CHAPTER 3

THE DOG THAT DIDN'T BARK: HAS INFLATION BEEN MUZZLED OR WAS IT JUST SLEEPING?

"Is there any point to which you would wish to draw my attention?"
"To the curious incident of the dog in the night-time."
"The dog did nothing in the night-time."
"That was the curious incident," remarked Sherlock Holmes.
Silver Blaze, *Arthur Conan Doyle*

Inflation has been remarkably stable in the wake of the Great Recession even though unemployment has increased significantly. The analysis reported here finds that, over the past decade or so, inflation in advanced economies has become less responsive to changes in economic slack and that longer-term inflation expectations have become more firmly anchored. Thus, the recent stability of inflation is consistent with the prevalence of ongoing economic slack and a more muted response of inflation to cyclical conditions. Looking to the future, our analysis suggests that ongoing monetary accommodation is unlikely to have significant inflationary consequences, as long as inflation expectations remain anchored. In this regard, preserving central banks' independence is key. Notwithstanding this, policymakers must remain alert to possible imbalances that may not be reflected in consumer price inflation.

Introduction

Inflation has been remarkably quiet of late. While previous recessions were usually associated with marked declines in inflation, the Great Recession barely made a dent (Figure 3.1). And so, in a curious incident, we find a dog that did not bark. Some have inferred that the failure of inflation to fall is evidence that output gaps are small and that the large increases in unemployment are mostly structural. Thus, they fear that the monetary stimulus already in the pipeline may reduce unemployment, but only at the cost of overheating and a strong increase in inflation—just as during the 1970s. Others have argued that the stability of inflation reflects the success of inflation-targeting central

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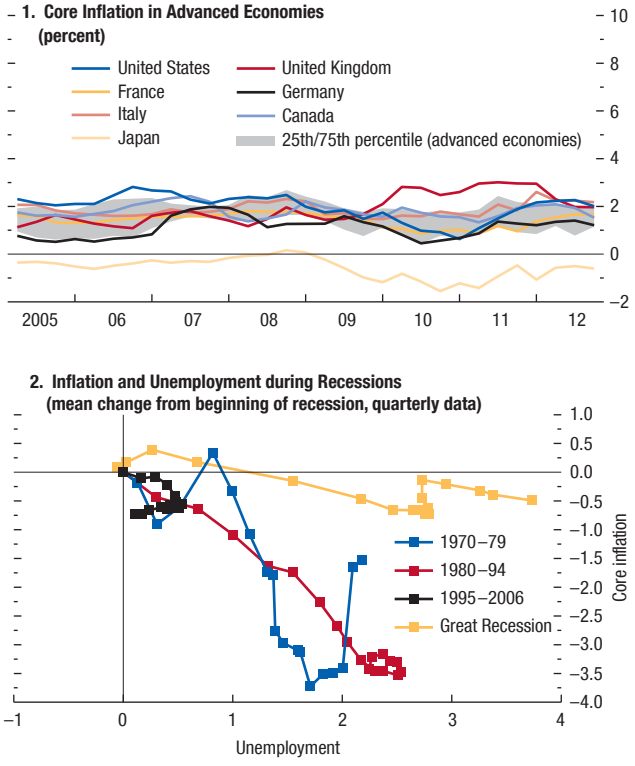
Figure 3.1. The Behavior of Inflation Has Changed

Despite large rises in unemployment during the Great Recession, inflation has been remarkably stable in almost all advanced economies. This is different from the recessions in the 1970s and 1980s, when inflation fell much more when unemployment rose.



Sources: Organization for Economic Cooperation and Development; and IMF staff calculations.

banks in anchoring inflation expectations and, thus, inflation.

This chapter seeks to grasp, in Sherlock Holmes's words, "the significance of the silence of the dog, for one true inference invariably suggests others." To do this, we use a simple economic framework to interpret some basic summary data on recent developments. This provides some suggestive hints about what may have been going on. We then put the data together in an econometric model that more formally tests the alternative views of what drove inflation in the past and what is driving it now. These tests suggest that inflation has been quiescent recently because expectations have become more anchored and the relationship between cyclical unemployment and inflation has become more muted. We then look to the future and ask what other inferences these findings suggest for inflation. We first assess the implications for the risks, alluded to above, that ongoing monetary stimulus may lead to a strong cyclical increase in inflation. We then consider the possibility that current conditions may be a prelude to stagflation, facilitated by a disanchoring of expectations as occurred during the 1970s. To do this, we consider lessons from the contrasting experiences of the United States and Germany in the 1970s. We conclude by considering the policy implications of our findings.

The Missing Disinflation: Why Didn't Inflation Fall More?

Two broad explanations have been offered for the recent stability of inflation. The first suggests that much of the rise in unemployment during the Great Recession was structural and, consequently, current high levels of unemployment exert less of an influence on wages and prices than in the past.[1] The second suggests that the behavior of inflation has changed and it is now much less volatile and less responsive to changes in economic slack than in the past. We discuss these two hypotheses informally, introduce an economic framework that helps organize the competing explanations, and look at what the data suggest.

The first explanation focuses on the behavior of the labor market. In normal recessions, when many unemployed workers are looking for jobs, inflation tends to be lower since wage pressures are more moderate and people have less money to spend. If, however, many of those who are unemployed cannot effectively compete for jobs, they may have much less influence on the wages of those who are employed. This can translate into less influence on the prices firms charge for their goods and services. Such unemployment is termed "structural."

There are certainly reasons for suspecting that many currently unemployed workers could be structurally unemployed. For example, the length of the Great Recession has put long-term unemployment near record levels. And the longer people are out of work, the more likely it is that their skills have faded or become less applicable to the available jobs. Thus, the high levels of long-term unemployment may suggest high levels of structural unemployment.

The second explanation for the stability of inflation focuses on the behavior of inflation more directly. For example, it is argued that the strengthening of central banks' credibility and their success in delivering stable inflation over the past decade have affected the way people think about future inflation. And people's expectations about the future affect inflation today. For example, if prices are expected to increase in the future, workers will demand increased wages today, and those increases will be passed on in the form of higher prices today. Thus, more stable inflation expectations resulting from credible central banks may have contributed to more stable inflation.

The behavior of inflation may also have been affected by central banks' low inflation targets. It has been suggested that at low levels, inflation may become stickier and less responsive to economic fluctuations. For example, workers are very resistant to wage cuts, and this may prevent producers from cutting prices when aggregate demand falls. It has also been suggested that the presence of costs to adjustment in nominal prices (menu costs) leads firms to change prices less frequently when inflation is lower. Similarly, globalization may have made inflation more responsive to global demand developments and less responsive to domestic demand developments.

Framework

Each of these explanations is reflected in the conceptual framework known as the New Keynesian Phillips curve, which focuses on the core issue of interest here—the relationship between inflation and unemployment. Under this framework, inflation, π_t, is

[1]Kocherlakota (2010), for example, expresses this view in the case of the United States.

determined by inflation expectations, π_t^e, and the level of cyclical unemployment, $\tilde{u}_t$, according to the following simple equation:

$$\pi_t = \pi_t^e - \kappa \tilde{u}_t, \tag{3.1}$$

in which κ is a parameter commonly referred to as the slope of the Phillips curve.[2] It captures the strength of the relationship between cyclical unemployment and inflation. Viewed through the lens of this framework, we can then summarize the ideas above as follows. First, inflation may not have fallen much because the increased unemployment was structural and there was minimal change in cyclical unemployment, $\tilde{u}_t$. Second, improved central bank credibility may have made inflation expectations more stable. Finally, the lower level of inflation at the beginning of the Great Recession, or other changes, may account for the reduced inflationary response to cyclical developments—that is, the Phillips curve is flatter than in the past and κ is smaller.

A Look at the Data

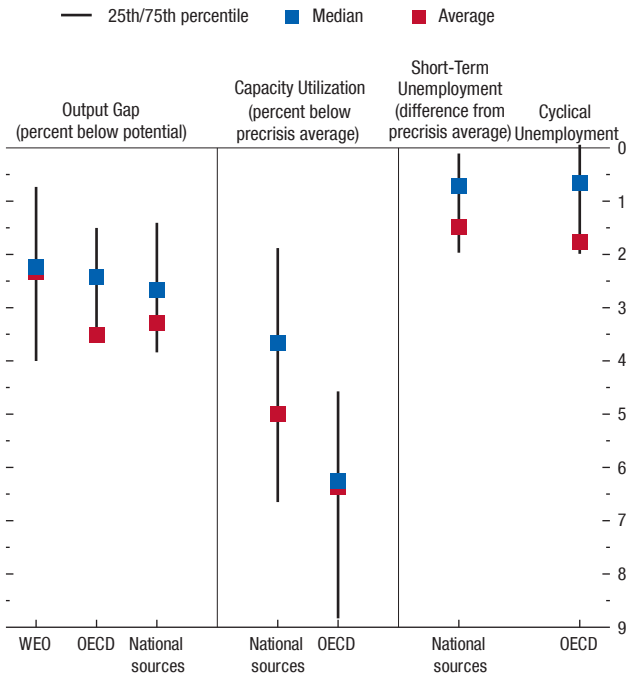
Critical elements in thinking about these possibilities are the amount of economic slack in economies today, the anchoring of inflation expectations, and the responsiveness of inflation to economic slack. We begin with the available estimates of economic slack. As shown in Figure 3.2, current estimates from the IMF, Organization for Economic Cooperation and Development (OECD), and national authorities indicate the presence of significant output gaps, suggesting considerable economic slack. A similar picture emerges from a comparison of current and precrisis capacity utilization and unemployment (see Figure 3.2). The OECD and national authorities estimate that capacity utilization decreased by about 5 to 6 percent since the beginning of the Great Recession. The picture is similar in the labor market.[3] Unemployment gaps average about 2 percent, judging by changes in short-term

[2]Despite its apparent simplicity, this framework is surprisingly rich and is the workhorse for most work in this area. It can incorporate additional influences, such as import price effects and asset price effects. A number of these elements are introduced in the econometrics below. For a fuller treatment of the New Keynesian theory, see Woodford (2003) and Galí (2008).

[3]The magnitude of the estimates cannot be directly compared across these measures. For example, as documented in Abel and Bernanke (2005), it is fairly standard to assume that output gaps are approximately twice the size of unemployment gaps based on Okun's law.

