciation. The exchange rate movement in 2014 was meaningfully larger than would be expected based on monetary policy—possibly a side effect from expectations that the U.K. would have a divergent monetary policy from other major economies.

Finally, this U.K. example is helpful in clarifying what measure of policy "divergence" is most important for feedback effects and constraints to monetary policy autonomy—the point from the last section. Is it the *policy rate* or the *policy stance* (which adjusts for the country's r^*) that is most important when evaluating the role of monetary policy divergence? The example above suggests that it is differences in *policy rates*—not *policy stances*—that matter most from the perspective of feedback effects and interest rate divergence. In the U.K. example, JT estimates suggest that r^* increased from –0.89 in 2012 to –0.32 in 2014. According to this measure, if the U.K. raised the policy interest rate by 0.50 in 2014, this would have implied no change to the *policy stance*—instead of "tighter" monetary policy—and therefore probably would not have corresponded to such a sharp exchange rate appreciation (and corresponding drag on inflation) This suggests that, at least to the extent that currency movements reflect decisions by international investors seeking higher returns, it may be the *policy rate*—not the *policy stance*—that is most important for thinking about monetary policy divergence.

IV.   Conclusions

The questions addressed in this paper are of first-order importance. Are countries able to adjust interest rates if their monetary policy

diverges from that in the rest of the world? Is monetary policy now determined primarily by developments in the slow-moving natural interest rate? And if so, does this imply a loss of autonomy, such that central banks are unable to use monetary policy to meet their domestic mandates?

Answering these questions is challenging, however, as results can depend on estimates of the natural rate of interest—a concept that is important in theory, but extremely hard to measure in practice. With this caveat, the paper finds increased synchronization in its G-4 sample for output gaps, inflation and monetary policy stances. This could be explained by a number of factors—including greater integration through trade or finance, a larger role for global shocks, or shared secular trends that effect the "stars." There are also a number of factors over the last decade that could have made it more difficult for monetary policy in individual economies to diverge from global trends—especially if changes in interest rates around very low levels, changes through unconventional monetary policy, or changes after an extended period of low rates work more through exchange rates than simply adjustments to the policy rates set by central banks.

If monetary policy has recently worked more through adjustments in currencies, this could aggravate tensions around "currency wars" and have implications for different sectors of the economy. There is no evidence, however, to suggest that these effects would cause central banks to lose their autonomy in the sense that they can no longer achieve their domestic mandates. In fact, if exchange rates continue to be an important mechanism through which monetary policy achieves domestic mandates, central banks might even make smaller changes in their policy rates to achieve their domestic goals in the future (holding everything else constant). Continuing the sea analogy from JT, exchange rates could increasingly act as an automatic autopilot for the ship. The central bank Captain would need to adjust the dials of the policy rate less frequently as the economy automatically adjusted. The ship will still arrive at its harbor, even if some object to the new method of navigation.

Endnotes

[1]See Rey (2014). "Small open" economies refers to the standard economic definition of a country which is meaningfully affected by its terms-of-trade with the rest of the world.

[2]Greg Ip, "The Undeclared Currency War: How the ECB is Forcing the Fed's Hand," *The Wall Street Journal*, July 30, 2019.

[3]*https://www.federalreserve.gov/newsevents/speech/powell20180824a.htm*

[4]For example, see Doh and Choi (2016), Lombardi and Zhu (2014) or Wu and Xia (2016).

[5]Statistics from the IMF Data Mapper, accessed Aug. 16, 2019. Emerging markets includes emerging markets and developing economies. GDP calculated based on U.S. dollar. Data for euro area GDP starts in 1991.

[6]I use the annual average of the quarterly HLW (2017) and LW (2003) estimates for comparison to annual JT (2019) estimates.

[7]Dispersion is calculated as the standard deviation for the euro area, U.K. and the United States. Japan is excluded from the top panel to maintain a consistent sample and because HLW does not report estimates for Japan.

[8]The dispersion in the policy stance using the HLW r^* is 1.09 in 2018, compared with an average of 1.06 since 1980 or 1.11 since 1960. The dispersion using the JT r^* is 0.36 today, as compared with an average of 0.85 since 1980 and since 1960.

[9]For full disclosure, this was just before I joined the Monetary Policy Committee at the BOE.

[10]Market expectations are measured by instantaneous forward overnight index swap rates from Haver and the BOE.

[11]Recent work on inflation dynamics (such as Forbes 2019) provides evidence of a greater role for commodity shocks and global factors in explaining movements in CPI inflation in a cross section of countries over the last decade.

[12]These estimates are based on the BOE rule of thumb at the time, which assumed that pass-through from movements in the sterling exchange rate index was 90% to import prices and then 30% to headline CPI (so that a 10% depreciation corresponds to a 9% increase in the level of import prices and 3% increase in the level of the CPI). This rule of thumb was subsequently adjusted such that the pass-through to import prices was reduced to 60% (and no change in the second stage of pass-through).

[13]For more details, see Forbes (2014). This simulates the path of CPI inflation if there had been no other shocks or changes in policy. The shift in the exchange rate is assumed to result from an exogenous exchange rate shock, and the bands around

the grey line capture the range of outcomes based on different assumptions for the persistence of the appreciation.

[14]This band reflects historic averages as well as model estimates. The lower estimate reflects the rule of thumb from the BOE's COMPASS model under a set of standard assumptions. The higher number is estimated in Forbes et al. (2018).

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