

Empirical & Thematic Perspectives

Are the Euro-Area Countries an Optimal Monetary and Currency Zone? — A Comparison with U.S. Federal Reserve Districts*

- Are the euro-area countries simply too diverse to be a durable and effective monetary and currency zone? This essay seeks to shed some new light on this important question. We first document the extent of diversity among the euro-area countries, comparing the macro performance of these countries with that of the twelve U.S. Federal Reserve districts. We then consider the challenges that this heterogeneity has posed for the ECB in formulating a common monetary policy.
- The most striking gaps in euro-area performance have been between Germany on the one hand and Spain, Ireland, Portugal, and Greece on the other. In the years before the financial crisis, Germany recorded exceptionally low inflation and soft growth, while these other countries struggled with much higher inflation and, in some instances, signs of overheating. Italian performance has also differed from that of Germany, but such differences have been less stark than for the other peripherals.
- Divergences in unemployment rates and unit labor costs, reflecting persistent labor-market rigidities within the euro area, seem to have been a key underlying driver of these differences in macroeconomic outcomes. But importantly, we also find evidence of divergences among the Federal Reserve districts, especially through the middle years of the past decade, as the effects of the real estate boom differed appreciably across regions.
- At root, our work offers a warning to euro-area policymakers. At present, the ECB is shouldering a heavy burden in fitting policies appropriate for this relatively diverse group of countries. The integrity of the monetary union going forward will require complementary structures to curb divergences in regional performance. As such, reforms now being put in place, including the Fiscal Compact and efforts to integrate financial oversight and resolution, strike us as critical. Our work also cautions against the expansion of the monetary union to other large heterogeneous countries.
- In the course of this comparison, we also uncover two new observations about U.S. monetary policy. First, we find that since the financial crisis erupted, the Federal Reserve has tended to react much more aggressively to economic slack than was previously the case. Whether this shift in the Fed's reaction function reflects the difficult economic circumstances that have prevailed in recent years, or something more permanent, remains to be seen. (Indeed, the answer may ultimately hinge on who is appointed the next Fed Chairman.)
- Second, we find that those Federal Reserve districts that have achieved stronger GDP growth in recent years have been more likely to have seen their Bank Presidents cast dissenting votes for tighter policy. Specifically, the four fastest-growing districts since the crisis erupted have been Dallas, Minneapolis, Kansas City, and Richmond. Presidents from these four districts have cast a historically significant 28 dissents for tighter policy since the fall of 2007, the vast majority of such dissents. Conversely, Chicago—the weakest growing district over this period—has seen its President dissent for easier policy.

**Figures have been reformatted to sharpen their clarity for readers who print in black and white.*

Global Head of International Economics

Nathan Sheets

+1-212-816-9297
nathan.sheets@citi.com

Robert A Sockin

+1-212-816-1658
robert.andrew.sockin@citi.com

See Appendix A-1 for Analyst Certification, Important Disclosures and non-US research analyst disclosures.

Citi Research is a division of Citigroup Global Markets Inc. (the "Firm"), which does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that the Firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision.

Are the Euro-Area Countries an Optimal Monetary and Currency Zone?—A Comparison with U.S. Federal Reserve Districts

A broadly held view is that the euro-area countries have manifest significant heterogeneity in their economic performance and institutional structures and that this diversity, in turn, has created exceptional difficulties for the ECB in formulating a common monetary policy. Indeed, such heterogeneity is often cited as a key underlying driver of the fiscal and financial crisis that has plagued the euro area over the past three years.

However, the assessment in this regard is far from unanimous. In a June 2011 speech, Jean-Claude Trichet, ECB President at the time, articulated a dissenting view. Trichet compared data for euro-area countries with data for U.S. states and regions and came to a differing conclusion. He saw “convincing evidence that the euro area and the United States of America have similar features in terms of the diversity of the economies that are part of these vast continents.”¹

In this essay, we seek to shed further light on this important issue. We document the extent of diversity among the euro-area countries, comparing the performance of these countries across a number of economic variables with that of the twelve Federal Reserve districts. We also suggest some conclusions about what the observed diversity may imply for monetary policy in Europe going forward and, more deeply, for the optimality of the euro area as a monetary and currency union. This work draws heavily on a dataset that we have constructed, which includes a range of economic variables for each of the twelve Federal Reserve districts. (The details regarding the construction of these data are outlined in an Appendix at the end of the essay.)

An underlying premise of our analysis is that monetary union in the United States has been successful. The important implication of this premise is that the observed diversity in the performance of Federal Reserve districts is manageable within the context of a monetary union. We thus use the heterogeneity of the Federal Reserve districts as a yardstick to assess the viability of European monetary union. Our approach is admittedly subject to numerous qualifications. For example, a monetary union could perhaps be successful with significantly more heterogeneity among its constituent regions than has existed in the United States or, alternatively, flexible labor markets may have allowed U.S. monetary union to have been feasible despite significant divergences. Even so, this approach strikes us as an attractive framework for organizing the analysis.

To summarize, our work yields several important conclusions. First, we see striking gaps in economic performance between Germany on the one hand and many of the peripheral countries on the other. These differences have been particularly conspicuous in labor market performance, where sizable gaps in unemployment rates have persisted and unit labor costs have been on divergent paths. Second, however, we also find evidence of dispersion in performance across Federal Reserve districts, especially through the middle of the past decade as the footprint of the real estate boom differed across regions. Even so, by most metrics, we find notably less heterogeneity for Federal Reserve districts than for euro-area countries. Third, our work offers a warning to euro-area policymakers. At present, the burden on the ECB in fitting a policy appropriate for this diverse group of countries is significant. Assuming that full-blown political and fiscal union in Europe will not be feasible any time soon, the integrity of the monetary union going forward

¹ See “Two Continents Compared,” June 10, 2011.

will require stronger mechanisms to discipline divergences in regional performance. As such, reforms now being put in place, including the Fiscal Compact and efforts to integrate financial oversight and resolution, strike us as crucial for the success of the common currency.

Assessing Heterogeneity in the Euro Area

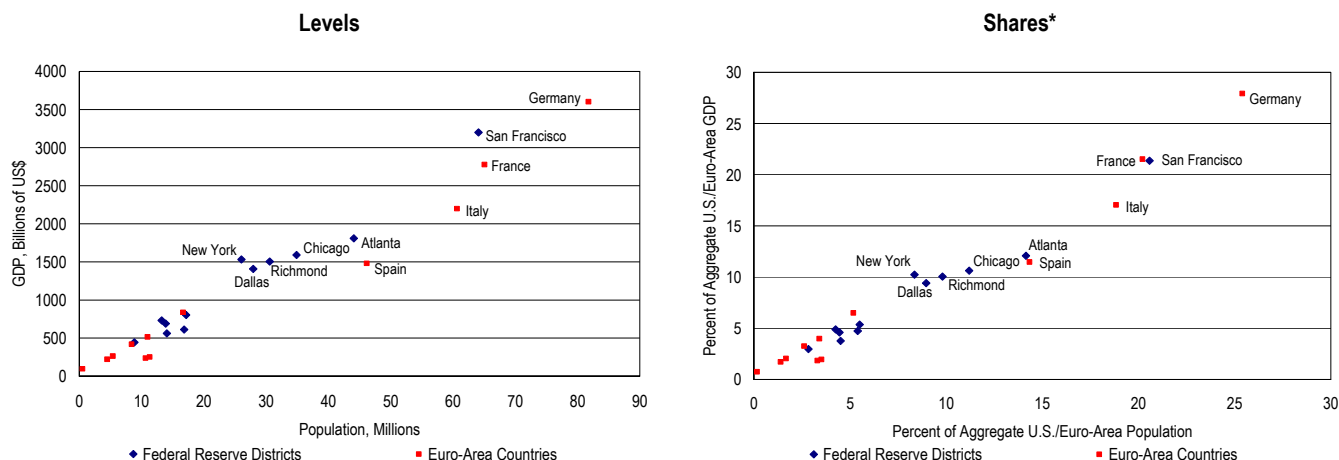
We begin by reviewing some key economic and structural features of the euro-area countries relative to the Federal Reserve districts. An important background point is that—although the euro area now has seventeen member countries—our work focuses on the original eleven members plus Greece (which joined in January 2000). This approach provides a reasonably uniform time series for the period since the introduction of the euro and also results in a nice match between the number of euro-area countries and Federal Reserve districts. We note that the regional U.S. data are generally available only through 2011—data for 2012 have not yet been published. This exercise yields a range of insights, but the following strike us as particularly notable:

Euro-area countries are of markedly different sizes and levels of per capita income.

Figure 1 shows the population and GDP of euro-area countries and Federal Reserve districts. Strikingly, the population and economic mass of the euro area is concentrated in its three largest members, with Germany, France, and Italy together representing about two-thirds of euro-area population and GDP. The seven smallest of the euro-area countries account for just 15 percent of the euro area's GDP and 16 percent of its population.²

In contrast, Federal Reserve districts are more uniform in size. All of the Fed districts except San Francisco have GDP that falls somewhere between roughly 3 percent and 12 percent of the national total, and the distribution for population is broadly similar. The San Francisco district is somewhat larger than the others, but even so, has population and GDP shares very similar to those of France—and much smaller than those for Germany. Stated differently, of these 24 countries and districts, three of the four largest in terms of both population and GDP are in the euro area, as are seven of the eight smallest.

Figure 1. GDP and Population (2011)



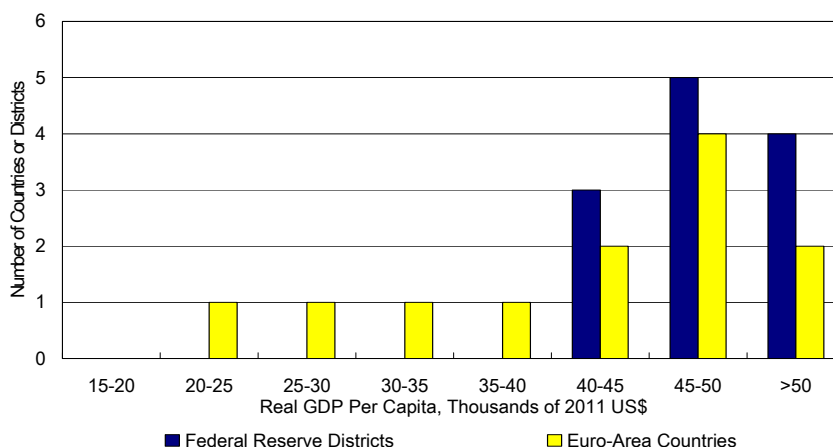
*Aggregate GDP and population data for the euro area include only the twelve countries in our sample.
Sources: Bureau of Economic Analysis, Census Bureau, Eurostat, and Citi Research.

² This observation would be even starker if we also included the five countries that have joined the euro area since 2000; these countries total just 3 percent of the euro area's population and less than 2 percent of its GDP.

Figure 2 highlights another dimension of heterogeneity in the euro area. Per capita incomes for the Federal Reserve districts are somewhat more uniform than is the case for euro-area countries. Eight Federal Reserve districts have per capita incomes falling into the \$40,000 to \$50,000 bins, with the remaining four districts at over \$50,000. Per capita incomes for the euro area are more dispersed, with four countries below \$40,000 and two more countries at over \$50,000.

Several further remarks about these data are useful. First, disparities in the size and income levels of euro-area countries are very much a historical feature of Europe's monetary union. For many countries, a key driver of integration was the desire to align themselves more closely with Germany's remarkable economic successes and, in particular, the inflation-fighting credibility that the Bundesbank had established. (Ironically, however, this asymmetry has not been reflected in the voting structure of the ECB, where all national governors have voted at each meeting and decisions have been taken by "consensus.") Our sense is that the heterogeneity of the size and incomes of ECB member countries is not necessarily a strength or a weakness of the euro-system, but it certainly hints at differences in the stature and influence of the constituent members.