Figure 3.2. Measures of Current Economic Slack

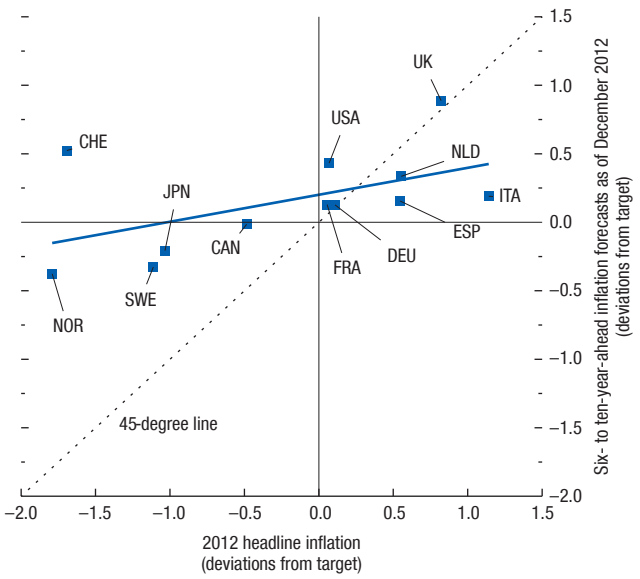
A wide range of indicators prepared by various institutions suggest that advanced economies are confronting considerable economic slack. This condition is particularly acute in a few countries, as seen in the fact that the cross-country means tend to be above the medians.



Sources: Haver Analytics; Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: OECD = Organization for Economic Cooperation and Development; WEO = *World Economic Outlook*.

Figure 3.3. Current Headline Inflation Compared with Expectations

Long-term inflation expectations have remained very close to central banks' targets. This is true even in countries where 2012 inflation was significantly above or below target.



Sources: *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: CAN = Canada; CHE = Switzerland; DEU = Germany; ESP = Spain; FRA = France; ITA = Italy; JPN = Japan; NLD = Netherlands; NOR = Norway; SWE = Sweden; UK = United Kingdom; USA = United States.

unemployment from its precrisis average and OECD estimates of cyclical unemployment, defined as the gap between current unemployment and the nonaccelerating inflation rate of unemployment (NAIRU). This suggests that a considerable share of the increase in unemployment during the Great Recession was cyclical.

A second critical element in exploring recent inflation dynamics is the anchoring of inflation expectations. Figure 3.3 compares long-term inflation expectations with 2012 inflation rates in advanced economies as deviations from central banks' inflation targets.[4] Although current and expected inflation are positively correlated, the low regression slope suggests that expectations are strongly anchored to the central banks' inflation targets rather than being particularly affected by current inflation levels. Indeed, despite wide variations in actual inflation, long-term inflation expectations remain close to targets. This was the case even for Japan, where expectations remained close to the 1 percent target announced in February 2012 despite a prolonged period of deflation.

To further explore the extent to which institutional and behavioral changes in central banks have helped anchor inflation expectations, we estimate the degree of anchoring over time using the following simple regression:

$$\tilde{\pi}_t^e - \pi^* = \alpha + \beta(\pi_t - \pi^*) + \varepsilon_t, \qquad (3.2)$$

in which $\tilde{\pi}_t^e$ is the long-term inflation expectation at a given time, π_t is the inflation rate when inflation expectations are collected, and π^* is the central bank's target level of inflation.

Inflation expectations that are strongly anchored to the inflation target should result in estimates for both α and β that are close to zero. A zero β coefficient implies that expectations are not influenced by the contemporaneous level of inflation, and a zero α means that the inflation expectations are centered at the target level. We ran the regression for 12 advanced economies over five-year rolling windows since 1990, reflecting the available data. The cross-country average

[4]The target is the rate announced by the central bank or the simple average of the announced range (Canada 2 percent, Norway 2.5 percent, Sweden 2 percent, Switzerland 1 percent, and United Kingdom 2 percent). A target of 1.9 percent is used for the countries in the euro area, given that the European Central Bank (ECB) defines price stability as an increase in inflation below, but close to, 2 percent. We use 1 percent for Japan, consistent with the announcement by the Bank of Japan on February 14, 2012. A target of 2 percent was introduced on January 22, 2013. Finally, we use 2 percent for the United States, the rate announced by the Federal Reserve on January 25, 2012.

of the estimates for α and β and the cross-country range of estimated coefficients are plotted in Figure 3.4. The estimates for both coefficients are clearly declining and are currently very close to zero. Inflation expectations have become much more anchored around targets during the past two decades.

Finally, we consider the evidence on the relationship between the level of inflation and the responsiveness of inflation to economic slack. Figure 3.5 shows the relationship between cyclical unemployment and the level of inflation. The figure shows the cross-country means of inflation and cyclical unemployment at quarterly frequencies since 1975, with fitted regression lines during several periods.[5] Broadly speaking, inflation was high in the late 1970s and early 1980s, when the relationship between inflation and unemployment appears relatively steep; it was more muted between 1985 and 1994, when many economies experienced disinflation as central banks started establishing the current targeting regimes; and it was particularly flat after 1995, a period of stable inflation around 2 percent.

This preliminary evidence suggests that economic slack persists and that the recent stability of inflation is indicative of greater anchoring of expectations and a more muted relationship between economic slack and inflation. This, however, is only a tentative observation. To test the robustness and plausibility of this possibility we make use of a formal econometric model.

Econometric Results

Although an initial look at the data suggested some possible explanations for the recent experience—a muted relationship between inflation and unemployment and better anchoring of expectations—they are only tentative and partial. This section examines these explanations to see whether they continue to hold within a formal econometric framework. This approach allows us to find the interpretation of the data that is both internally consistent and statistically most likely.

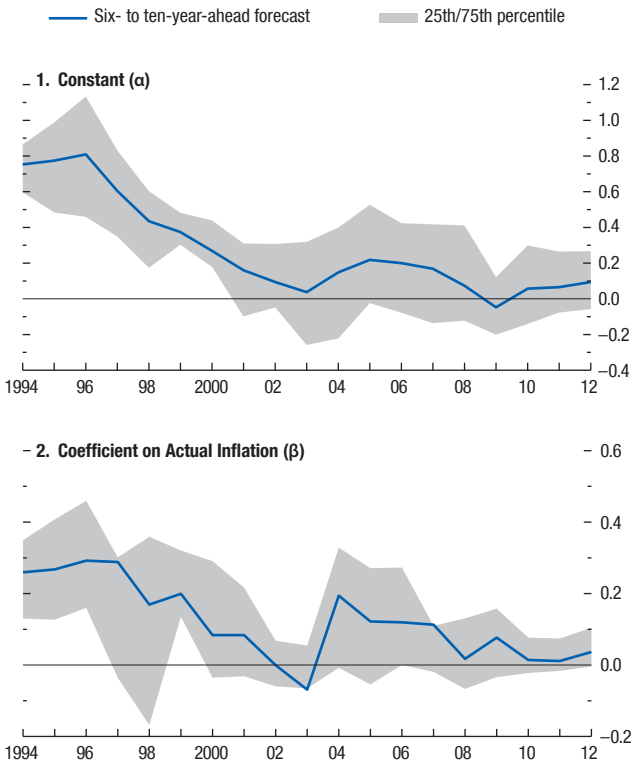
Based on the framework set out in equation (3.1), we estimate the following unemployment-based Phillips curve:

$$\pi_t = (1 - \vartheta)\pi_{t-1} + \vartheta\pi_t^e - \kappa\tilde{u}_t + \gamma\pi_t^m + \varepsilon_t, \qquad (3.3)$$

[5] Cyclical unemployment is computed by subtracting the OECD estimates of the NAIRU from the unemployment rate. The NAIRU is the rate of structural unemployment consistent with no inflation pressure. Because the NAIRU estimates are available only at annual frequencies, we use linear interpolation to generate quarterly values.

Figure 3.4. Rolling Regressions of Inflation Expectations over Actual Inflation
(Net of inflation target)

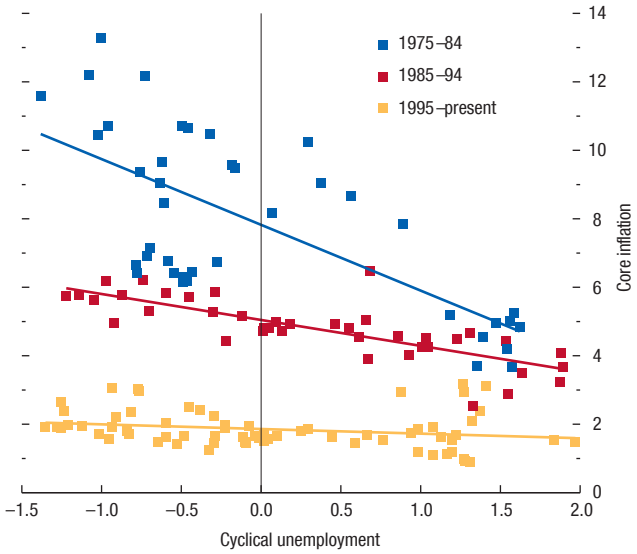
Inflation expectations are now better anchored to targets and respond less to actual changes in inflation. This is shown below in rolling regressions of inflation expectations over actual inflation in deviations from central banks' targets, which reveal that both the intercept α and the slope β have moved closer to zero.



Sources: *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.

Figure 3.5. Inflation and Cyclical Unemployment
(Percent; average across advanced economies)

From its peak in the 1970s, the average level of inflation has fallen as a result of central banks' disinflationary policies. What is also noticeable is that the relationship between cyclical unemployment and inflation appears to have moderated as the level has fallen.



Sources: Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: Each square represents the average across advanced economies of inflation and cyclical unemployment in one quarter.

in which π_t is headline consumer price index inflation, π_t^e is long-term inflation expectations, $\tilde{u}_t$ is cyclical unemployment, and π_t^m is inflation in the relative price of imports. Relative to the basic specification in equation (3.1), the estimated equation incorporates two new features that allow for a better characterization of the inflation process. First, we introduce lagged inflation, π_{t-1}, to allow for some inflation persistence. The idea is that when people set wages and prices, they may be incorporating both their expectations about future inflation and the latest actual inflation rate. The parameter ϑ determines the balance between these two factors. Second, we introduce the import price inflation term, π_t^m, for two reasons. First, headline inflation is used to estimate the regression because historical core inflation data are generally not available. But because headline inflation includes many short-term fluctuations caused by commodity price volatility and because commodities are traded internationally, the import price term allows us to capture many of these fluctuations. Second, incorporating import price effects allows us to investigate the contention that globalization makes inflation more dependent on global factors (captured through the import price term) than on domestic factors. The regression equation also allows for transitory shocks; ε_t, which captures fluctuations in inflation that may be driven by temporary supply factors. Furthermore, supply shocks, for example linked to swings in oil prices, are captured by the import inflation term, π_t^m, as well as by changes in the NAIRU that the model internally estimates given constraints we impose on how volatile this term can be. Cyclical unemployment, $\tilde{u}_t$, is then derived by subtracting from the unemployment data the estimates of the NAIRU. Asset price effects on inflation are also captured by this term to the extent that they affect aggregate demand. Appendix 3.1 provides technical details of the model.

An important feature of the estimation is that we allow for time variation in all the parameters: ϑ, γ, and κ.[6] This is essential for assessing whether the economy of today differs from the economy of the past. An increase in ϑ implies that current inflation has become more anchored to long-term expectations and is less influenced by past inflation. Given that long-term

[6]In the past, most work has assumed either that the slope of the Phillips curve was constant over the estimation period or that it was nonlinear in ways that linked the slope to the level of inflation. Our approach encompasses both possibilities without imposing them.

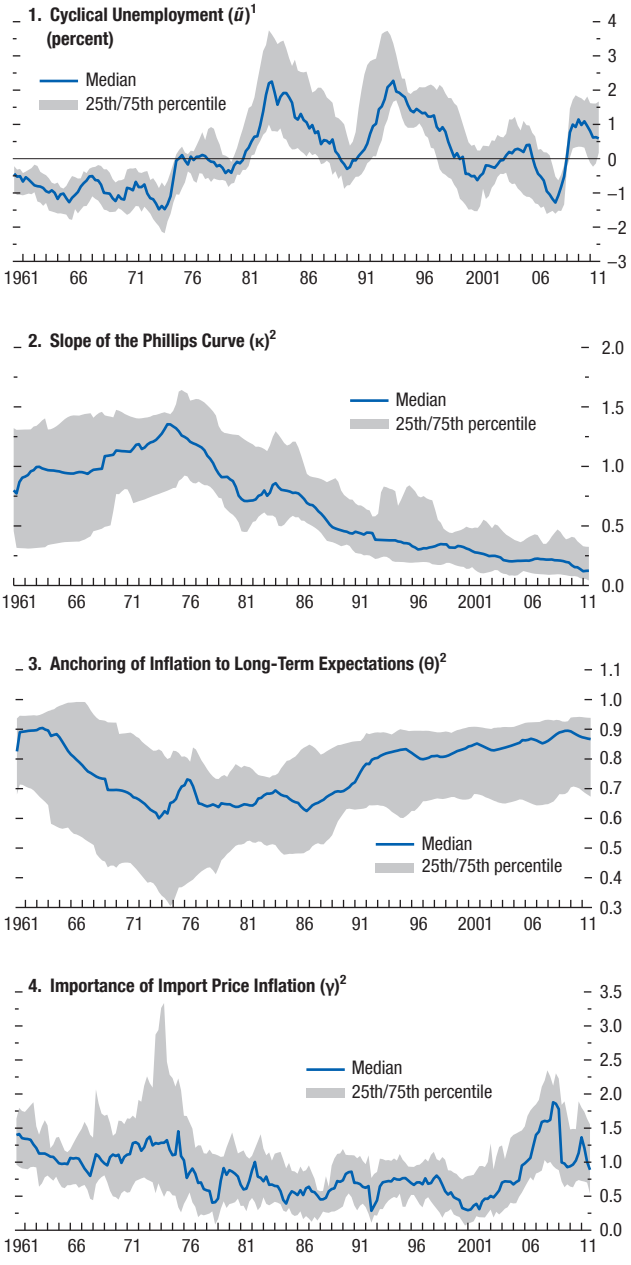
inflation expectations are now more stable than in the past (see Figure 3.4), a higher ϑ would also imply that inflation has become less persistent. Time variation in γ allows for the possibility that inflation is now more dependent on global developments, perhaps because of globalization. Finally, time variation in the parameter κ makes it possible to directly test the hypothesis suggested in Figure 3.5 that the relationship between inflation and unemployment may have become more muted—that is, that the Phillips curve is flatter.

We estimate the model for all advanced economies for which data are available, which produces estimates for 21 countries, usually starting in the 1960s. The results are remarkably consistent across countries (Figure 3.6) and tell a story that confirms the preliminary results:

- *Unemployment gaps have opened in many countries.* Figure 3.6, panel 1, confirms the findings reported in Figure 3.2 that there are unemployment gaps in almost all the countries in the data set. Furthermore, because a number of countries have very large unemployment gaps, the distribution is skewed and the average is above the median.
- *The responsiveness of inflation to unemployment has been gradually declining over the past several decades.* Figure 3.6, panel 2, shows that κ has decreased (that is, the average slope of the Phillips curve has flattened). The interquartile range also demonstrates that this decline occurred throughout the advanced economies in the data set. Furthermore, in results not reported here, there is a correlation between the level of inflation and the slope, as suggested by Figure 3.5. However, the degree of potential nonlinearity is very modest at the rates of inflation observed over the past few decades. We consider some of the implications of a flatter Phillips curve for policy in Box 3.1.
- *The relationship between current and past inflation has weakened over time.* Figure 3.6, panel 3, shows that θ has increased since the 1970s, which means that the persistence of inflation has declined such that deviations of inflation expectations from its long-term trend are more short lived relative to the 1970s—in short, inflation has become more "anchored." Once again, this is a change that has occurred throughout advanced economies.
- *At the aggregate level, the contribution of global inflation to country-specific inflation shows no clear trend.* While we find that, for a number of individual countries, the imported inflation parameter has

Figure 3.6. Changes in the Inflation Process

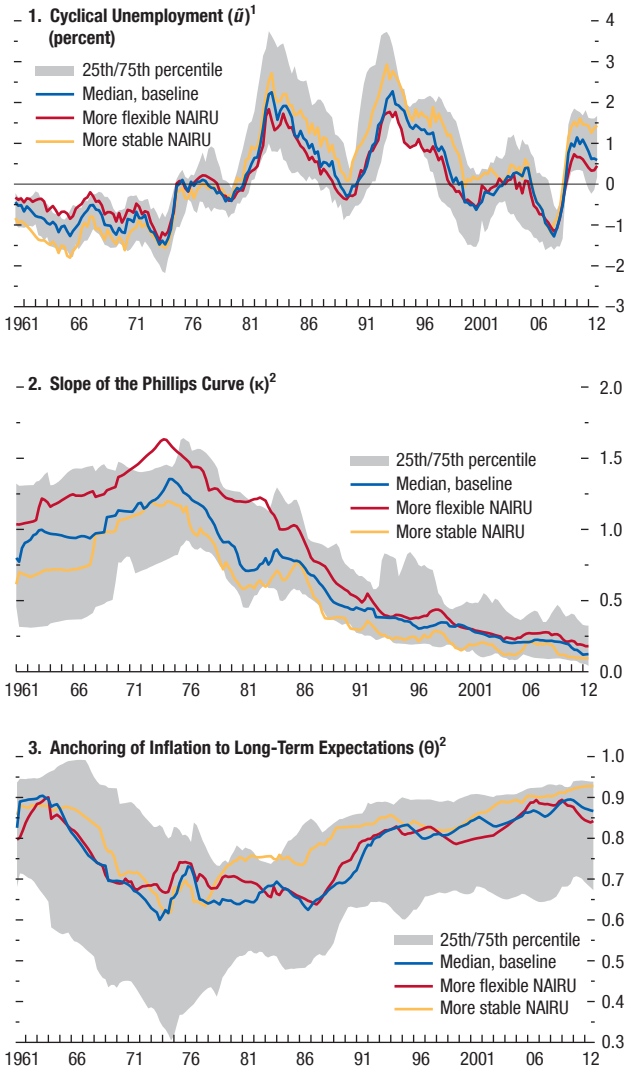
The recent rise in cyclical unemployment is similar to that in previous recessions, although the starting position was lower and there is a significant dispersion across countries. There has been a decline in the responsiveness of inflation to unemployment —that is, the slope of the Phillips curve—and a rise in the anchoring to long-term inflation expectations since the 1970s. There is no clear trend in the importance of import price inflation.



Sources: Board of Governors of the Federal Reserve System; *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: Country sample includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.
[1]Unemployment rate minus model-generated estimates of the nonaccelerating inflation rate of unemployment.
[2]See equation (3.3) in the text.

Figure 3.7. Robustness to Alternative Estimates of the NAIRU

Changes to the assumption about the flexibility of the NAIRU leave the core findings unchanged—inflation expectations are more anchored and the Phillips curve is flatter.



Sources: Board of Governors of the Federal Reserve System; *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: NAIRU = nonaccelerating inflation rate of unemployment. Country sample includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.
[1]Unemployment rate minus model-generated estimates of the NAIRU.
[2]See equation (3.3) in the text.

increased over time, which is consistent with greater import penetration associated with globalization, there is no clear trend in the median (Figure 3.6, panel 4).

These findings are also consistent with much of the earlier research. First, many researchers find evidence that, since the mid-1990s, inflation has become better anchored around long-term expectations, which themselves have become more stable.[7] It is natural to associate this with the simultaneous trends toward more central bank independence and the adoption of inflation-targeting regimes across advanced economies. Second, the observed flattening of the Phillips curve as inflation rates declined is consistent with evidence that there is downward nominal wage rigidity—that is, people are very resistant to nominal wage reductions (Yellen, 2012).

The flattening of the Phillips curve at low levels of inflation may also reflect the fact that there are costs associated with adjusting nominal prices that lead firms to change prices less frequently when inflation is lower (Ball, Mankiw, and Romer, 1988). Cross-country evidence compiled by Klenow and Malin (2010) confirms that firms do change prices less frequently when inflation is lower. As to whether globalization has affected the slope of the Phillips curve, consonant with our findings on the import price parameter, the evidence so far is either inconclusive or negative (Ball, 2006; Gaiotti, 2010).

Importantly, the flattening of the Phillips curves is robust to alternative specifications of the NAIRU. In the estimation procedure, we assume a certain flexibility in the NAIRU, which affects the size of unemployment gaps over time. It is possible that the implied estimates of the unemployment gap are wrong even though they match well with the alternative measures presented in Figure 3.2. To allow for this possibility we test specifications in which the NAIRU is more flexible and more stable than in the baseline. Figure 3.7 shows that this assumption does not materially affect the key findings. Regardless of one's view of the flexibility of the NAIRU and thus the current size of the output gap, the slope of the Phillips curve has fallen over time, and the slope is currently very flat.

These results are, of course, subject to the usual caveats that accompany any econometric work. It is possible that particular variations in the framework,

[7]See, for example, Stock and Watson (2007) and Kuttner and Robinson (2010).

data, or estimation technique could affect the results. Tests of a number of variations in the framework, data, and estimation method yielded results that were broadly unchanged. Nevertheless, the more compelling argument in favor of these results is that they agree both with the descriptive data and with earlier results on individual aspects of the model. That is, the accumulation of evidence points in the same direction—namely, that inflation has been more stable than in the past both because it has become better anchored to stable long-term expectations and because the relationship between inflation and unemployment is much more muted.

To illustrate this finding, Figure 3.8 shows actual inflation in the United States during the Great Recession compared with two predictions. The first prediction (yellow line) uses the latest parameter estimates of the econometric model with a flat Phillips curve and well-anchored inflation. The second path (red line) uses the parameters from the 1970s, when the slope of the Phillips curve was higher and expectations were less well anchored, which predicts deflation following the Great Recession. The absence of deflation can be explained by the changes in the economy and in institutions since the 1970s.