Figure 2. Real GDP per Capita (2011)



Sources: Bureau of Economic Analysis, Census Bureau, Eurostat, and Citi Research.

Second, the fact that the Federal Reserve districts are of relatively homogenous size is itself notable. The United States was divided into these twelve districts a century ago as part of a political compromise. If economic policymakers were given a blank sheet of paper today, they might very well draw different boundaries for the districts, and likely would not headquarter two of the districts in Missouri (St. Louis and Kansas City). Even so, the present structure of Federal Reserve districts does not seem to be too far removed from prevailing economic realities, at least relative to the euro-area countries.

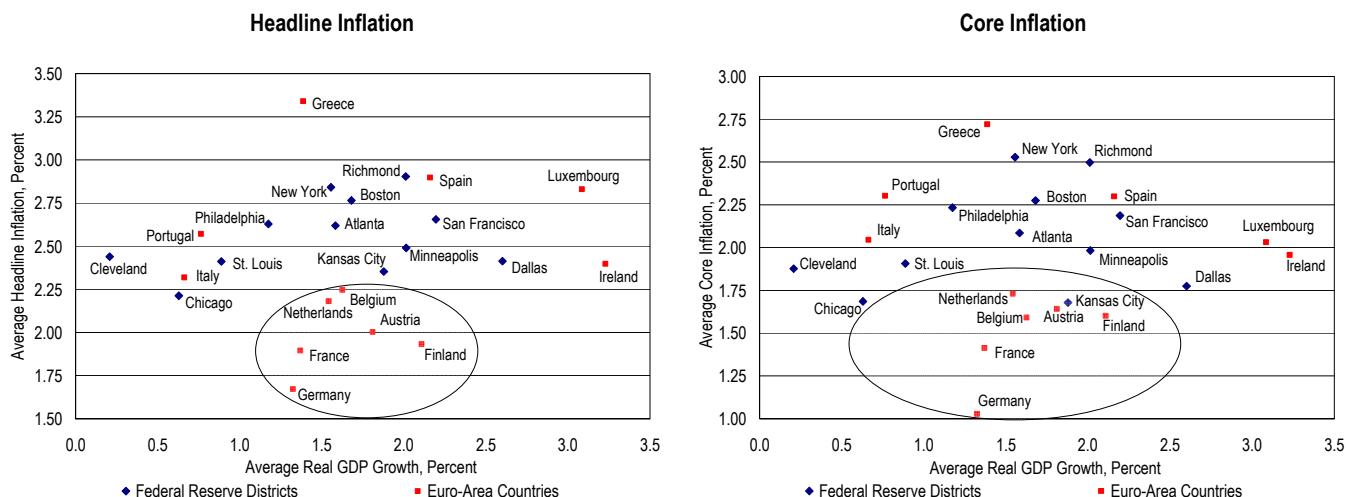
Third, an important feature of the boundaries dividing Federal Reserve districts is that they do not correspond to any other political divisions in the country—they group together various sets of states and, in many instances, even divide states along county lines. The vast majority of the general public has little awareness of which Federal Reserve district they reside in. This lack of political identity has freed the Federal Reserve Banks from political pressures to directly represent the economic interests of their home regions.

The euro area has shown greater heterogeneity in inflation performance—but not in GDP growth. The left panel of **Figure 3**, which shows average headline inflation versus real GDP growth from 1999 to 2011, highlights a two-tier euro area. Six countries—Germany, France, the Netherlands, Belgium, Austria, and Finland—had average real GDP growth roughly in a range of 1½ to 2 percent and headline inflation that averaged a few tenths or so above or below 2 percent. Of the six remaining countries, Italy and Portugal had higher inflation and lower growth; Spain and Greece had similar growth to the core countries but notably higher inflation; and Ireland and Luxembourg had higher inflation and higher growth. These six outlying countries, in terms of their economic performance, account for a consequential one-third of euro-area GDP. It strikes us as more than a coincidence that it has been in these countries (with the exception of Luxembourg) where the crisis in Europe erupted and has been the most intense.

In contrast, the inflation performance of the Federal Reserve districts was more uniform, ranging from an average of 2.2 percent (Chicago) to a high of 2.9 percent (Richmond). The convergence of inflation rates across Federal Reserve districts through the past tumultuous decade is a remarkable development. The story, however, is different for growth rates. As with euro-area countries, Federal Reserve districts showed substantial variation in their GDP growth.

The story for core inflation (i.e., headline inflation excluding food and energy) is broadly similar. The six “core” euro-area countries dominate the bottom portion of the chart, with core inflation of less than 1¾ percent. Of these, Germany has been a striking downside outlier, with core inflation averaging just a bit over 1 percent. Notably, the three highest core inflation rates for the euro area were in the peripherals—Spain, Greece, and Portugal. For the Federal Reserve, core inflation was above 2 percent in six districts and below 2 percent in six districts. Kansas City and Chicago recorded the lowest core inflation (a little below 1¾ percent), while New York and Richmond had the highest (2½ percent).

Figure 3. Real GDP Growth and Inflation (1999–2011)



Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Eurostat, and Citi Research.

Figure 4 examines the performance of growth and core inflation in the years before the global financial crisis (1999-2007) and after the financial crisis erupted (2008-2011). Importantly, in the years before the crisis, Ireland, Greece, and Spain registered rapid growth rates and high levels of core inflation. In addition, Spain and Ireland saw soaring real estate prices. We conjecture that monetary policy in these countries might have been appreciably tighter if they had had independent central banks.

Notably, the two other peripheral countries—Italy and Portugal—had a different footprint. They had weak growth (indeed the weakest of the euro-area countries), but with average inflation above the ECB's 2 percent ceiling. On the other hand, Germany's performance was characterized by sluggish growth and very low inflation.³

The Federal Reserve districts in the years before the crisis showed less dispersion in their inflation rates than the euro-area countries, with inflation in all of these districts between roughly 1¼ and 2½ percent. Even so, the Fed districts saw roughly comparable dispersion in their growth rates—with Cleveland, Chicago, and St. Louis putting in the weakest performances on the chart. Strong performing Fed districts were San Francisco and Dallas, but Spain, Finland, Greece, Luxembourg, and Ireland all grew faster.

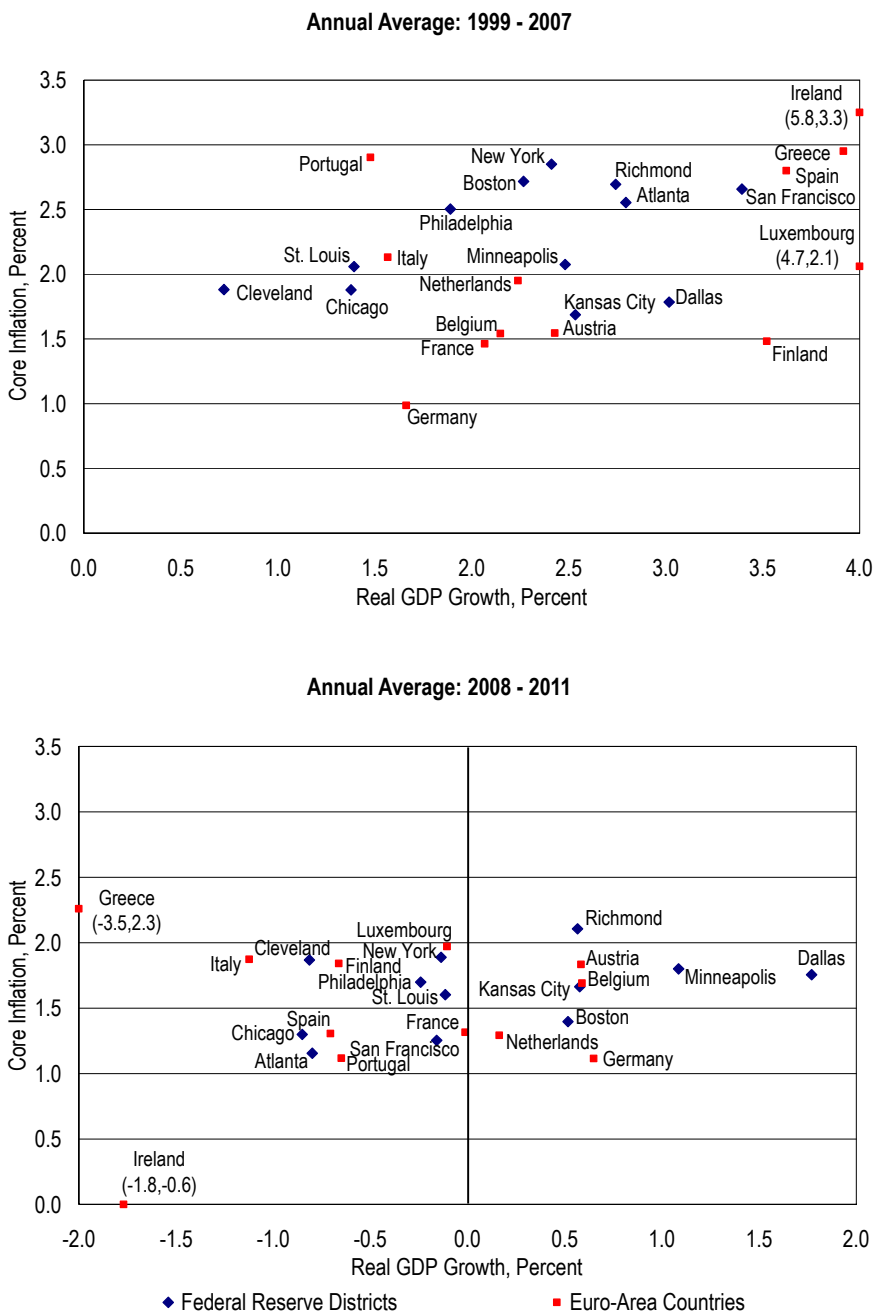
The scatterplot for the 2008-11 averages is striking—both for the euro area and for the United States. Inflation rates during this period were lower than before the crisis, and the dispersion of inflation was more muted. All of these countries and districts averaged inflation of roughly 1 to 2 percent over these years, with the only notable exception being Ireland, which has suffered deflation as wage levels there have rapidly unwound.⁴

In contrast to the relatively uniform performance of inflation in the years since the crisis, both the euro area and the United States have seen marked divergences in regional growth. That said, the United States boasts the two fastest growers on the chart (Dallas and Minneapolis), while the three slowest growers (Greece, Ireland, and Italy) are in the euro area.

³ This raises an interesting hypothetical question: Would an independent Bundesbank have been more stimulative through this period than the ECB proved to be? On the one hand, German economic performance during these years does seem to justify a much more stimulative policy stance. On the other hand, given its culture, the Bundesbank might very well have been hesitant to have pursued such accommodative policies. (For further thoughts on this issue, please see our earlier essay, ["Germany's 'Windfall' from Euro-Area Membership and European Imbalances,"](#) January 27, 2012.)

⁴ Several of the peripheral euro-area countries, including Greece, hiked their VAT taxes during this period in an effort to raise fiscal revenues. This tended to support inflation in these countries, despite the weak performance of economic activity.

Figure 4. Real GDP Growth and Core Inflation



Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Eurostat, and Citi Research.

Box 1: Regional divergences and policy debates at the Fed and the ECB

Another notable observation from the lower panel of Figure 4 is that those Federal Reserve districts where growth has been stronger have been much more likely to have seen their regional Bank Presidents cast dissenting votes in favor of tighter policy. Specifically, the four fastest-growing districts since the crisis erupted have been Dallas, Minneapolis, Kansas City, and Richmond. As shown in Figure 5, all of these Reserve Banks have cast multiple dissents for tighter policy over the crisis period. Conversely, Chicago has been the weakest performing district, and its President has twice dissented for easier policy.

This observation, however, requires some important qualifications. Other factors beyond regional performance also determine voting behavior. Charles Plosser of the Philadelphia Fed has dissented for tighter policy despite the fact that his district has not performed particularly well. In contrast, Eric Rosengren of the Boston Fed has dissented for easier policy, but his district's growth performance has been relatively strong. More generally, we believe that the Reserve Bank Presidents focus on the needs of the national economy in casting their monetary policy votes—but such assessments are notoriously judgmental. This evidence suggests that it may be difficult for FOMC voters to entirely divorce themselves from developments in their local economies in making such judgments.

A broadly similar story can be told for the euro area. Growth in Germany, Austria, Belgium, and the Netherlands has held up relatively well, particularly compared with Italy, Ireland, and Greece. While the ECB does not release formal voting tallies, these stronger-performing countries seem to have generally led the hawkish wing of the ECB's Governing Council.

Figure 5: FOMC Votes of Federal Reserve Districts, September 2007 - Present

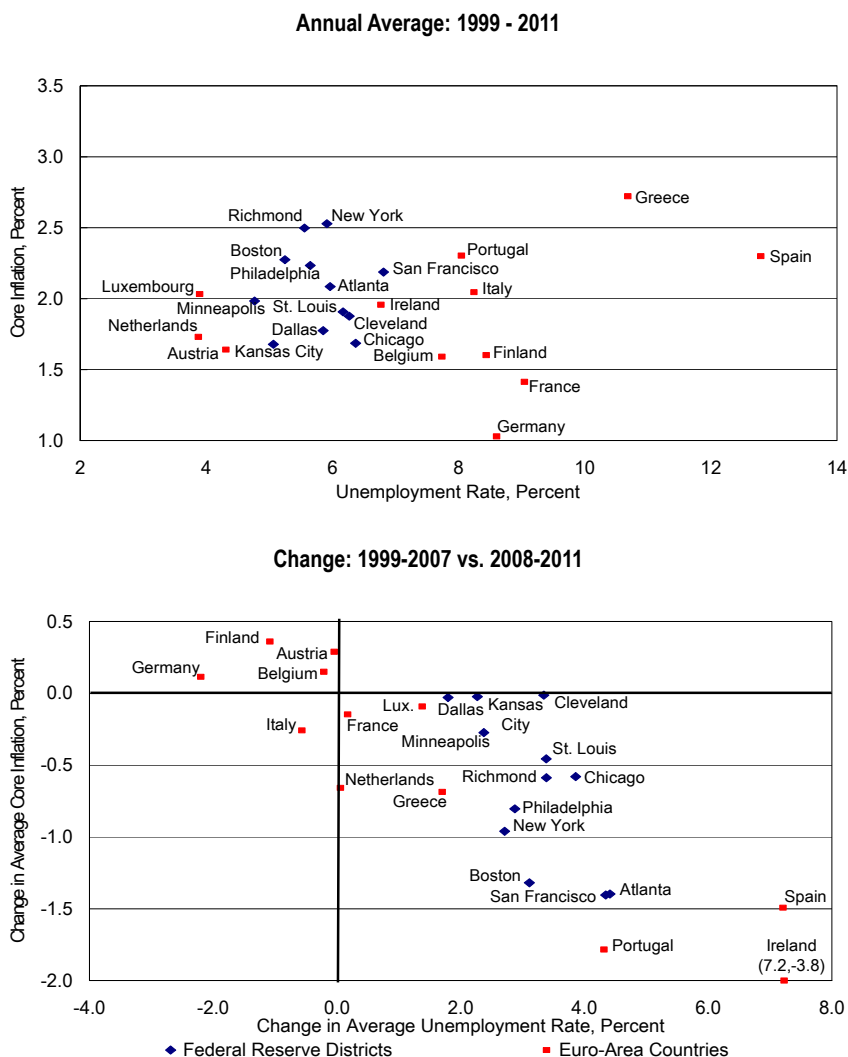
	Dissent for:		Average Real GDP Growth, 2008-2011
	Easier Policy	Tighter Policy	
Dallas	0	7	1.8
Minneapolis	0	2	1.1
Kansas City	0	10	0.6
Richmond	0	9	0.6
Boston	1	0	0.5
St. Louis	0	0	-0.1
New York	0	0	-0.1
San Francisco	0	0	-0.2
Philadelphia	0	4	-0.2
Atlanta	0	0	-0.8
Cleveland	0	0	-0.8
Chicago	2	0	-0.9

Sources: Federal Reserve Board and Citi Research.

Unemployment rates in the euro-area have shown disparities. The upper panel of **Figure 6** highlights the joint behavior of unemployment and inflation from 1999-2011. Notably, the Federal Reserve districts are tightly clustered in the center of the chart, with core inflation at around 2 percent and unemployment rates between roughly 5 and 7 percent.

In contrast, the euro-area countries are distributed broadly across the chart, with some countries showing low inflation and low unemployment (the Netherlands and Austria); some having low inflation and relatively high unemployment (German and France); and still others recording high inflation and high unemployment (Spain and Greece). Of course, these countries may have differing rates of structural unemployment, which are largely beyond the purview of monetary policy. However, this marked divergence in unemployment rates—from below 4 percent on average in the Netherlands to over 12 percent in Spain—has at a minimum posed challenges for the ECB in gearing a common policy.

Figure 6. Core Inflation and Unemployment Rate

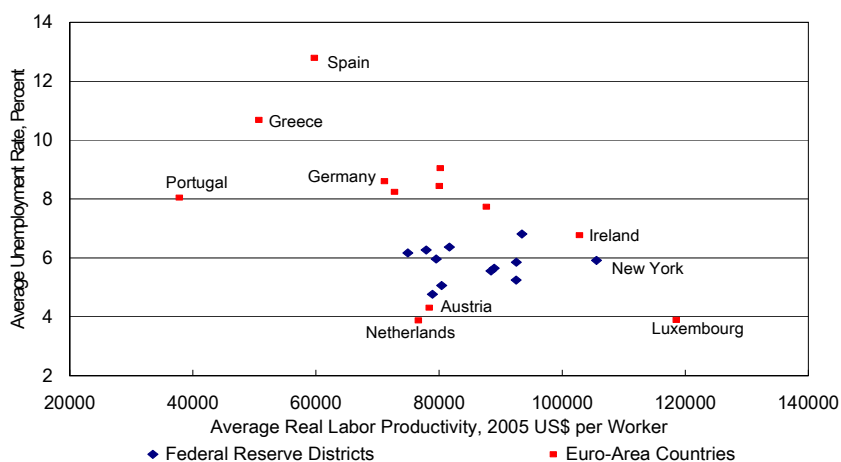


Sources: Bureau of Labor Statistics, Eurostat, and Citi Research.

The lower panel frames the ECB's dilemma even more crisply. In the years since the financial crisis erupted, Germany, Belgium, Austria, and Finland have all seen *higher* inflation and *lower* unemployment than before the financial crisis. Conversely, in Spain, Ireland, and Portugal, inflation has fallen sharply and unemployment has surged upward. The Fed districts have been more uniformly affected by the crisis, with core inflation rates falling as much as 1½ percentage points and district unemployment rates all moving up by about 2 to 4 percentage points.

Unit labor costs across euro-area countries have been on divergent paths. **Figure 7** displays the relationship between labor productivity and average unemployment rates. For the euro-area countries, there is a distinct negative relationship between the unemployment rate and labor productivity—i.e., those countries with lower labor productivity tended to have higher unemployment rates. Portugal, Greece, and Spain are particular outliers in this regard. For the Federal Reserve districts, however, no such relationship emerges: Unemployment rates appear to be largely independent of labor productivity levels. This discussion points to incomplete labor market integration and limited wage flexibility in the euro area. In an integrated and flexible labor market, differing unemployment rates would trigger adjustments in wages and movements of workers until unemployment rates across regions were broadly equilibrated, as appears to have been the case for the Fed districts over the past decade.⁵

Figure 7. Labor Productivity and Unemployment Rate (1999-2011)



Note: Real labor productivity defined as real output per employed person.

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Eurostat, and Citi Research.

⁵ For a discussion of migration in the euro area, see Michael Saunders, "Shrinking Populations and Workforces in the Periphery," October 9, 2012.

Consistent with this discussion, the euro area has seen a significant divergence in unit labor costs (wages relative to productivity) between Germany and the rest of the euro area. As shown in **Figure 8**, from 1999 to 2007, German unit labor costs were essentially unchanged, while those in other euro-area countries were up in some cases by as much as 25 to 30 percent. In the years since the crisis erupted, this gap has closed a bit, especially against the peripherals, but divergences between Germany and the rest of the euro area remain significant.

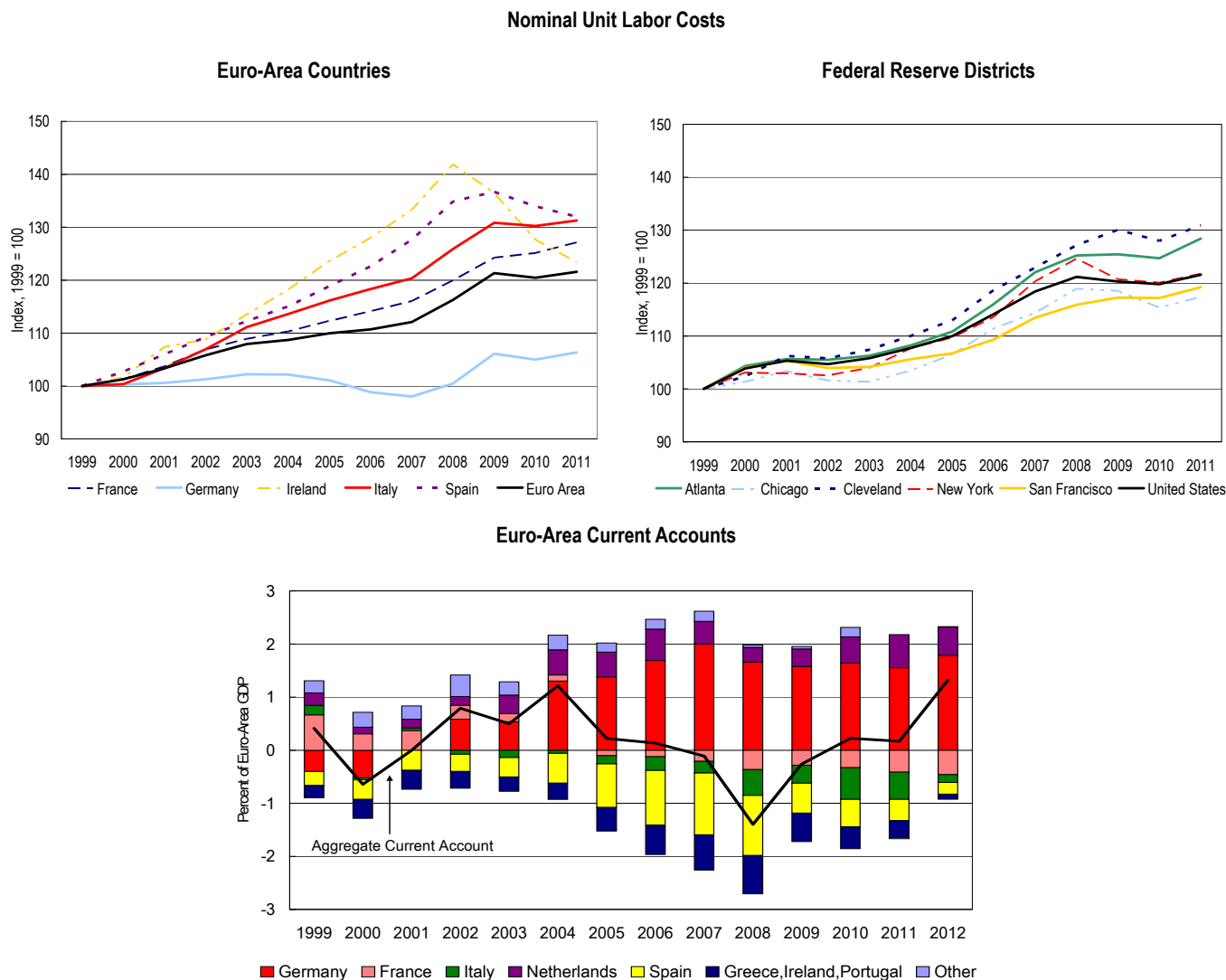
Such competitiveness imbalances are clearly manifest in the behavior of euro-area current account balances (the lower panel). Germany began the period of monetary union with its current account in slight deficit. From 1999 to 2007, the German balance was on an increasing trajectory. With the common currency generally keeping the euro area's aggregate current account about in balance, the counterpart to Germany's rising surplus was mounting deficits in other euro-area countries. Given the peripherals' increasing unit labor costs, these deficits were lodged particularly in those countries. Since 2007, the deficits of the peripherals have narrowed meaningfully, but France's deficit has grown substantially, and the euro area as a whole has shifted into current account surplus.