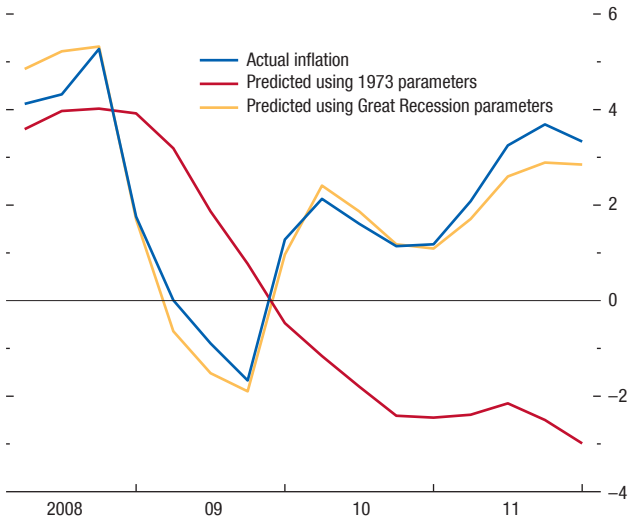
How Much Should We Worry about Inflation?

If the inflation stability during the Great Recession reflects a flat Phillips curve and the anchoring of inflation expectations, there seems little risk of strong inflation pressure during the ongoing recovery. However, there is a risk that inflation could become much more sensitive to output gaps during future periods of expansion. For example, there could be nonlinearities in the Phillips curve: the slope of the curve could be flat when the economy faces cyclical unemployment but steep if unemployment falls below the NAIRU. This concern becomes particularly salient if estimates that suggest there are now large output gaps and high cyclical unemployment (see Figure 3.2) turn out to be wrong. For example, it may be that slower productivity growth and yet-unrecognized structural changes have lowered potential output and raised the NAIRU—just as during the 1970s.

In this respect, there are useful lessons from the experiences of several countries during the early 2000s, when unemployment was below the NAIRU for an extended period but inflation and inflation expectations remained remarkably stable (Figure 3.9). These phenomena were particularly evident in several euro

Figure 3.8. Actual and Predicted Inflation in the United States
(Percent, year over year)

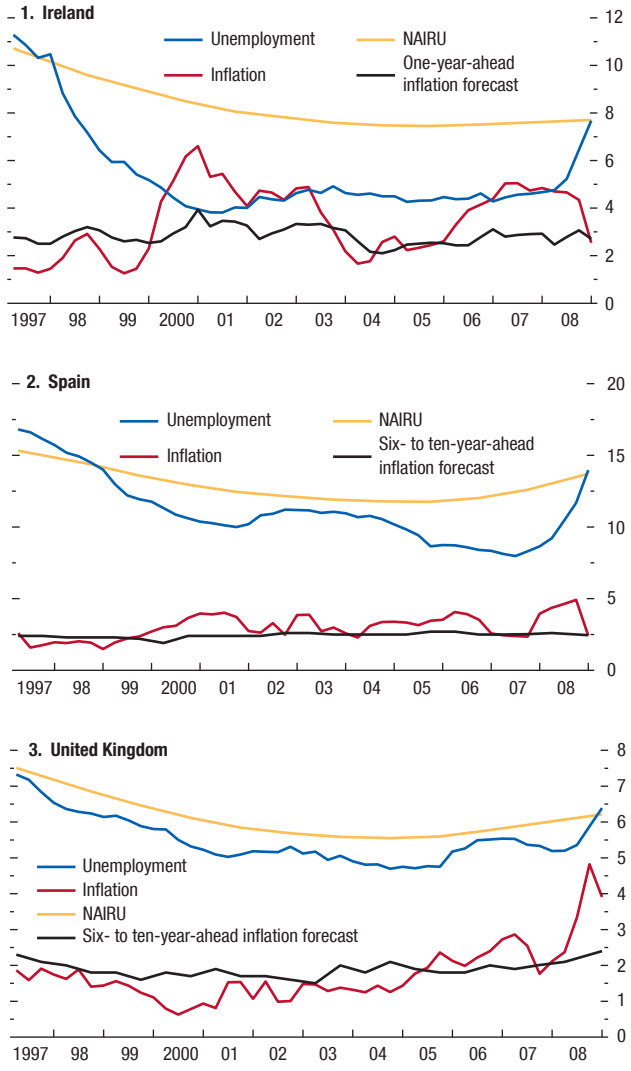
If inflation in the U.S. economy behaved as it did during the 1970s, the United States would have experienced significant deflation starting in 2010. The fact that it did not is evidence that the behavior of inflation and its reaction to economic slack have changed. Inflation is now much more stable than in the past. (The large fall in inflation in 2009 reflects the commodity price swing that affected headline inflation in most economies at that time. The contribution from economic slack was relatively minor.)



Sources: Board of Governors of the Federal Reserve System; Organization for Economic Cooperation and Development; and IMF staff calculations.

Figure 3.9. Unemployment and Inflation in Selected Economies
(Percent)

Despite unemployment below the NAIRU for about a decade, inflation and inflation expectations remained remarkably stable and well anchored in Ireland, Spain, and the United Kingdom.



Sources: *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: NAIRU = nonaccelerating inflation rate of unemployment (from Organization for Economic Cooperation and Development).

area countries that entered the monetary union and became subject to ECB monetary policies that were too loose for their particular circumstances. Emblematic cases are Ireland and Spain (Figure 3.9, panels 1 and 2). Despite large reductions in unemployment fueled by inappropriately loose monetary policies, inflation did not rise nearly as much as the experience of the 1970s would suggest.[8] This pattern was not confined to the euro area. The United Kingdom had a similar experience during this period (Figure 3.9, panel 3). Although there was less overheating, there was the same combination of modest inflation pressure and a sustained period of tight capacity. These cases clearly demonstrate that flat Phillips curves are just as applicable to periods of strong growth as to recessions and are readily observable in the economic experiences of the past decade.[9]

An important implication of a flat Phillips curve under both positive and negative unemployment gaps is that the precise determination of the current degree of economic slack is not that important in terms of the consequences for inflation. It is notoriously difficult to estimate potential output and employment in real time. Therefore, even though the indicators presented in Figure 3.2 and our own econometric estimates all suggest continuing slack, we cannot rule out the possibility that advanced economies are much closer to potential. But even in this case, the experiences of the early 2000s suggest that the monetary stimulus in the pipeline is unlikely to generate high inflation because the Phillips curve is likely to remain flat.

Given that the risks from movement along a flat Phillips curve seem modest—and that most economies are still operating with significant output gaps—the greatest risk for inflation, just as in the 1970s, is the possibility that expectations will become disanchored. Even though long-term expectations are currently close to targets and well anchored, our estimates show that

[8]For example, contemporary analysis of the Spanish economy acknowledged that the monetary policies, set as they were for the whole of the euro area, were inappropriate for Spain. This can be seen, for example, in the IMF Article IV report from 2001: "Even before the November 8 cut in interest rates, monetary conditions were easier than justified from a purely Spanish perspective, the authorities noted." (IMF, 2002)

[9]As mentioned in the discussion of the results, we find some evidence that the slope of the Phillips curve is higher at higher levels of inflation. If we restrict the model such that the slope of the Phillips curve is related to the level of inflation, we find that the nonlinearity is very modest—that is, the slope does not rise appreciably at moderate inflation levels.

the behavior of inflation has changed in the past and may change again in the future.

To assess the risk that inflation expectations will disanchor, we look back to the 1970s—the last time they did. In particular, we contrast the experiences of the United States and Germany. In the 1970s both countries experienced rising unemployment as the rapid growth of the immediate postwar period slowed and the world economy suffered from oil shocks. However, even though inflation kept increasing in the United States, it remained remarkably well anchored in Germany (Figure 3.10). Comparing these two cases yields valuable insights about the factors that can guard against a possible disanchoring today.

Anchoring and Disanchoring in the 1970s

United States: Disanchoring of inflation expectations

U.S. economic policy after World War II was shaped against the vivid memory of the Great Depression. High unemployment and deflation were more feared than inflation. In this climate, inflation pressure built up gradually as policy targeted a "natural rate" of unemployment of about 4 percent—a level achieved only briefly in the late 1960s and today recognized as too low.[10]

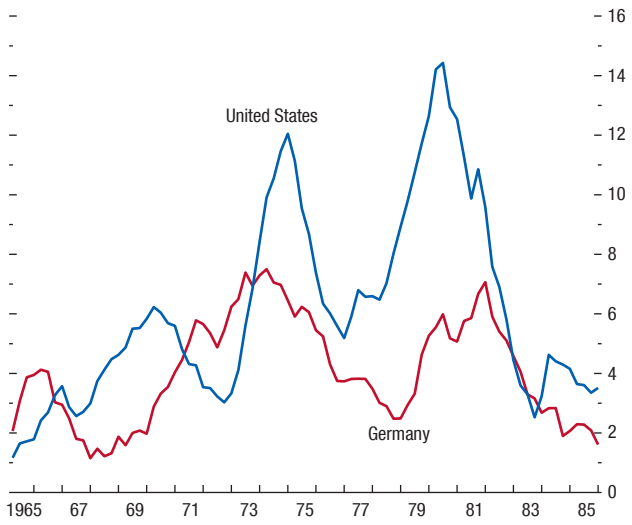
This gradual buildup in inflation has been linked to several factors. First, there was limited understanding of how to effectively control inflation. The economic approach was initially shaped by simple Keynesian models and the idea of a stable trade-off between unemployment and inflation. Furthermore, some believed that inflation could be managed through wage and price controls, and these were, in fact, used sporadically during the 1970s, including two complete wage and price freezes under President Richard Nixon.[11] One consequence was that there was less use of more effective monetary tools. Second, as Orphanides (2002) argues, there was a misperception about the sustainable rate of unemployment

[10]Meltzer (2009, p. 2) summarizes it thus: "The principal monetary and financial legacies of the Great Depression were a highly regulated financial system and the Employment Act of 1946, which evolved into a commitment by the government and the Federal Reserve to maintain economic conditions consistent with full employment. The Employment Act was not explicit about full employment and even less explicit about inflation. For much too long, the Federal Reserve and the administration considered a 4 percent unemployment rate to be the equilibrium rate. The Great Inflation changed that."

[11]See, for example, Nelson (2005), who discusses the cases of Australia, Canada, and New Zealand.

Figure 3.10. Headline Inflation in the United States and Germany
(Percent)

Despite facing similar shocks during the 1970s, Germany ended the decade with much lower inflation than the United States. This largely reflects the countries' differing approaches to monetary policy.



Source: Organization for Economic Cooperation and Development.

and, more generally, the size of the output gap. These errors spurred policies that, in hindsight, were too stimulative.