In our view, the observed divergences in euro-area competitiveness cannot be attributed to the ECB's monetary policy *per se*. Indeed, the fact that the evolution of the euro has successfully kept the euro-area current account in rough balance over this period, at least hints that the ECB has done a reasonably good job of formulating a policy that meets the needs of the euro area on average. But the lack of labor market integration—and the sustained divergences in competitiveness that have emerged—have reinforced structural imbalances and threatened the integrity of the monetary union.

The evolution of unit labor costs across Federal Reserve districts has been more tightly configured. Notably, Cleveland (one of the weakest-growing districts) recorded the sharpest increase in unit labor costs, at a little over 30 percent between 1999 and 2011.⁶ In contrast, Chicago (another region with weak GDP growth) recorded the slowest gains in unit labor costs among the twelve districts, at around 17 percent. On the whole, aggregate unit labor costs for the United States and the euro area both posted nearly identical increases of roughly 22 percent through the 1999 to 2011 period.

⁶ Although nominal wage growth for the Cleveland district was relatively subdued, the district's productivity growth was very soft, averaging just ½ percent annually. Given Cleveland's weak GDP growth, this seems to be an example of wages outstripping productivity—with the upshot being an unfortunate loss in competitiveness.

Figure 8. Determinants of Competitiveness



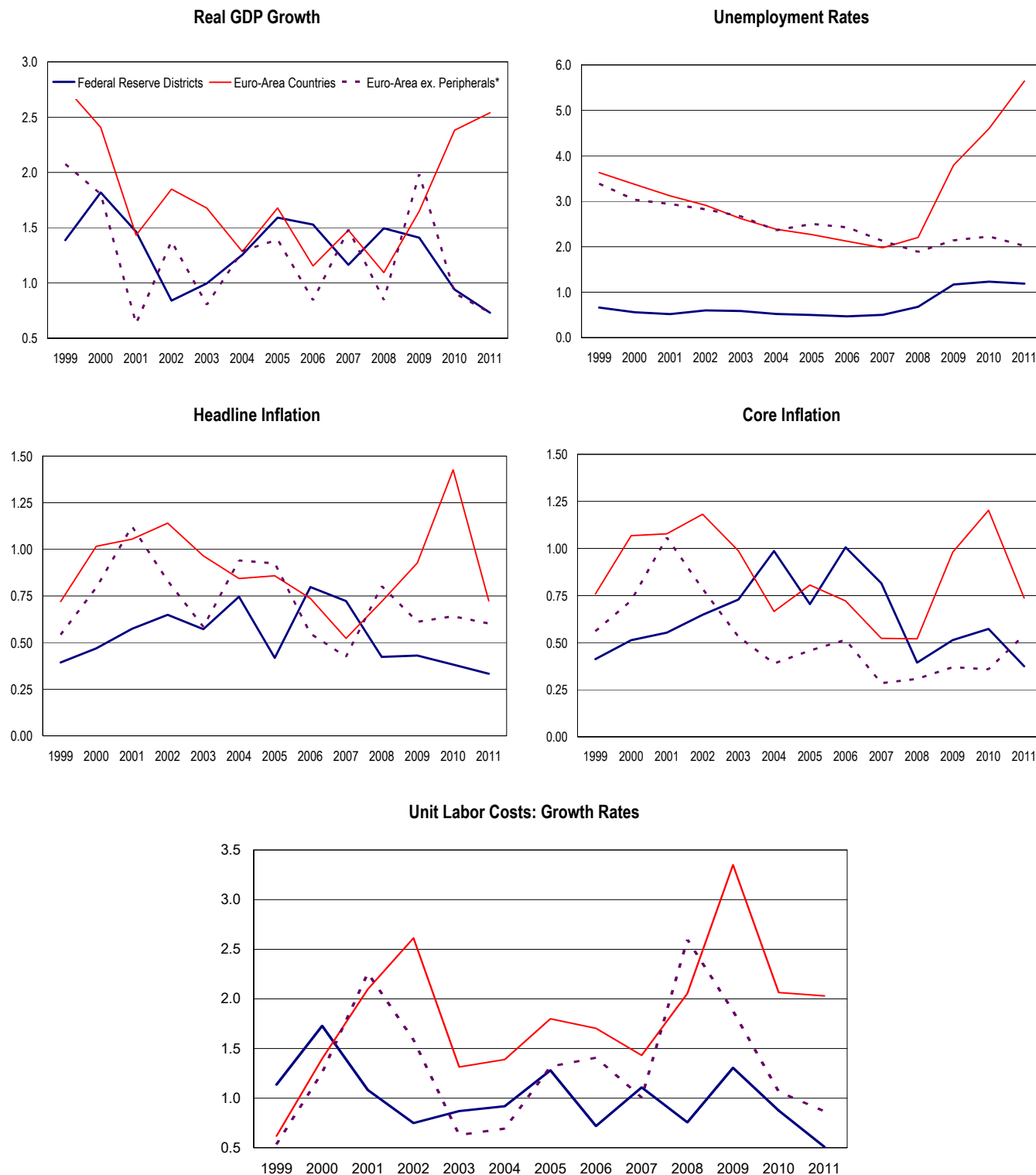
Note: 2012 current account data are OECD estimates.

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Eurostat, OECD, and Citi Research.

In sum, the euro-area has recorded greater dispersion in many (but not all) macro-economic variables. Figure 9 focuses directly on the dispersion of economic variables across euro-area countries and Federal Reserve districts. The underlying point is that in a monetary union composed of regions with highly disparate performance, it will be more difficult to find a monetary stance that consistently meets the needs of the constituent members. Our work yields two important conclusions in this regard. First, the dispersion of most economic variables appears to be somewhat higher for euro-area countries than is the case for Federal Reserve districts. But second, once the five peripherals are excluded, the dispersion of performance on the two continents is quite similar.

The top-left panel shows the cross-sectional dispersion of real GDP growth (calculated as the standard deviation of regional growth rates in any given year), which was broadly comparable in the euro area and the United States in the years before the financial crisis. Once the crisis erupted, euro-area dispersion increased

Figure 9. Dispersion of Macroeconomic Variables



*Excludes Greece, Ireland, Italy, Portugal, and Spain. Note: Dispersion defined as cross-sectional standard deviation of country/district data in each year. Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Eurostat, and Citi Research.

noticeably, but—as highlighted by the dashed line—this reflected divergence in the five peripheral countries (i.e., Greece, Ireland, Portugal, Spain, and Italy). Excluding these countries, the dispersion of euro-area countries was almost identical to that of Federal Reserve districts through the entire period.

The right panel focuses on unemployment. The dispersion of unemployment rates across euro-area countries moderated some from 1999 to 2007, but it remained significantly above that in the United States. Once the financial crisis erupted, the dispersion of unemployment rates in the Federal Reserve districts increased a notch, but dispersion among the euro-area countries rose much more significantly. This upward lurch for the euro area, however, was due entirely to surging unemployment rates in the peripheral countries.

The middle panels show the dispersion of headline and core inflation rates. The dispersion of annual headline inflation was somewhat higher in the euro area than in the United States, except for a brief dip in 2007, before shooting up again during the financial crisis. The performance of core inflation rates, however, was somewhat more similar. And, notably, excluding the peripherals, the dispersion of core inflation in the euro area was actually well *below* that of the Federal Reserve districts. Finally, the bottom panel displays the dispersion of the growth rates of unit labor costs. Consistent with the discussion in the previous section, the growth of unit labor costs showed significantly less dispersion in the Fed districts than in the euro-area.

Implications for the ECB's Monetary Policy?

We now consider whether the differences in economic performance that we have documented imply meaningfully different policy prescriptions across the euro-area countries and Federal Reserve districts. We start with a traditional Taylor rule, which translates inflation performance and the output gap into a desired policy rate. If these countries and districts had instead had independent monetary policies, what would the counterfactual paths of policy rates have looked like?

More specifically, the Taylor rule reflects the following relationship:

$$\text{Policy rate}(t) = i^* + \gamma \cdot (\text{Inflation}(t) - \text{Inflation goal}) + \beta \cdot (\text{Output gap}(t))$$

Thus, the Taylor rule suggests that moves in the policy rate are determined by the performance of inflation relative to the central bank's inflation goal ("the inflation gap") and the evolution of the output gap. If inflation runs above the goal, the central bank tends to tighten policy. And as output falls below potential, pushing the output gap into negative territory, the central bank tends to ease policy. Finally, i^* can be interpreted as the policy rate that prevails when both the output gap and the inflation gap have closed.

Following Taylor, we assume that the coefficient on the inflation gap (γ) equals 1.5. This means that the central bank adjusts its policy rate more than one-for-one with moves in inflation, or equivalently, that the central bank responds to a rise in inflation with an increase in both the nominal and real policy rates. We consider two versions of the Taylor rule: One with the coefficient on the output gap (β) equal to 0.5 and another that is twice as responsive to slack, with β equal to 1.0.⁷ For both

⁷ These rules follow Taylor 1993 and Taylor 1999, respectively. See "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series in Public Policy*, December 1993; and "A Historical Analysis of Monetary Policy Rules," in *Monetary Policy Rules*, University of Chicago Press, 1999.

the euro area and the United States, we set i^* equal to the average policy rate that has prevailed since 1999.⁸

We now calibrate indicative Taylor rules for each of the euro-area countries and Federal Reserve districts. Recognizing that this is an ambitious undertaking, we make several further simplifying assumptions to streamline the analysis:

Inflation Gaps. We focus on core consumer price inflation for each country and district. In the past, we have calculated rules that were driven by headline inflation and found that they implied implausibly large whipsaws in policy rates in recent years, given the wide swings in oil and other commodity prices that have occurred. We also assume that the inflation goal in each country and district is set at 2 percent. The upper-left panel of **Figure 10** reports the resulting inflation gaps. Consistent with our work above, the Federal Reserve districts all had average inflation in the neighborhood of 2 percent, while the performance of the euro-area countries has been more varied, with some countries recording average inflation rates much higher or much lower than 2 percent.

Output Gaps. The output gaps for the euro-area countries come from the OECD. For the Fed districts, we de-trend regional GDP data using the Hodrick-Prescott filter, as described in the Data Appendix. The resulting output gaps, when aggregated across Federal Reserve districts, produce an output gap series for the U.S. economy as a whole that also closely matches the series published by the OECD.

The upper-right panel of **Figure 10** shows the distribution of output gaps across euro-area countries and Federal Reserve districts. Our estimated gaps for the Fed districts are centered around zero, with their averages falling into a range a $\frac{1}{2}$ percentage point above and below zero. The OECD gaps for the euro-area countries indicate that output was a bit above potential on average over this period, with eight countries recording an average output gap in the range of $\frac{1}{2}$ to 1 percent and only one country (notably Germany) in which output was below potential on average.⁹

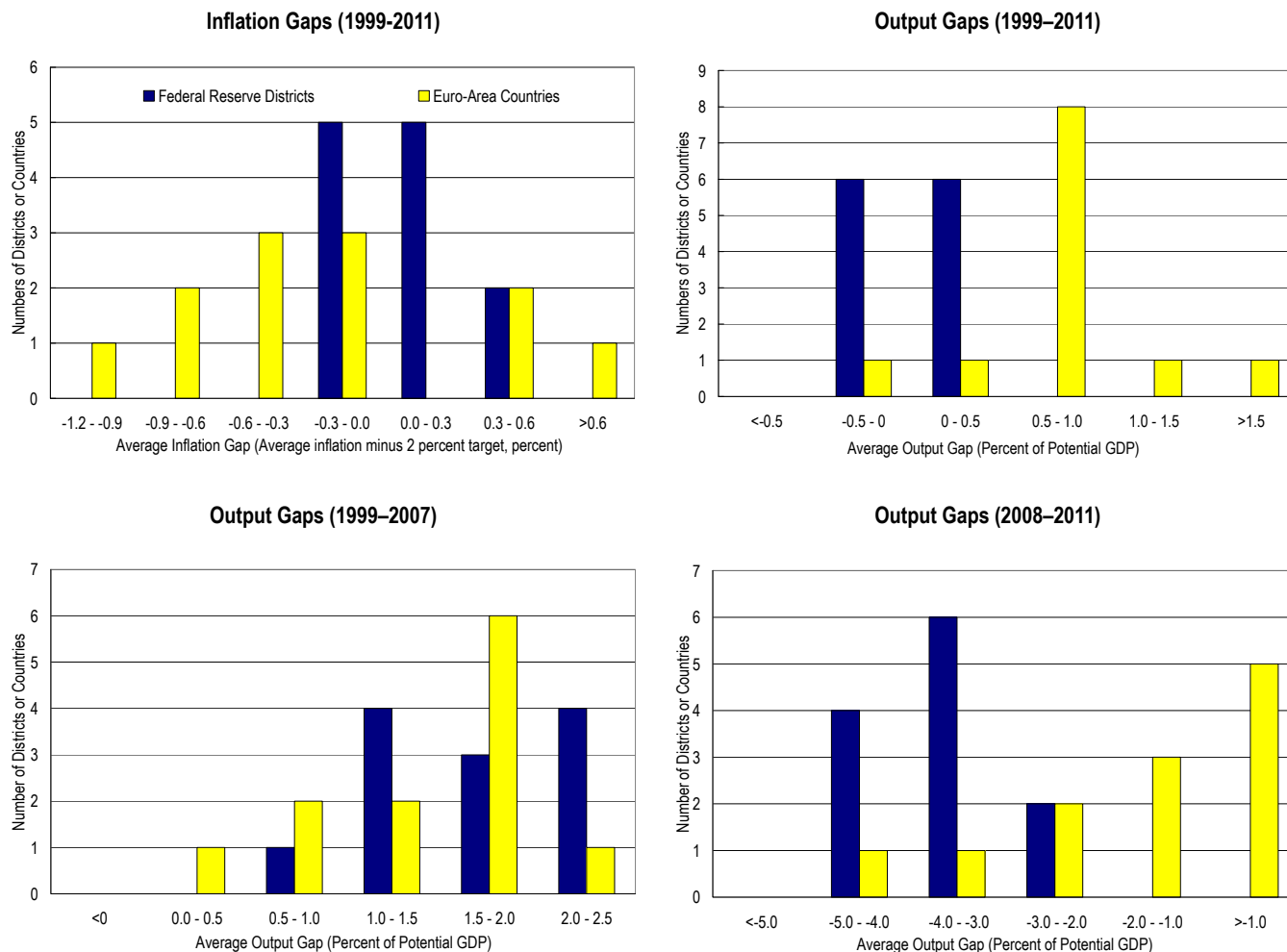
As shown in the lower-left panel, our estimated output gaps suggest that the Fed districts and the euro-area countries were both running above potential on average during the years before the financial crisis. Output gaps swung negative through the 2008-11 period, but the gaps for the Federal Reserve districts were somewhat larger on average than those for the euro-area countries.¹⁰

⁸ Our formulation of the Taylor rule is outlined in more detail in a previous essay, [“Escaping the Zero Lower Bound — Are Bulging Central Bank Balance Sheets a Good Substitute for Rate Cuts?”](#) April 23, 2012.

⁹ Notably, this is not a feature unique to the OECD’s output gaps. Output gaps from Eurostat/European Commission (EC) are broadly similar, with GDP above potential on average in nine of the twelve countries.

¹⁰ This result is broadly consistent with the fact that when the crisis erupted the unemployment rate in the United States spiked upward more rapidly than in the euro area, which in turn suggests that there was more slack in U.S. labor markets on average during this period as well.

Figure 10.

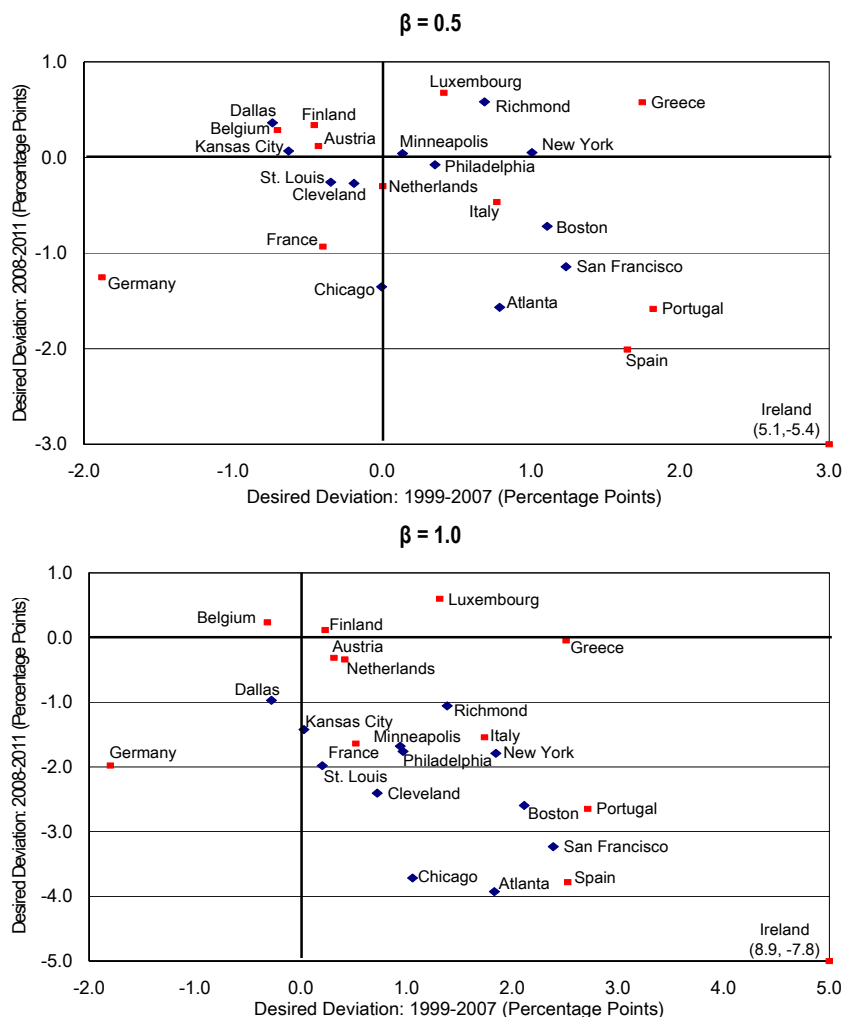


Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Eurostat, OECD, and Citi Research.

Results from the Taylor rules. With this background, **Figure 11** reports the results of our Taylor rule exercise. Specifically, the chart shows for each district the average deviation between the Taylor rule prescription for the policy rate and the rate that has actually prevailed. Notably, in constructing these estimates, we have not attempted to account for the effects of unconventional monetary policy tools.¹¹ As such, these reported deviations can be interpreted as the additional stimulus that these countries and districts desired relative to actual moves in the policy rate; this additional stimulus could have been delivered either through further rate cuts or through unconventional policies. An important related issue, however, is that the *transmission* of monetary policy has also varied significantly across the euro area countries in recent years. The ECB's OMT program is designed to address this issue; but there are still wide gaps between bank lending rates in the periphery versus Germany.

¹¹ We are mainly interested in the *relative* performance of euro-area countries versus other euro-area countries and Federal Reserve districts versus other Federal Reserve districts. Incorporating balance sheet policies into the analysis would not influence this relative performance, at least assuming that such policies have not had significantly divergent effects across regions (an issue that is well beyond the scope of our current essay).

Figure 11. Taylor Rules: Average Desired Deviations from Actual Policy*



*The "average desired deviation" is the difference between the average Taylor rule solution for a given period (1999-2007 or 2008-2011) and the average actual policy rate that prevailed during that period.

Note: β is the coefficient on the output gap.

Source: Citi Research.

Notably, for both values of β , the Taylor rules clearly indicate that before the financial crisis, Ireland, Portugal, Spain, and Greece all would have benefited from substantially tighter policy, while the Taylor rule prescribes a policy rate for Germany that is nearly 200 basis points easier than the ECB's actual stance. Still focusing on the years before the financial crisis, we find that the results for the Fed districts are distributed comparatively tightly—none of the districts desired as much additional restraint as Ireland, Portugal, Spain, and Greece and none desired as much additional easing as Germany. That said, we do observe an importance divergence between the coastal districts such as San Francisco, Boston, New York, and Atlanta (which includes Florida)—where real estate booms were the most powerful—and some of the interior districts such as Dallas, Kansas City, and St. Louis.

A broader point is that for both the Federal Reserve and the ECB, the Taylor rule with $\beta=0.5$ seems to better fit the pattern of policy in the years before the financial crisis. Specifically, with this lower value of β , the countries and districts are split about evenly between those desiring tighter policy and those desiring easier policy.

By this metric, monetary policy in the years before the financial crisis seems to have been about right on average in both economies. However, in the case with $\beta=1$, only Germany, Belgium, and Dallas desired easier policy. Significantly, these results suggest that before the crisis both the Fed and the ECB were gearing policy more or less in line with a Taylor rule in which $\beta=0.5$.

Turning now to the 2008-2011 period, we find that among the euro-area countries Ireland, Portugal, and Spain continued to be outliers for both values of β , desiring much easier policy than other euro-area countries. The three largest countries—Germany, France, and Italy—also would have preferred somewhat more stimulative policy. The Taylor rules indicate, however, that policy was about right or even a little too easy for a sizable group of countries including Belgium, Finland, Austria, Luxembourg, and the Netherlands. Surprisingly, using these OECD output gaps, Greece also falls into the group of countries for which policy has been about right. Notably, however, results obtained using Eurostat/EC output gaps indicate (more plausibly in our view) that Greece would have indeed benefited from more stimulative monetary policy.¹²

For the Federal Reserve districts, the results for the 2008-2011 period point to some divergence between San Francisco, Boston, Atlanta, and Chicago—which all desired much more stimulus—and the eight other districts. When $\beta=0.5$, the other districts saw the gearing of the policy rate as being about right. For $\beta=1$, the Taylor rule indicates that these other districts would have generally desired another 100 to 200 basis points of easing, consistent with the view that the zero-lower bound on the fed funds rate was a significant constraint on Federal Reserve policy.