Another important contributor to the disanchoring of inflation expectations in the United States during the 1970s was the lack of independence of the Federal Reserve (Fed), which stemmed from the lack of social consensus on the appropriate objectives for monetary policy. The Fed's lack of independence and its deference to political interests are evident in Arthur Burns's 1979 Per Jacobsson lecture in which he looked back over his experiences as chairman of the Fed:

> Viewed in the abstract, the Federal Reserve System had the power to abort the inflation at its incipient stage fifteen years ago or at any later point, and it has the power to end it today… It did not do so because the Federal Reserve was itself caught up in the philosophic and political currents that were transforming American life and culture… If the Federal Reserve then sought to create a monetary environment that fell seriously short of accommodating the upward pressures on prices that were being released or reinforced by government action, severe difficulties could be quickly produced in the economy. Not only that, the Federal Reserve would be frustrating the will of Congress to which it was responsible. (Burns, 1979, pp. 15–16)

Throughout this period, increases in inflation and inflation expectations were not reversed and were effectively condoned.[12] Indeed, there was a sense of fatalism about increased inflation. This is expressed by President Jimmy Carter in 1978:

> The human tragedy and waste of resources associated with policies of slow growth are intolerable, and the impact of such policies on the current inflation is very small. (*Economic Report of the President*, 1978, p. 17)[13]

Inflation was finally brought down only when the de facto independence of the Fed was established with the appointment of Paul Volcker in 1979, who made it clear to President Carter that he was "mainly concerned that the president not be under any misunderstanding about my own concern about the importance of an independent central bank and the need for the tighter money…" (Volcker and Gyohten, 1992, p. 164). This development reflected a social and political evolution that ranked inflation as a more important problem than unemployment only toward the end of the 1970s and not at the beginning of the decade.

Germany: Institutional independence and anchoring

German economic policy in the post–World War II era was shaped against the vivid memory of the hyperinflation of the 1920s and the monetary reform of 1948 that wiped out savings. Inflation was feared more than anything else. The Bundesbank, set up as an independent institution by the war powers, fought to maintain this independence in the mid-1950s, when the governing law was rewritten. As reported in 1957:

> President Vocke had incurred the Chancellor's wrath because he pursued a monetary policy that paid scant attention to Konrad Adenauer's amateurish ideas and politically dictated wishes… On such occasions Vocke demonstrated that the Chancellor's power ceased to apply at the gates of the central bank. (*Der Spiegel*, July 17, 1957, pp. 18–20)

Public support for an independent, inflation-fighting central bank ensured that the Bundesbank emerged from this political fight with legal and, more important, practical independence. It wasn't until the end of the 1970s that the United States developed a social aversion to high inflation; Germans required no such persuasion.

However, the Bretton Woods fixed exchange rate system meant that the Bundesbank was constrained in its implementation of monetary policy. The upshot was that Germany ended up importing inflation from the United States throughout the late 1960s and early 1970s (see Figure 3.10). When it regained its independence in 1973 with the abandonment of the Bretton Woods system, the Bundesbank strengthened its reputation for independence and anti-inflation credibility. Its first step was to quickly raise interest rates to about 7 percent. It also looked for ways to anchor expectations. In 1974 it introduced a system of monetary targeting. Moreover, the Bundesbank made pronouncements about the level of "unavoidable inflation," which were gradually ratcheted down, as an additional way to communicate its objectives and manage expectations. Bundesbank Chief Economist Helmut Schlesinger explained the purpose of the targets in 1979:

> But as the monetary target tends to act as a signpost the pressure to exercise cost and price discipline is likely to grow. Indeed, experience even permits the conclusion that the formulation of this target helped bring about a "social consensus" among all groups… (Schlesinger, 1979, p. 308)

[12]See Levin and Taylor (2010) for a more extensive discussion of this point.

[13]Available at www.presidency.ucsb.edu/economic_reports/1978.pdf.

This framework was, in many ways, the precursor to the "flexible inflation targeting" practiced today by central banks. The ECB's current 2 percent target for inflation descends from the Bundesbank's concept of "unavoidable inflation."

The Bundesbank's success, however, was not based on it being infallible. Its success in hitting the monetary targets was limited—the authorities overshot their point target before moving to a target range in 1979, which it still struggled to hit. Moreover, as demonstrated by Gerberding, Seitz, and Worms (2005), the Bundesbank overestimated the output gap—just as U.S. authorities did. In 1975, the bank calculated the output gap at about 9 percent, whereas ex post estimates put it closer to 1 percent. These overestimations were persistent from 1974 until the mid-1980s.

Nor was the Bundesbank's success based on its being, in the words of Bank of England Governor Mervyn King, an "inflation nutter." The bank did not behave as if it had an inflation-only target but also placed weight on the output gap and cyclical developments.[14] For example, a recession in 1975 led the Bundesbank to so fear weak growth and undershooting its newly introduced monetary targets that it engaged in what is now known as quantitative easing. In a move that stirred considerable controversy, the bank bought government bonds on the secondary market totaling about 4 percent of the outstanding stock, or 1 percent of GDP. More explicitly, in its 1976 and 1977 annual reports the Bundesbank indicated that its goal was "strong economic growth and a further containment of inflation."

During this period, and in common with the Fed, the Bundesbank was also pressured to place greater weight on reducing unemployment. Helmut Schmidt, the minister for economics and finance, famously declared in 1972 that "5 percent inflation is easier to bear than 5 percent unemployment." In addition, as in the United States, government concerns over rising unemployment meant that fiscal policy was relatively loose in the 1970s, with the government running a deficit from 1974 on. The pressure can be seen, for example, in a *Der Spiegel* cover in 1975 that asked, "1.3 million unemployed: Is the Bundesbank to blame?"

[14]Both Clarida and Gertler (1997) and Gerberding, Seitz, and Worms (2005) estimate policy reaction functions for the Bundesbank and conclude that it placed significant weight on short-term objectives such as output stabilization.

Given these "errors" and concerns about unemployment, it may seem surprising that the Bundesbank managed to bring down inflation in the challenging environment of the 1970s. But it did. Through the use of explicit monetary and inflation targets, the authorities managed to anchor expectations. As a truly independent central bank with the flexibility to do what it judged best to achieve its mandate, the Bundesbank outstripped its peers.

Case Study Analysis

The large increase in inflation and the disanchoring of inflation expectations in the United States have been attributed to a variety of factors. Although we cannot rule out the possibility that other factors, including some not mentioned above—such as labor and product market differences—may have contributed to the different inflation dynamics in Germany and the United States, we focus on two that are particularly relevant today. First, the increase in unemployment was for some time erroneously interpreted as cyclical, thus requiring fiscal and monetary support. Second, the Fed was strongly influenced by political pressures to address increasing unemployment. As a result the Fed was reluctant to tighten policies enough to reduce inflation both because it overestimated the amount of economic slack and because such tightening would have involved "unacceptably" high unemployment. As a consequence, inflation expectations were gradually but inexorably disanchored, which eventually led to the stagflation that is a lasting symbol of those times.

The relative importance of these two elements in explaining the disanchoring of expectations is illuminated by a comparison with Germany. The Bundesbank shared many similarities with the Fed: both overestimated the size of the output gap, interpreting the increase in unemployment as mostly cyclical, and both operated within a political context that placed great weight on unemployment. What set them apart was their degree of actual independence. Unlike the Fed, the Bundesbank enjoyed a broad social consensus regarding its primary task of ensuring the stability of the currency.

This independence was reflected in the framework adopted by the Bundesbank, which allowed it to preserve its independence and keep expectations stable without excess tightening. As the case reveals, the Bundesbank's success was not linked to meticulously meeting the monetary targets, which it actually missed

throughout the 1970s, or to focusing on inflation with no regard for output developments. Rather the Bundesbank's success was a reflection of the robust framework it developed, which allowed it to keep longer-term inflation expectations anchored while flexibly responding to shorter-term output shocks.[15] The importance of operational independence has been emphasized in a large body of literature (such as Alesina and Summers, 1993) and is also underscored by the experience of the Fed: once the Fed was free to focus on inflation under chairman Volcker, it also achieved lower inflation and, after a painful recession, lower unemployment.

These experiences offer several valuable lessons for today. First, the similarities between the Bundesbank's approach then and the "flexible inflation targeting" framework used by many central banks today suggest that mistaken estimates of current economic slack seem unlikely, by themselves, to generate a sharp rise in inflation or in inflation expectations. Both the Fed and the Bundesbank overestimated the output gap, but inflation remained under control in Germany while it rose dramatically in the United States. Although it is hard to be definitive, a crucial difference was that the Bundesbank had the operational independence to credibly commit to taking action if inflation was projected to drift away from target. In the United States, the Fed effectively condoned increases in inflation and inflation expectations and thereby ratified them.

Conclusions

The data and case studies presented here suggest some important conclusions. First, the Phillips curve is considerably flatter today than in the past, and the inflation consequences of changes in economic slack are therefore much smaller. Second, inflation expectations are much better anchored now than in the past. Together, these two factors largely explain why the declines in inflation during the Great Recession were small. It also follows that these small declines are consistent with continued economic slack in most advanced economies.

An important policy conclusion is that, as long as inflation expectations remain firmly anchored, fears about high inflation should not prevent monetary authorities from pursuing highly accommodative monetary policy. Indeed the combination of a relatively flat Phillips curve and strongly anchored inflation expectations implies that any temporary overstimulation of the economy—perhaps stemming from misperception about the size of output gaps—is likely to have only small effects on inflation.

There are two important caveats. First, moderate inflation could induce complacency—and complacency would be a mistake. Although consumer price inflation was well contained in the first decade of the 2000s, many economies experienced rampant asset price inflation, most notably in residential housing. These housing bubbles helped destabilize the global financial system and contributed to the subsequent recession. Therefore, low consumer price inflation does not necessarily equate with a lack of economic imbalances. Policymakers must be alert to signs of growing imbalances and respond with appropriate policies. Furthermore, as discussed in Box 3.1, the muted relationship between inflation and output raises particular challenges for monetary policymaking for which there are no clear solutions.

Second, the comparison of the U.S. and German experiences in the 1970s should serve as an important reminder about the inflation risks arising from political pressure and limited central bank independence. Although a flatter Phillips curve can mitigate the inflationary effects of expansion, history clearly demonstrates the risks associated with curtailing appropriate monetary tightening in response to persistently rising inflation. The end result can be the disanchoring of inflation expectations and stagflation.

In the wake of the Great Recession, there is political urgency to reduce unemployment, as during the 1970s. In addition, the unprecedented growth in central bank balance sheets has been suggested as a possible vector through which central bank independence could be undermined during the recovery.[16] For example, capital losses on large bond holdings could expose central banks to political pressure. Similarly, there are concerns that the stimulative effects of unconventional monetary policies may gather momentum as the recovery strengthens, and these policies may be hard to reverse. We do not analyze these issues here (see Chapter 1). Instead, what our analysis underscores is that, whatever the source, limits on central banks' independence and operational restrictions that limit their flexibility in

[15]This conclusion is very much in line with the findings of Beyer and others (2009).

[16]See the April 2013 *Global Financial Stability Report* for a discussion of the potential financial stability risks of such actions, which are not addressed here.

responding to evolving challenges can cause problems and must be avoided.

In short, the dog did not bark because the combination of anchored expectations and credible central banks has made inflation move much more slowly than caricatures from the 1970s might suggest—inflation has been muzzled. And, provided central banks remain free to respond appropriately, the dog is likely to remain so.