A related observation is that the Taylor rule with the larger value of β provides much stronger rationale for the aggressive balance sheet policies that the Fed has pursued in recent years. These results thus suggest that in the years since the financial crisis erupted, the Federal Reserve has tended to think about monetary policy more in terms of a Taylor rule that puts greater emphasis on economic slack. This strikes us as a shift relative to the years before the financial crisis. That said, we see much less evidence of a similar shift by the ECB.

Figure 12 reports the dispersion of desired policy rates across euro-area countries and Fed districts. Broadly consistent with our work above, we see more dispersion in the euro area than in the United States if all twelve euro-area countries are included, but somewhat less dispersion than in the United States when the five peripheral countries are excluded. Significantly, adding Italy to the core countries does not appreciably increase the observed dispersion.

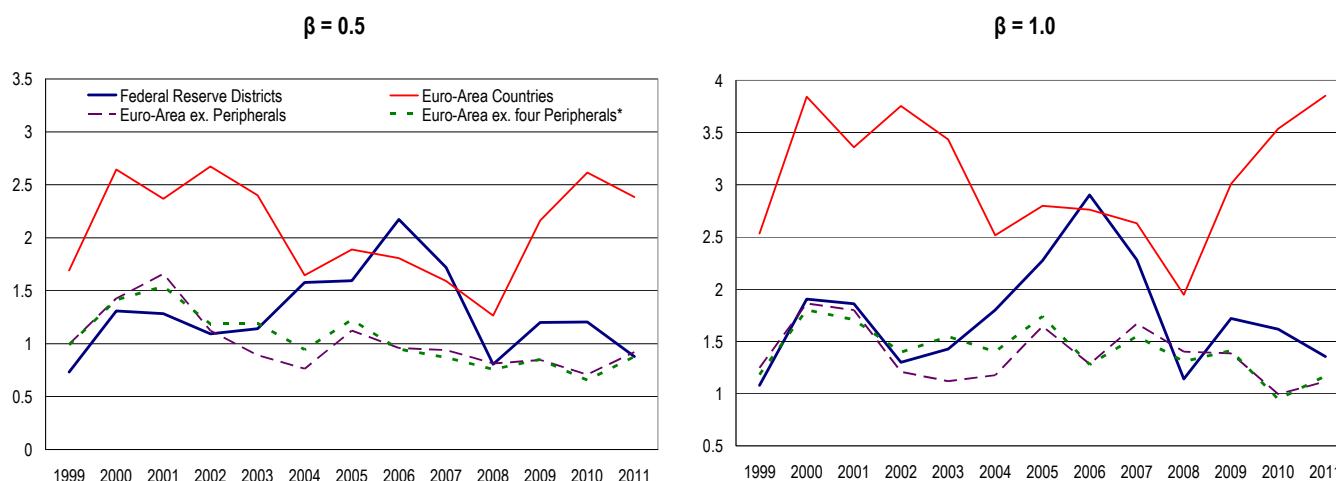
We also find that dispersion among the Federal Reserve districts moved up meaningfully between 2003 and 2006. Surging real estate markets in key districts—particularly San Francisco and Atlanta (which includes Florida)—caused desired policy rates for such districts to rise. Conversely, performance in some of the interior districts was much softer. These interior districts were also recording housing price gains, but typically not to the same extent as on the coasts.

The notable insight is that Fed policy through the period of rising house prices was probably about right for the country on average. However, our work suggests that if the twelve districts had each had their own central banks, some divergence in policy

¹² The results for Greece using the OECD gaps reflect two factors. First, the OECD estimates that Greek GDP was well above potential in the years before the financial crisis. Thus, even with the sharp drop in activity that has subsequently occurred, the output gap through the 2008-11 period *on average* was not particularly wide. Second, as noted above, Greece has significantly increased its VAT as part of its economic adjustment programs, and this has kept inflation above 2 percent despite the plunge in its economic activity.

rates would likely have opened up in response to the differing strength of the housing boom across districts. And these differing responses might very well have tempered the extent of house price increases in some of the more exuberant regions. As such, the Federal Reserve System also is not immune from challenges associated with regional divergences.

Figure 12. Taylor Rules: Dispersion of Desired Policy Rates



*Excludes Greece, Ireland, Portugal, and Spain. Note: β is the coefficient on the output gap.
Source: Citi Research.

Some Concluding Thoughts

In this essay, we have documented some significant divergences within the euro area. The most striking gaps in performance have been between Germany on the one hand and Spain, Ireland, Portugal, and Greece on the other hand. This differing performance was vividly apparent in the years before the financial crisis. Germany recorded exceptionally low inflation and soft growth, while these other countries were struggling with much higher inflation rates and, in some instances, were showing signs of overheating. Divergences in unemployment rates and unit labor costs, reflecting persistent labor-market rigidities within the euro area, were conspicuous and seem to have been a key underlying driver of the observed differences in macroeconomic outcomes.

An important point, however, is that while Italian performance has also differed from that of Germany, these differences have not typically been as stark as with the other peripherals. Indeed, our Taylor rule exercise suggests that ECB policy has not been too far off the mark for Italy.

More generally, we uncover little evidence that the gearing of ECB policy has been inappropriate for the euro area on average. On the contrary, monetary policy seems to have balanced the competing needs of the member countries quite well and, in addition, has delivered a level of the euro that has maintained the euro area's aggregate current account position reasonably close to balance.

Rather, the key question is whether a common monetary policy can effectively meet the needs of such a diverse group of countries? This question is of crucial importance. If the answer is no, the euro-area—as now configured—may be doomed to have an ongoing series of disruptions similar to those that have occurred over the past several years. The key contours of our analysis are not entirely

comforting on this score. The dispersion of economic performance and desired policy rates for the twelve euro-area countries does by our reckoning significantly exceed that of the Federal Reserve districts. In contrast, measures of dispersion for a core group of euro-area countries, which excludes the peripherals, are broadly similar to those for the Federal Reserve districts.

But how much regional heterogeneity is simply too much? This is a rich topic that merits further analysis. But here we put forward just a few thoughts. Our work suggests that even with a relatively integrated labor market and national economy, regional divergences may have plagued U.S. monetary policy through the housing boom that occurred in the middle of the past decade. We hypothesize that an independent monetary policy may very well have been tighter in some of the districts where the run-up in house prices proved most unsustainable. More recently, regional divergences may be reflecting themselves in the dissenting votes of Reserve Bank Presidents from relatively strong performing districts. If such issues continue to be a challenge for the United States, the road ahead for the euro-area may prove uncomfortably rocky.

But two more hopeful thoughts are also relevant. First, with monetary and currency union likely to support deepening convergence and integration, economic and financial performance across the euro-area countries is likely to become more similar in the years ahead. This, in fact, is an important point that merits emphasis, but it should also be recognized that such convergence is likely to be gradual and require many years, if not decades. Second, our work also highlights that in order for monetary union to be successful, given the absence of political and fiscal union, it must be complemented with other policies that discipline divergences in regional performance. Although the Stability and Growth Pact failed to achieve this objective, we are hopeful that the structural reforms that are now being put in place, including the Fiscal Compact and efforts to integrate financial oversight and resolution, will prove more effective and reduce the burdens on the ECB.

Finally, we note that our analysis has focused on the twelve countries that have been members of the euro area through the entirety of the past decade. Presumably the heterogeneity that we have documented would be even more acute if the five countries that have subsequently joined the euro area were also considered. This no doubt is the case, but these countries are small, together accounting for just 2 percent of euro-area GDP. Beyond possibly complicating ECB governance, the presence of such countries in the monetary union strikes us as unlikely to meaningfully exacerbate the broad vulnerabilities that we have documented. But, at a minimum, our work represents a warning regarding the risks of further expanding the monetary union, especially to include additional large heterogeneous economies.

Data Appendix

The data for the euro-area countries are drawn from Eurostat, the OECD, and other standard data sources. However, one important innovation in our work is the construction of a broadly comparable dataset for the twelve Federal Reserve districts. The following are a few comments on how we have gone about constructing these regional U.S. data:

District GDP data. In constructing the district GDP series, we drew on state-level GDP data produced by the BEA. These data are available in real terms at an annual frequency starting in 1977, and available in nominal terms back to 1963. In those instances in which a state is split between two Federal Reserve districts, we divided the state's GDP between the two districts using county-level income data as weights. (Importantly, Federal Reserve districts do not cross county lines.)

Labor market data. Labor market data are constructed in a broadly parallel fashion, drawing on state-level data published by the BLS and dividing states where necessary using county-level income data. Wage data reflect annual compensation per person (including both salary and benefits), and our measure of the labor force includes people 16 years of age and older. We calculate unit labor costs as the ratio between nominal wages and real productivity (regional real GDP relative to regional employment).

Potential GDP and output gaps. We calculate regional potential GDP by de-trending actual GDP using the Hodrick-Prescott filter (with a smoothing coefficient of 400). The resulting series for aggregate U.S. potential GDP suggests growth rates that are broadly consistent with the OECD's measure of potential growth for the United States. Consistent with this observation, we used the OECD's estimates of potential growth for the euro-area to achieve as much compatibility as possible with our output gaps for the Federal Reserve districts.

Consumer prices. Headline and core CPI data are published by the BLS for twenty-seven Metropolitan Statistical Areas (MSAs). As with the GDP and labor market data, we map these MSAs into Federal Reserve Districts, dividing MSAs using county-level income data, in those instance when MSAs are split between Federal Reserve Districts.

Empirical & Thematic Perspectives—Previous Essays

	Publication Date
<u>Does Size Really Matter?: The Evolving Role of Small Firms in the U.S. Economy</u>	10 December 2012
<u>Dissecting the Disappointing U.S. Recovery — A Comparison to Previous Cycles</u>	19 October 2012
<u>Stall Speeds and Spillovers: Some New Evidence for the Global Economy</u>	6 September 2012
<u>Assessing Japan's Long-term Economic Performance — Implications for the United States and the Euro Area</u>	9 August 2012
<u>Is the United States Following in Japan's Footsteps?</u>	26 June 2012
<u>Fiscal Deleveraging, Financial Repression, and Central Bank Independence — Lessons from the U.S. Experience after World War II</u>	14 May 2012
<u>Escaping the Zero Lower Bound — Are Bulging Central Bank Balance Sheets a Good Substitute for Rate Cuts?</u>	23 April 2012
<u>Prospects for Central Bank Balance Sheets (March 2012 GEOS)</u>	21 March 2012
<u>How Much is This Going to Hurt? — New Evidence on Global Adjustment to Oil Shocks</u>	13 March 2012
<u>The Outlook for Global Imbalances</u>	17 February 2012
<u>Germany's "Windfall" from Euro-Area Membership and European Imbalances</u>	27 January 2012
<u>Alexander Hamilton and Germany's "Windfall" from Euro-Area Membership</u>	17 January 2012
<u>U.S. Household Saving and Deleveraging — What's Next?</u>	20 December 2011

Notes

Notes

Appendix A-1

Analyst Certification

The research analyst(s) primarily responsible for the preparation and content of this research report are named in bold text in the author block at the front of the product except for those sections where an analyst's name appears in bold alongside content which is attributable to that analyst. Each of these analyst(s) certify, with respect to the section(s) of the report for which they are responsible, that the views expressed therein accurately reflect their personal views about each issuer and security referenced and were prepared in an independent manner, including with respect to Citigroup Global Markets Inc and its affiliates. No part of the research analyst's compensation was, is, or will be, directly or indirectly, related to the specific recommendation(s) or view(s) expressed by that research analyst in this report.