Appendix 3.1. Econometric Model

An unemployment-based Phillips curve is estimated that allows for time-varying parameters. The Phillips curve is:

$$\pi_t = \theta_t \bar{\pi}_t + (1 - \theta_t)\pi^4_{t-1} - \kappa_t(u_t - u^*_t) + \gamma_t \hat{\pi}^m_t + \varepsilon^\pi_t, \quad (3.4)$$

in which π_t is headline consumer price index (CPI) inflation, $\bar{\pi}_t$ is long-term inflation expectations, π^4_{t-1} is year-over-year headline CPI inflation (lagged one quarter), θ_t is a time-varying parameter, u_t is the unemployment rate, u^*_t is the nonaccelerating inflation rate of unemployment (NAIRU), $\hat{\pi}^m_t$ is inflation in the relative price of imports (deviation from average), and ε^π_t is a cost-push shock. The unemployment gap and the NAIRU are assumed to evolve as follows:

$$(u_t - u^*_t) = \rho(u_{t-1} - u^*_{t-1}) + \varepsilon^{(u-u^*)}_t,$$

with

$$u^*_t = u^*_{t-1} + \varepsilon^{u^*}_t. \quad (3.5)$$

The parameters (κ_t, γ_t, θ_t) are assumed to be constrained random walks (κ_t and $\gamma_t \geq 0$ and $0 \leq \theta_t \leq 1$), and ρ is assumed to be constant ($0 \leq \rho \leq 1$).

The data are measured at a quarterly frequency and are seasonally adjusted. The relative price of imports is the import-price deflator relative to the GDP deflator. All inflation rates are annualized. Where possible, inflation data have been adjusted for changes in indirect taxes. Sample periods vary across countries, depending on data availability, with most data beginning in the early 1960s. Long-term inflation expectations are six- to ten-year-ahead inflation forecasts from Consensus Economics.[17]

The parameters and shock variances are estimated with maximum likelihood using a constrained, nonlinear Kalman filter. The parameters are initialized using estimates from 10-year rolling regressions using nonlinear least squares, subject to the same constraints described above and with the NAIRU assumed to be fixed in each rolling window. For each country, the variance of demand shocks $\varepsilon^{(u-u^*)}_t$ relative to NAIRU shocks $\varepsilon^{u^*}_t$ is calibrated.

In addition to the robustness check discussed in the main text, the baseline results were found to be qualitatively similar if different estimation methods are used. Various approaches were examined, including rolling regressions (with a variety of rolling-window sizes) and regressions with deterministic trends in the parameters. Likewise, the results are robust to changing the assumptions relating to the stability of long-term inflation expectations.

[17]Long-term inflation expectations for the United States are sourced from the Federal Reserve Board. If data are missing, long-term inflation expectations are estimated using a model similar to that used by Stock and Watson (2007).

Box 3.1. Does Inflation Targeting Still Make Sense with a Flatter Phillips Curve?

This box considers some of the possible implications of a flatter Phillips curve for the conduct of monetary policy. It does not, however, suggest particular solutions—its purpose is merely to review some of the issues currently under debate.

Over the past couple of decades, many central banks have adopted inflation targeting or similar frameworks. These decades, at least until the Great Recession, were also some of the least troubled from a macroeconomic point of view, with stable economic growth and lengthy expansions. Indeed, some have linked the Great Moderation with improvements to monetary policymaking over this period.[1] And the acceptability of these frameworks by the public was certainly helped by their seeming ability to deliver stable inflation, low unemployment, and stable output growth. The Great Recession changed all that.

There are suggestions that, particularly in the current economic circumstances, inflation-targeting frameworks may be less than optimal. Wren-Lewis (2013) suggests that the combination of a flatter Phillips curve and persistent shocks to inflation that are unrelated to domestic cyclical conditions means that central banks may end up stabilizing inflation at the cost of economic growth. For example, central banks may cease providing stimulus to an economy that is experiencing high inflation due to exchange rate effects or commodity price cycles, even though unemployment remains high and there are large amounts of economic slack. Analogously, stabilizing inflation may involve much larger swings in economic activity than in the past because the flatter Phillips curve means central banks must effect larger changes in economic slack to obtain a given change in inflation. These considerations suggest a need to reconsider how monetary policy can best contribute to general economic welfare under the circumstances now facing advanced economies.

Any such reconsideration should, however, clearly recognize that the stability of inflation and the anchoring of expectations are essential in order to avoid repeating the experiences of the 1970s. The key issue is whether there is a need to modify the monetary policy framework to ensure that stabilizing inflation is more consistent with stabilizing output.

Various central banks have already adopted "flexible inflation-targeting" regimes that give weight to output stabilization if it is not in conflict with their inflation targets. For example, inflation is allowed to deviate from the target for extended periods if it results from external or tax shocks. To the extent that such shocks are now more important relative to domestic cyclical conditions, extra flexibility may be appropriate. For example, in countries with considerable economic slack, the central bank can react less aggressively than in the past when inflation fluctuates above the target, provided expectations remain anchored.

Another approach is to focus on inflation measures other than the consumer price index that respond more closely to domestic cyclical conditions. For example, targets could be defined in terms of the rate of increase in labor earnings net of productivity gains. Monetary policy would thus be tightened when abnormal increases in wages signal bottlenecks in the labor market. Another suggestion is to give asset price inflation more prominence in monetary policymaking, given the large asset price rises that occurred during the first decade of the 2000s and their role in the financial crisis. However, Bernanke and Gertler (2000) point out the unintended consequences that can attend such an approach.

A more far-reaching approach would complement the inflation target with an explicit mandate to stabilize output. In this dual-mandate framework, central banks' decisions would be based not only on their views about inflation, but also on direct measures of output and unemployment gaps. Central banks would thus have more discretion to allow inflation fluctuations if addressing them would exacerbate cyclical downturns. There is some debate about whether such a dual mandate is compatible with inflation targeting. Bullard (2012) argues that the two are compatible and that differences amount only to the relative weight that is placed on inflation and output fluctuations.

Central banks are already making use of whatever flexibility they have in responding to the unprecedented circumstances following the Great Recession. However, changes in the behavior of inflation and profound challenges in the aftermath of the Great Recession may mean there is need for even greater flexibility. As such, it is worth thinking about whether improvements can be made to frameworks in light of the changed circumstances.

The authors of this box are Damiano Sandri and John Simon.
[1]See Bernanke (2004) or Blanchard and Simon (2001).

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CHAPTER 4

BREAKING THROUGH THE FRONTIER: CAN TODAY'S DYNAMIC LOW-INCOME COUNTRIES MAKE IT?

The frequency of growth takeoffs in low-income countries (LICs) has risen markedly during the past two decades, and these takeoffs have lasted longer than those that took place before the 1990s. Economic structure has not mattered much in sparking takeoffs—takeoffs have been achieved by LICs rich in resources and by those oriented toward manufacturing. A striking similarity between recent takeoffs and those before the 1990s is that they have been associated with higher investment and national saving rates and with stronger export growth, which sets them apart from LICs that were unable to take off and confirms the key role of capital accumulation and trade integration in development. However, recent takeoffs stand out from earlier takeoffs in two important aspects. First, today's dynamic LICs have achieved strong growth without building macroeconomic imbalances—as reflected in declining inflation, more competitive exchange rates, and appreciably lower public and external debt accumulation. For resource-rich LICs, this has been due to a much greater reliance on foreign direct investment (FDI). For other LICs, strong growth was achieved despite lower investment levels than in the previous generation. Second, recent takeoffs are associated with a faster pace of implementing productivity-enhancing structural reforms and strengthening institutions. For example, these LICs have a lower regulatory burden, better infrastructure, higher education levels, and greater political stability. Looking forward, there remain many challenges to maintaining strong growth performance in today's dynamic LICs, including the concentration of their growth in only a few sectors and the need to diversify their economies, and ensuring that growth leads to broad-based improvements in living standards. Still, if these countries succeed in preserving their improved policy foundation and maintaining their momentum in structural reform, they seem more likely to stay on course and avoid the reversals in economic fortunes that afflicted many dynamic LICs in the past.

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Introduction

LICs have made a comeback during the past two decades (Figure 4.1). Growth in their output per capita rebounded beginning in the 1990s. Furthermore, they have grown at a faster pace than advanced economies since the turn of the 21st century and have even outpaced other emerging market and developing economies since the Great Recession.[1] Could this be the beginning of a new era for LIC growth and convergence?

For skeptics, however, this comeback evokes the 1960s and early 1970s, when LIC growth looked promising, only to disappoint when global economic conditions turned sour in the 1980s. LICs' subsequent economic deceleration induced deep pessimism about their prospects, and many wondered if they could escape poverty and economic divergence given their weak institutions, unimpressive economic reform, and resource-curse issues.[2] Is the recent comeback just déjà vu?

This chapter sheds light on the above debate by analyzing growth takeoffs in LICs during the past 60 years and comparing takeoffs beginning in the 1990s with those in earlier decades. It assesses whether recent takeoffs are less vulnerable than in the past, improving LICs' ability to take off and rise out of poverty even in a sluggish world economy. Specifically, the chapter addresses the following questions:

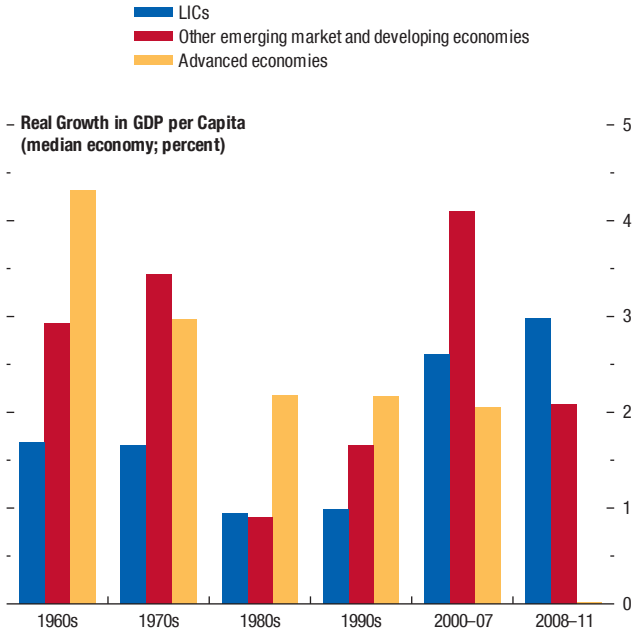
- How do recent growth takeoffs in LICs compare with those of the past? Are they stronger? Have they lasted longer?
- What has changed in the economic and structural conditions and policies of LICs that have taken off since the 1990s compared with those that took off in the past? For both eras, what separated LICs that launched a takeoff from those that did not?

[1]Some studies have also noted the recent increased persistence of LIC growth. See Chapters 2 and 3, respectively, of the October 2008 and April 2011 *Regional Economic Outlook: Sub-Saharan Africa* reports.

[2]See Pritchett (1997), Sachs and Warner (1997, 2001), Easterly and Levine (1997), and Rodrik (1999).