IMPORTANT DISCLOSURES

Analysts' compensation is determined based upon activities and services intended to benefit the investor clients of Citigroup Global Markets Inc. and its affiliates ("the Firm"). Like all Firm employees, analysts receive compensation that is impacted by overall firm profitability which includes investment banking revenues.

For important disclosures (including copies of historical disclosures) regarding the companies that are the subject of this Citi Research product ("the Product"), please contact Citi Research, 388 Greenwich Street, 28th Floor, New York, NY, 10013, Attention: Legal/Compliance [E6WYB6412478]. In addition, the same important disclosures, with the exception of the Valuation and Risk assessments and historical disclosures, are contained on the Firm's disclosure website at https://www.citivelocity.com/cvr/eppublic/citi_research_disclosures. Valuation and Risk assessments can be found in the text of the most recent research note/report regarding the subject company. Historical disclosures (for up to the past three years) will be provided upon request.

NON-US RESEARCH ANALYST DISCLOSURES

Non-US research analysts who have prepared this report (i.e., all research analysts listed below other than those identified as employed by Citigroup Global Markets Inc.) are not registered/qualified as research analysts with FINRA. Such research analysts may not be associated persons of the member organization and therefore may not be subject to the NYSE Rule 472 and NASD Rule 2711 restrictions on communications with a subject company, public appearances and trading securities held by a research analyst account. The legal entities employing the authors of this report are listed below:

Citigroup Global Markets Inc

Nathan Sheets; Robert A Sockin

OTHER DISCLOSURES

For securities recommended in the Product in which the Firm is not a market maker, the Firm is a liquidity provider in the issuers' financial instruments and may act as principal in connection with such transactions. The Firm is a regular issuer of traded financial instruments linked to securities that may have been recommended in the Product. The Firm regularly trades in the securities of the issuer(s) discussed in the Product. The Firm may engage in securities transactions in a manner inconsistent with the Product and, with respect to securities covered by the Product, will buy or sell from customers on a principal basis.

Securities recommended, offered, or sold by the Firm: (i) are not insured by the Federal Deposit Insurance Corporation; (ii) are not deposits or other obligations of any insured depository institution (including Citibank); and (iii) are subject to investment risks, including the possible loss of the principal amount invested. Although information has been obtained from and is based upon sources that the Firm believes to be reliable, we do not guarantee its accuracy and it may be incomplete and condensed. Note, however, that the Firm has taken all reasonable steps to determine the accuracy and completeness of the disclosures made in the Important Disclosures section of the Product. The Firm's research department has received assistance from the subject company(ies) referred to in this Product including, but not limited to, discussions with management of the subject company(ies). Firm policy prohibits research analysts from sending draft research to subject companies. However, it should be presumed that the author of the Product has had discussions with the subject company to ensure factual accuracy prior to publication. All opinions, projections and estimates constitute the judgment of the author as of the date of the Product and these, plus any other information contained in the Product, are subject to change without notice. Prices and availability of financial instruments also are subject to change without notice. Notwithstanding other departments within the Firm advising the companies discussed in this Product, information obtained in such role is not used in the preparation of the Product. Although Citi Research does not set a predetermined frequency for publication, if the Product is a fundamental research report, it is the intention of Citi Research to provide research coverage of the/those issuer(s) mentioned therein, including in response to news affecting this issuer, subject to applicable quiet periods and capacity constraints. The Product is for informational purposes only and is not intended as an offer or solicitation for the purchase or sale of a security. Any decision to purchase securities mentioned in the Product must take into account existing public information on such security or any registered prospectus.

Investing in non-U.S. securities, including ADRs, may entail certain risks. The securities of non-U.S. issuers may not be registered with, nor be subject to the reporting requirements of the U.S. Securities and Exchange Commission. There may be limited information available on foreign securities. Foreign companies are generally not subject to uniform audit and reporting standards, practices and requirements comparable to those in the U.S. Securities of some foreign companies may be less liquid and their prices more volatile than securities of comparable U.S. companies. In addition, exchange rate movements may have an adverse effect on the value of an investment in a foreign stock and its corresponding dividend payment for U.S. investors. Net dividends to ADR investors are estimated, using withholding tax rates conventions, deemed accurate, but investors are urged to consult their tax advisor for exact dividend computations. Investors who have received the Product from the Firm may be prohibited in certain states or other jurisdictions from purchasing securities mentioned in the Product from the Firm. Please ask your Financial Consultant for additional details. Citigroup Global Markets Inc. takes responsibility for the Product in the United States. Any orders by US investors resulting from the information contained in the Product may be placed only through Citigroup Global Markets Inc.

Important Disclosures for Morgan Stanley Smith Barney LLC Customers: Morgan Stanley & Co. LLC (Morgan Stanley) research reports may be available about the companies that are the subject of this Citi Research research report. Ask your Financial Advisor or use smithbarney.com to view any available Morgan Stanley research reports in addition to Citi Research research reports.

Important disclosure regarding the relationship between the companies that are the subject of this Citi Research research report and Morgan Stanley Smith Barney LLC and its affiliates are available at the Morgan Stanley Smith Barney disclosure website at www.morganstanleysmithbarney.com/researchdisclosures.

For Morgan Stanley and Citigroup Global Markets, Inc. specific disclosures, you may refer to www.morganstanley.com/researchdisclosures and https://www.citivelocity.com/cvr/eppublic/citi_research_disclosures.

This Citi Research research report has been reviewed and approved on behalf of Morgan Stanley Smith Barney LLC. This review and approval was conducted by the same person who reviewed this research report on behalf of Citi Research. This could create a conflict of interest.

The Citigroup legal entity that takes responsibility for the production of the Product is the legal entity which the first named author is employed by.

The Product is made available in **Australia** through Citi Global Markets Australia Pty Ltd. (ABN 64 003 114 832 and AFSL No. 240992), participant of the ASX Group and regulated by the Australian Securities & Investments Commission. Citigroup Centre, 2 Park Street, Sydney, NSW 2000. The Product is made available in Australia to Private Banking wholesale clients through Citigroup Pty Limited (ABN 88 004 325 080 and AFSL 238098). Citigroup Pty Limited provides all financial product advice to Australian Private Banking wholesale clients through bankers and relationship managers. If there is any doubt about the suitability of investments held in Citigroup Private Bank accounts, investors should contact the Citigroup Private Bank in Australia. Citigroup companies may compensate affiliates and their representatives for providing products and services to clients. The Product is made available in **Brazil** by Citigroup Global Markets Brasil - CCTVM SA, which is regulated by CVM - Comissão de Valores Mobiliários, BACEN - Brazilian Central Bank, APIMEC - Associação dos Analistas e Profissionais de Investimento do Mercado de Capitais and ANBID - Associação Nacional dos Bancos de Investimento. Av. Paulista, 1111 - 11º andar - CEP. 01311920 - São Paulo - SP. If the Product is being made available in certain provinces of **Canada** by Citigroup Global Markets (Canada) Inc. ("CGM Canada"), CGM Canada has approved the Product. Citigroup Place, 123 Front Street West, Suite 1100, Toronto, Ontario M5J 2M3. This product is available in **Chile** through Banchile Corredores de Bolsa S.A., an indirect subsidiary of Citigroup Inc., which is regulated by the Superintendencia de Valores y Seguros. Agustinas 975, piso 2, Santiago, Chile. The Product is made available in **France** by Citigroup Global Markets Limited, which is authorised and regulated by Financial Services Authority. 1-5 Rue Paul Cézanne, 8ème, Paris, France. The Product is distributed in **Germany** by Citigroup Global Markets Deutschland AG ("CGMD"), which is regulated by Bundesanstalt fuer Finanzdienstleistungsaufsicht (BaFin). CGMD, Reuterweg 16, 60323 Frankfurt am Main. Research which relates to "securities" (as defined in the Securities and Futures Ordinance (Cap. 571 of the Laws of Hong Kong)) is issued in **Hong Kong** by, or on behalf of, Citigroup Global Markets Asia Limited which takes full responsibility for its content. Citigroup Global Markets Asia Ltd. is regulated by Hong Kong Securities and Futures Commission. If the Research is made available through Citibank, N.A., Hong Kong Branch, for its clients in Citi Private Bank, it is made available by Citibank N.A., Citibank Tower, Citibank Plaza, 3 Garden Road, Hong Kong. Citibank N.A. is regulated by the Hong Kong Monetary Authority. Please contact your Private Banker in Citibank N.A., Hong Kong, Branch if you have any queries on or any matters arising from or in connection with this document. The Product is made available in **India** by Citigroup Global Markets India Private Limited, which is regulated by Securities and Exchange Board of India. Bakhtawar, Nariman Point, Mumbai 400-021. The Product is made available in **Indonesia** through PT Citigroup Securities Indonesia. 5/F, Citibank Tower, Bapindo Plaza, Jl. Jend. Sudirman Kav. 54-55, Jakarta 12190. Neither this Product nor any copy hereof may be distributed in Indonesia or to any Indonesian citizens wherever they are domiciled or to Indonesian residents except in compliance with applicable capital market laws and regulations. This Product is not an offer of securities in Indonesia. The securities referred to in this Product have not been registered with the Capital Market and Financial Institutions Supervisory Agency (BAPEPAM-LK) pursuant to relevant capital market laws and regulations, and may not be offered or sold within the territory of the Republic of Indonesia or to Indonesian citizens through a public offering or in circumstances which constitute an offer within the meaning of the Indonesian capital market laws and regulations. The Product is made available in **Israel** through Citibank NA, regulated by the Bank of Israel and the Israeli Securities Authority. Citibank, N.A. Platinum Building, 21 Ha'arba'ah St, Tel Aviv, Israel. The Product is made available in **Italy** by Citigroup Global Markets Limited, which is authorised and regulated by Financial Services Authority. Via dei Mercanti, 12, Milan, 20121, Italy. The Product is made available in **Japan** by Citigroup Global Markets Japan Inc. ("CGMJ"), which is regulated by Financial Services Agency, Securities and Exchange Surveillance Commission, Japan Securities Dealers Association, Tokyo Stock Exchange and Osaka Securities Exchange. Shin-Marunouchi Building, 1-5-1 Marunouchi, Chiyoda-ku, Tokyo 100-6520 Japan. If the Product was distributed by SMBC Nikko Securities Inc. it is being so distributed under license. In the event that an error is found in an CGMJ research report, a revised version will be posted on the Firm's Citi Velocity website. If you have questions regarding Citi Velocity, please call (81 3) 6270-3019 for help. The Product is made available in **Korea** by Citigroup Global Markets Korea Securities Ltd., which is regulated by the Financial Services Commission, the Financial Supervisory Service and the Korea Financial Investment Association (KOFIA). Citibank Building, 39 Da-dong, Jung-gu, Seoul 100-180, Korea. KOFIA makes available registration information of research analysts on its website. Please visit the following website if you wish to find KOFIA registration information on research analysts of Citigroup Global Markets Korea Securities Ltd. <http://dis.kofia.or.kr/fs/dis2/fundMgr/DISFundMgrAnalystPop.jsp?companyCd=A03030&pageDiv=02>. The Product is made available in Korea by Citibank Korea Inc., which is regulated by the Financial Services Commission and the Financial Supervisory Service. Address is Citibank Building, 39 Da-dong, Jung-gu, Seoul 100-180, Korea. The Product is made available in **Malaysia** by Citigroup Global Markets Malaysia Sdn Bhd (Company No. 460819-D) ("CGMM") to its clients and CGMM takes responsibility for its contents. CGMM is regulated by the Securities Commission of Malaysia. Please contact CGMM at Level 43 Menara Citibank, 165 Jalan Ampang, 50450 Kuala Lumpur, Malaysia in respect of any matters arising from, or in connection with, the Product. The Product is made available in **Mexico** by Acciones y Valores Banamex, S.A. De C. V., Casa de Bolsa, Integrante del Grupo Financiero Banamex ("Accival") which is a wholly owned subsidiary of Citigroup Inc. and is regulated by Comisión Nacional Bancaria y de Valores. Reforma 398, Col. Juárez, 06600 Mexico, D.F. In **New Zealand** the Product is made available to 'wholesale clients' only as defined by s5C(1) of the Financial Advisers Act 2008 ("FAA") through Citigroup Global Markets Australia Pty Ltd (ABN 64 003 114 832 and AFSL No. 240992), an overseas financial adviser as defined by the FAA, participant of the ASX Group and regulated by the Australian Securities & Investments Commission. Citigroup Centre, 2 Park Street, Sydney, NSW 2000. The Product is made available in **Pakistan** by Citibank N.A. Pakistan branch, which is regulated by the State Bank of Pakistan and Securities Exchange Commission, Pakistan. AWT Plaza, 1.1. Chundrigar Road, P.O. Box 4889, Karachi-74200. The Product is made available in the **Philippines** through Citicorp Financial Services and Insurance Brokerage Philippines, Inc., which is regulated by the Philippines Securities and Exchange Commission. 20th Floor Citibank Square Bldg. The Product is made available in the Philippines through Citibank NA Philippines branch, Citibank Tower, 8741 Paseo De Roxas, Makati City, Manila. Citibank NA Philippines NA is regulated by The Bangko Sentral ng Pilipinas. The Product is made available in **Poland** by Dom Maklerski Banku Handlowego SA an indirect subsidiary of Citigroup Inc., which is regulated by Komisja Nadzoru Finansowego. Dom Maklerski Banku Handlowego S.A. ul.Senatorska 16, 00-923 Warszawa. The Product is made available in the **Russian Federation** through ZAO Citibank, which is licensed to carry out banking activities in the Russian Federation in accordance with the general banking license issued by the Central Bank of the Russian Federation and brokerage activities in accordance with the license issued by the Federal Service for Financial Markets. Neither the Product nor any