Figure 4.1. Economic Performance of Low-Income Countries and Others

Low-income countries (LICs) have seen a major improvement in their economic performance since the 1990s. Growth in output per capita for the median LIC has increased since the 1990s. It is now higher than median growth in other economy groups.



Sources: IMF, World Economic Outlook database (October 2012); Penn World Table 7.1; World Bank, World Development Indicators database; and IMF staff calculations.
Note: Economy groups and indicators are defined in Appendix 4.1. Real GDP per capita is in purchasing-power-parity terms. The 2008–11 median of real GDP per capita growth of advanced economies is near zero (0.02 percentage point).

- Can historical experience shed further light on specific policies that can help LICs ignite and sustain growth takeoffs?
- What are the key policy lessons for today's LICs?

This chapter addresses these questions by examining the nature of growth takeoffs in more than 60 LICs since the 1950s. It first defines and identifies LIC growth takeoffs and compares the strength of these takeoffs from a historical perspective. It then uses statistical associations and multivariate estimations to gauge the differences in the economic conditions and policies in LICs that experienced growth takeoffs since the 1990s compared with LICs that took off in earlier periods, and between today's dynamic LICs and their counterparts that could not take off. The analysis then zooms in on country-specific experiences to draw lessons for today's LICs. The chapter concludes by assessing the economic prospects for LICs.

LIC Takeoffs in Historical Perspective

This section identifies growth takeoffs in LICs during the past two decades and compares them with earlier takeoffs.[3] A growth takeoff is identified as an upswing in LIC output per capita that lasts at least five years, with average annual growth in real output per capita during the upswing of at least 3.5 percent. The Harding and Pagan (2002) methodology is used to pick turning points in each LIC's annual level of purchasing-power-parity (PPP)-adjusted real GDP per capita from 1950 to 2011 and then to identify the upswings.[4] The threshold of 3.5 percent growth is the 60th percentile of growth in output per capita in all emerging market and developing economies over the past two decades and is the standard threshold used in

[3]Throughout the chapter, growth is expressed in terms of growth in PPP-adjusted real GDP per capita. Advanced economies correspond to the member economies of the Organization for Economic Cooperation and Development as of 1990, with the exception of Turkey. All other economies are classified as emerging market and developing economies (EMDEs). At any given time, an LIC is defined as an economy whose average real output per capita over the previous five years is lower than a time-varying low-income threshold. The low-income threshold in 1990 is set at the bottom 45th percentile of average EMDE output per capita (about $2,600 in PPP-adjusted constant 2005 U.S. dollars). This threshold is extrapolated backward and forward using the average growth rate of global output per capita during 1950–2011 (about 2.3 percent per year) to get a low-income threshold for each year. To ensure that the results are unaffected by very small economies, the sample excludes economies whose average 1950–2011 population was less than 1 million. China and India are included in EMDEs, but not LICs.

[4]See Appendix 4.1 for a description of the methodology.

Table 4.1. Takeoffs in Low-Income Countries, 1990–2011

Economic Structure	Country	Start	End[1]	Duration (years)[2]	Average Annual Real GDP per Capita Growth (percent)[3]
Predominantly Agricultural	Sudan	1994		18	4.62
	Rwanda	1995		17	6.93
	Kyrgyz Republic	1996	2008	13	3.65
	Liberia	1996	2002	7	17.54
	Nigeria[4]	1996	2008	13	4.70
	Lao P.D.R.[4]	1999		13	6.10
	Sierra Leone	2000		12	5.87
	Ethiopia	2004		8	7.09
	Liberia	2006		6	4.12
Predominantly Manufacturing	Sri Lanka	1992	2000	9	4.39
	Yemen[4]	1992	1998	7	5.12
	Cambodia	1996		16	5.63
	Bangladesh	1997		15	3.93
	Tajikistan	1997	2007	11	6.20
	Indonesia[4]	2000		12	3.76
	Moldova	2000	2008	9	6.00
	Sri Lanka	2002		10	4.88
Predominantly Nonrenewable Resource and Forestry	Azerbaijan	1997	2010	14	11.97
	Chad	1997	2005	9	6.55
	Zambia	2000	2008	9	4.70
	Angola	2002	2009	8	10.72
	Georgia	2002		10	6.28
	Ghana	2002		10	4.59
	Mongolia	2002	2008	7	6.22
	Uzbekistan	2002		10	6.04
Other (no specialized economic structure)	Mozambique	1996		16	5.78
	Tanzania	1997		15	4.10
	Afghanistan	2002	2007	6	13.15
	Malawi	2002		10	4.32

Source: IMF staff calculations.

Note: The table lists emerging market and developing economies that started with real output per capita (purchasing-power-parity-adjusted constant 2005 U.S. dollars) below the time-varying threshold at the beginning of the episode and grew at an average rate of 3.5 percent or higher for at least five years at any time since 1990. See Appendix 4.1 for details on how the economic structure classifications are derived. Countries in red were experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See Appendix 4.1 for the definition of conflict and the source of the conflict data.

[1]Ongoing takeoffs as of 2011 are left blank.

[2]Ongoing takeoffs as of 2011 use duration as of 2011.

[3]Ongoing takeoffs as of 2011 use average growth as of 2011.

[4]Countries are also validly classified as predominantly nonrenewable resource and forestry producers.

other studies.[5] The window of five years is long enough to rule out one-time increases in growth in output per capita within shorter periods. Together, these criteria identify 29 growth takeoffs during 1990–2011 (Table 4.1) and 41 episodes in earlier decades (Table 4.2).[6]

The frequency of LICs starting or sustaining a takeoff has increased since 1990. Figure 4.2, panel 1, shows the number and share of LICs that embarked on a takeoff each year and confirms an increase in this frequency since the late 1990s.

Panel 2 shows the total number and share of LICs that either took off or sustained an ongoing takeoff. It suggests that there were two waves of takeoffs, one from the mid-1960s to the early 1970s and one beginning in the 1990s. The frequency of growth takeoffs declined after 2008, in part because of data censoring, but also because of a drop in the share of LICs that had sustained their takeoffs.[7] Nevertheless, despite the Great Recession, one-third of LICs still sustained their takeoffs as of 2011 compared with an average of 20 percent during the 1980s.

Takeoffs since the 1990s have lasted longer than those in the previous generation (Figure 4.2, panel 3). Over the past two decades, the median duration was 9 years for growth episodes that were already completed and 12 years for episodes that were still ongoing as of

[5]See Hausmann, Pritchett, and Rodrik (2005) and Johnson, Ostry, and Subramanian (2007). The empirical results hold for modifications to the definition for low-income (for instance, a fixed low-income threshold) or to the criteria for identifying takeoffs (for example, a higher growth threshold or a longer-lived upswing). See Appendices 4.2 and 4.3 for details.

[6]Some of these episodes followed serious internal or external conflicts and were excluded from the analysis (see Appendix 4.1 for the definition of a postconflict takeoff). However, the results hold even with the inclusion of postconflict cases. Note also that some of the episodes in Tables 4.1 and 4.2 would be considered to be of longer duration if short-lived breaks between episodes for the same country were excluded. The empirical results of the chapter are broadly unchanged with an alternative definition of growth takeoffs that allows for such breaks. See Appendices 4.2 and 4.3 for details.

[7]Given the criterion that a takeoff must last at least five years, it is not possible to identify new takeoffs that began after 2007.

Table 4.2. Takeoffs in Low-Income Countries before 1990

Economic Structure	Country	Start	End[1]	Duration (years)[2]	Average Annual Real GDP per Capita Growth (percent)[3]
Predominantly Agricultural	Mauritania[4]	1962	1976	15	7.95
	Nigeria[4]	1969	1974	6	8.93
	Mali	1975	1986	12	4.00
	Lao P.D.R.	1980	1986	7	5.43
	Lao P.D.R.	1989	1997	9	4.28
Predominantly Manufacturing	Sri Lanka	1966	1970	5	4.87
	Morocco[4]	1967	1971	5	5.32
	Malawi	1968	1978	11	5.24
	Zimbabwe[4]	1969	1974	6	9.09
	Morocco[4]	1973	1977	5	7.33
	Thailand	1973	1982	10	4.95
	Zimbabwe[4]	1978	1983	6	5.72
	Vietnam	1981		31	4.89
	Egypt[4]	1982	2010	29	4.19
	Indonesia[4]	1983	1997	15	4.81
Predominantly Nonrenewable Resource and Forestry	Zambia	1963	1968	6	6.69
	Indonesia	1964	1981	18	4.87
	Botswana	1966	1973	8	15.48
	Republic of Congo	1978	1984	7	9.10
	Uganda	1988	1994	7	4.70
Other (no specialized economic structure)	Thailand	1959	1971	13	5.43
	Togo	1963	1972	10	4.38
	Republic of Congo	1964	1973	10	6.41
	Cameroon	1968	1979	12	4.38
	Sierra Leone	1968	1972	5	5.49
	Lesotho	1972	1978	7	9.97
	Sri Lanka	1972	1982	11	4.82
	Sierra Leone	1981	1987	7	4.65
	Lesotho	1985	1990	6	3.71
	Tanzania	1985	1991	7	4.33
	Mozambique	1987	1991	5	4.19
Missing Data	Bulgaria	1953	1988	36	5.28
	Cambodia	1954	1963	10	3.58
	Morocco	1958	1964	7	8.69
	Malawi	1960	1966	7	5.97
	Burundi	1962	1973	12	3.81
	Tanzania	1962	1975	14	3.76
	Ghana	1968	1974	7	5.01
	Haiti	1973	1980	8	3.91
	Vietnam	1975	1979	5	4.55
	Cambodia	1983	1988	6	6.32

Source: IMF staff calculations.

Note: The table lists emerging market and developing economies that started with real output per capita (purchasing-power-parity-adjusted constant 2005 U.S. dollars) below the time-varying threshold at the beginning of the episode and grew at an average rate of 3.5 percent or higher for at least five years at any time before 1990. See Appendix 4.1 for details on how the economic structure classifications are derived. Countries in red were experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See Appendix 4.1 for the definition of conflict and the source of the conflict data.

[1]Ongoing takeoffs as of 2011 are left blank.

[2]Ongoing takeoffs as of 2011 use duration as of 2011.

[3]Ongoing takeoffs as of 2011 use average growth as of 2011.

[4]Countries are also validly classified as predominantly nonrenewable resource and forestry producers.