information contained in the Product shall be considered as advertising the securities mentioned in this report within the territory of the Russian Federation or outside the Russian Federation. The Product does not constitute an appraisal within the meaning of the Federal Law of the Russian Federation of 29 July 1998 No. 135-FZ (as amended) On Appraisal Activities in the Russian Federation. 8-10 Gasheka Street, 125047 Moscow. The Product is made available in **Singapore** through Citigroup Global Markets Singapore Pte. Ltd. ("CGMSPL"), a capital markets services license holder, and regulated by Monetary Authority of Singapore. Please contact CGMSPL at 8 Marina View, 21st Floor Asia Square Tower 1, Singapore 018960, in respect of any matters arising from, or in connection with, the analysis of this document. This report is intended for recipients who are accredited, expert and institutional investors as defined under the Securities and Futures Act (Cap. 289). The Product is made available by The Citigroup Private Bank in Singapore through Citibank, N.A., Singapore Branch, a licensed bank in Singapore that is regulated by Monetary Authority of Singapore. Please contact your Private Banker in Citibank N.A., Singapore Branch if you have any queries on or any matters arising from or in connection with this document. This report is intended for recipients who are accredited, expert and institutional investors as defined under the Securities and Futures Act (Cap. 289). This report is distributed in Singapore by Citibank Singapore Ltd ("CSL") to selected Citigold/Citigold Private Clients. CSL provides no independent research or analysis of the substance or in preparation of this report. Please contact your Citigold/Citigold Private Client Relationship Manager in CSL if you have any queries on or any matters arising from or in connection with this report. This report is intended for recipients who are accredited investors as defined under the Securities and Futures Act (Cap. 289). Citigroup Global Markets (Pty) Ltd. is incorporated in the **Republic of South Africa** (company registration number 2000/025866/07) and its registered office is at 145 West Street, Sandton, 2196, Saxonwold. Citigroup Global Markets (Pty) Ltd. is regulated by JSE Securities Exchange South Africa, South African Reserve Bank and the Financial Services Board. The investments and services contained herein are not available to private customers in South Africa. The Product is made available in **Spain** by Citigroup Global Markets Limited, which is authorised and regulated by Financial Services Authority. 29 Jose Ortega Y Gasset, 4th Floor, Madrid, 28006, Spain. The Product is made available in the **Republic of China** through Citigroup Global Markets Taiwan Securities Company Ltd. ("CGMTS"), 14 and 15F, No. 1, Songzhi Road, Taipei 110, Taiwan and/or through Citibank Securities (Taiwan) Company Limited ("CSTL"), 14 and 15F, No. 1, Songzhi Road, Taipei 110, Taiwan, subject to the respective license scope of each entity and the applicable laws and regulations in the Republic of China. CGMTS and CSTL are both regulated by the Securities and Futures Bureau of the Financial Supervisory Commission of Taiwan, the Republic of China. No portion of the Product may be reproduced or quoted in the Republic of China by the press or any third parties [without the written authorization of CGMTS and CSTL]. If the Product covers securities which are not allowed to be offered or traded in the Republic of China, neither the Product nor any information contained in the Product shall be considered as advertising the securities or making recommendation of the securities in the Republic of China. The Product is for informational purposes only and is not intended as an offer or solicitation for the purchase or sale of a security or financial products. Any decision to purchase securities or financial products mentioned in the Product must take into account existing public information on such security or the financial products or any registered prospectus. The Product is made available in **Thailand** through Citicorp Securities (Thailand) Ltd., which is regulated by the Securities and Exchange Commission of Thailand. 18/F, 22/F and 29/F, 82 North Sathorn Road, Silom, Bangrak, Bangkok 10500, Thailand. The Product is made available in **Turkey** through Citibank AS which is regulated by Capital Markets Board. Tekfen Tower, Eski Buyukdere Caddesi # 209 Kat 2B, 23294 Levent, Istanbul, Turkey. In the **U.A.E.**, these materials (the "Materials") are communicated by Citigroup Global Markets Limited, DIFC branch ("CGML"), an entity registered in the Dubai International Financial Center ("DIFC") and licensed and regulated by the Dubai Financial Services Authority ("DFS") to Professional Clients and Market Counterparties only and should not be relied upon or distributed to Retail Clients. A distribution of the different Citi Research ratings distribution, in percentage terms for Investments in each sector covered is made available on request. Financial products and/or services to which the Materials relate will only be made available to Professional Clients and Market Counterparties. The Product is made available in **United Kingdom** by Citigroup Global Markets Limited, which is authorised and regulated by Financial Services Authority. This material may relate to investments or services of a person outside of the UK or to other matters which are not regulated by the FSA and further details as to where this may be the case are available upon request in respect of this material. Citigroup Centre, Canada Square, Canary Wharf, London, E14 5LB. The Product is made available in **United States** by Citigroup Global Markets Inc, which is a member of FINRA and registered with the US Securities and Exchange Commission. 388 Greenwich Street, New York, NY 10013. Unless specified to the contrary, within EU Member States, the Product is made available by Citigroup Global Markets Limited, which is regulated by Financial Services Authority.

Pursuant to Comissão de Valores Mobiliários Rule 483, Citi is required to disclose whether a Citi related company or business has a commercial relationship with the subject company. Considering that Citi operates multiple businesses in more than 100 countries around the world, it is likely that Citi has a commercial relationship with the subject company.

Many European regulators require that a firm must establish, implement and make available a policy for managing conflicts of interest arising as a result of publication or distribution of investment research. The policy applicable to Citi Research's Products can be found at https://www.citivelocity.com/cvr/eppublic/citi_research_disclosures.

Compensation of equity research analysts is determined by equity research management and Citigroup's senior management and is not linked to specific transactions or recommendations.

The Product may have been distributed simultaneously, in multiple formats, to the Firm's worldwide institutional and retail customers. The Product is not to be construed as providing investment services in any jurisdiction where the provision of such services would not be permitted.

Subject to the nature and contents of the Product, the investments described therein are subject to fluctuations in price and/or value and investors may get back less than originally invested. Certain high-volatility investments can be subject to sudden and large falls in value that could equal or exceed the amount invested. Certain investments contained in the Product may have tax implications for private customers whereby levels and basis of taxation may be subject to change. If in doubt, investors should seek advice from a tax adviser. The Product does not purport to identify the nature of the specific market or other risks associated with a particular transaction. Advice in the Product is general and should not be construed as personal advice given it has been prepared without taking account of the objectives, financial situation or needs of any particular investor. Accordingly, investors should, before acting on the advice, consider the appropriateness of the advice, having regard to their objectives, financial situation and needs. Prior to acquiring any financial product, it is the client's responsibility to obtain the relevant offer document for the product and consider it before making a decision as to whether to purchase the product. With the exception of our product that is made available only to Qualified Institutional Buyers (QIBs) and other product that is made available through other distribution channels only to certain categories of clients to satisfy legal or regulatory requirements, Citi Research concurrently disseminates its research via proprietary and non-proprietary electronic distribution platforms. Periodically, individual Citi Research analysts may also opt to circulate research posted on such platforms to one or more clients by email. Such email distribution is discretionary and is done only after the research has been disseminated via the aforementioned distribution channels. Citi Research simultaneously distributes product that is limited to QIBs only through email distribution.

The level and types of services provided by Citi Research analysts to clients may vary depending on various factors such as the client's individual

preferences as to the frequency and manner of receiving communications from analysts, the client's risk profile and investment focus and perspective (e.g. market-wide, sector specific, long term, short-term etc.), the size and scope of the overall client relationship with Citi and legal and regulatory constraints. Citi Research product may source data from dataCentral. dataCentral is a Citi Research proprietary database, which includes Citi estimates, data from company reports and feeds from Reuters and Datastream.

© 2013 Citigroup Global Markets Inc. Citi Research is a division of Citigroup Global Markets Inc. Citi and Citi with Arc Design are trademarks and service marks of Citigroup Inc. and its affiliates and are used and registered throughout the world. All rights reserved. Any unauthorized use, duplication, redistribution or disclosure of this report (the "Product"), including, but not limited to, redistribution of the Product by electronic mail, posting of the Product on a website or page, and/or providing to a third party a link to the Product, is prohibited by law and will result in prosecution. The information contained in the Product is intended solely for the recipient and may not be further distributed by the recipient to any third party. Where included in this report, MSCI sourced information is the exclusive property of Morgan Stanley Capital International Inc. (MSCI). Without prior written permission of MSCI, this information and any other MSCI intellectual property may not be reproduced, disseminated or used to create any financial products, including any indices. This information is provided on an "as is" basis. The user assumes the entire risk of any use made of this information. MSCI, its affiliates and any third party involved in, or related to, computing or compiling the information hereby expressly disclaim all warranties of originality, accuracy, completeness, merchantability or fitness for a particular purpose with respect to any of this information. Without limiting any of the foregoing, in no event shall MSCI, any of its affiliates or any third party involved in, or related to, computing or compiling the information have any liability for any damages of any kind. MSCI, Morgan Stanley Capital International and the MSCI indexes are services marks of MSCI and its affiliates. The Firm accepts no liability whatsoever for the actions of third parties. The Product may provide the addresses of, or contain hyperlinks to, websites. Except to the extent to which the Product refers to website material of the Firm, the Firm has not reviewed the linked site. Equally, except to the extent to which the Product refers to website material of the Firm, the Firm takes no responsibility for, and makes no representations or warranties whatsoever as to, the data and information contained therein. Such address or hyperlink (including addresses or hyperlinks to website material of the Firm) is provided solely for your convenience and information and the content of the linked site does not in anyway form part of this document. Accessing such website or following such link through the Product or the website of the Firm shall be at your own risk and the Firm shall have no liability arising out of, or in connection with, any such referenced website.

ADDITIONAL INFORMATION IS AVAILABLE UPON REQUEST