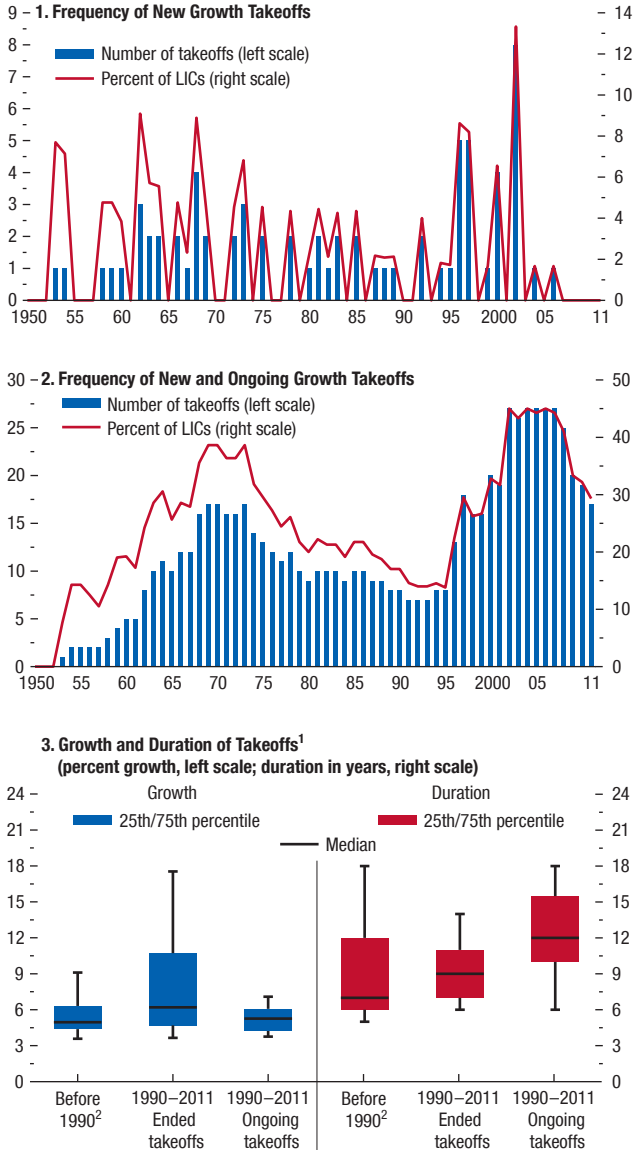
2011. Before 1990, the median duration of a takeoff was seven years. Median growth in output per capita was 6¼ percent and 5¼ percent, respectively, in ended and ongoing takeoffs over the past two decades, compared with about 5 percent for takeoffs before 1990.

Global conditions helped spur LIC takeoffs, but there was obviously more at play. Figure 4.3 documents the behavior of global growth, the U.S. real interest rate as a proxy for global interest rates, and terms-of-trade growth underlying LIC takeoffs before and after the 1990s. Each global indicator is presented in three snapshots: its average level during the five years before takeoff, five years after takeoff, and during years six to ten after takeoff.[8] Compared with pre-1990 takeoffs, recent takeoffs started under weaker global growth and higher global interest rates. However, global growth and interest rate conditions tended to improve after takeoff for the current generation, whereas they deteriorated for the previous generation. Terms-of-trade growth before takeoff was more favorable for the former than the latter, although terms-of-trade growth rose for both

[8]Global growth and interest rates are expressed as deviations from their average value during the entire sample period (1950–2011).

Figure 4.2. Frequency of New and Ongoing Takeoffs in Low-Income Countries

The share of low-income countries (LICs) starting and sustaining growth takeoffs increased sharply beginning in the 1990s. Nearly one-third of LICs were still sustaining a takeoff in 2011 despite the Great Recession. On average, takeoffs during the past two decades have been stronger and longer than those before the 1990s.

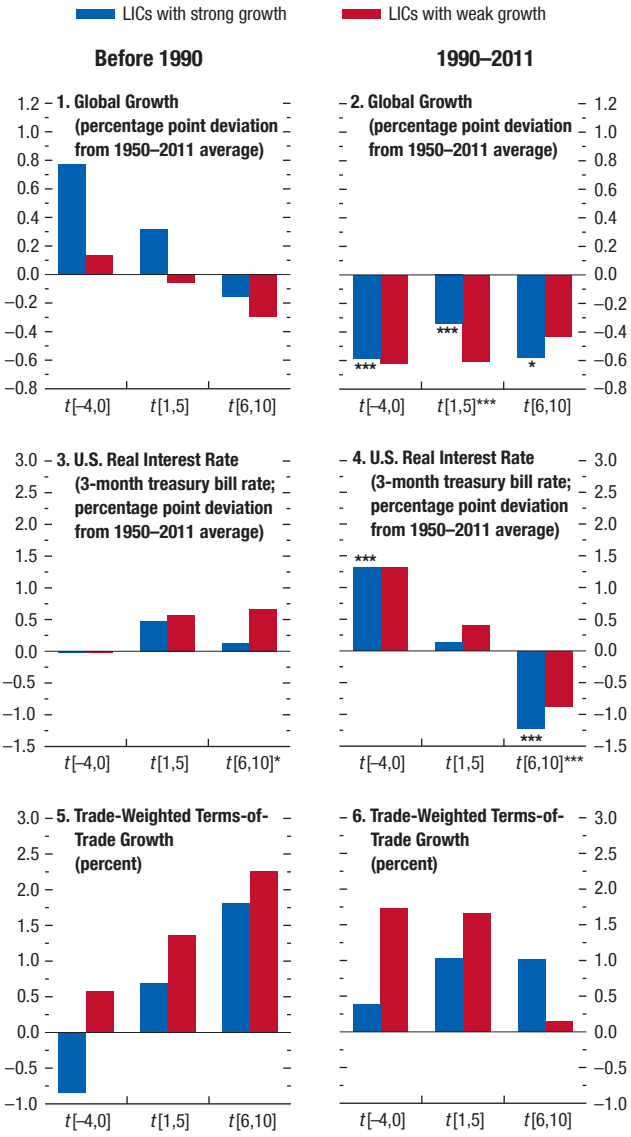


Sources: IMF, World Economic Outlook database (October 2012); Penn World Table 7.1; World Bank, World Development Indicators database; and IMF staff calculations.
Note: Economy groups and indicators are defined in Appendix 4.1. See the text for definitions of new and ongoing growth takeoffs.
[1]The horizontal line inside each box is the median within the group; the upper and lower edges of each box show the top and bottom quartiles. The distance between the black lines (adjacent values) above and below the box indicates the range of the distribution within that generation, excluding outliers.
[2]The episodes before 1990 include one ongoing takeoff (Vietnam since 1981).

Figure 4.3. The Global Environment behind Low-Income Countries' Growth Takeoffs

(Median economy; t = 1 in the first year of a strong or weak growth episode)

Global growth and interest rate conditions tended to improve after takeoff for the current generation, whereas they deteriorated for the previous generation. Terms-of-trade growth tended to improve during takeoffs for both generations.

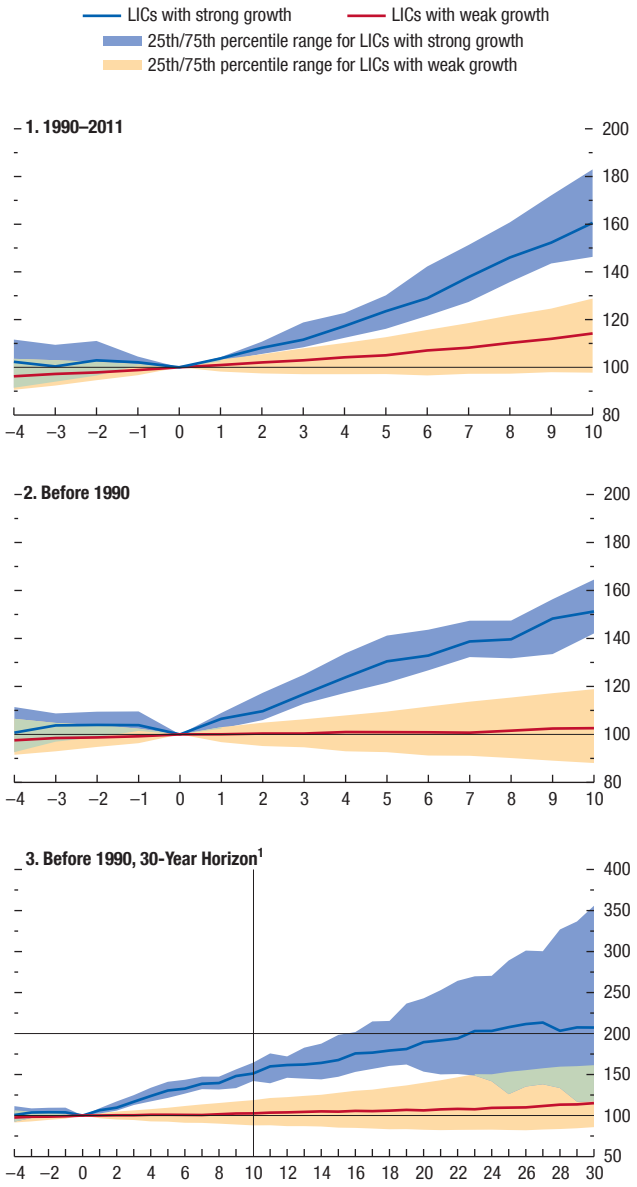


Sources: Haver Analytics; IMF, World Economic Outlook database (October 2012); Penn World Table 7.1; World Bank, World Development Indicators database (2012); and IMF staff calculations.
Note: LICs = low-income countries. Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data. *, **, and *** denote statistically significant difference in distributions (based on the Kolmogorov-Smirnov test) at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance tests on the *x*-axis are for the difference in the distributions between the groups of strong and weak growth. Significance tests on the blue bars are for the difference in the distributions across 1990–2011 and before 1990 (not shown for red bars). A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel.

Figure 4.4. Real Output per Capita after Takeoff in Low-Income Countries

(Median economy; normalized to 100 at t = 0, the year before the start of a strong or weak growth episode; years on x-axis)

Output per capita tended to stay on a higher trajectory for low-income countries (LICs) that succeeded in taking off, compared with those that did not. It typically increased by 60 percent during the 10 years after takeoff for the current generation of dynamic LICs and by 50 percent for the previous generation. This compares with an increase of less than 15 percent for the LICs that were unable to take off for the current generation and less than 5 percent for the previous generation. However, some dynamic LICs in the previous generation experienced reversals in output per capita growth within 20 years of takeoff.



Source: IMF staff calculations.
Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data.
[1]The vertical line indicates the 10-year horizon.

generations after takeoff. That said, LICs that were unable to take off faced similar global conditions as those that did, suggesting that domestic conditions and policies also affect whether or not an LIC takes off.

Igniting takeoffs pays off in long-term gains in output per capita. Figure 4.4 shows that LICs that succeeded in taking off tended to remain on a stronger trajectory for output per capita in the years after takeoff.[9] For the current generation, output per capita increased by 60 percent over the 10 years following takeoff, compared with about 15 percent for LICs with weaker growth (Figure 4.4, panel 1). For the previous-generation dynamic LICs, output per capita typically increased by 50 percent 10 years after takeoff and doubled within 25 years (Figure 4.4, panels 2 and 3).

LICs that took off had a variety of economic structures, with some rich in resources and others focused on manufacturing. The same holds for their peers that did not take off. Among the current generation of takeoffs, the resource-rich LICs performed particularly well—their GDP per capita typically rose by 80 percent in 10 years—but many of their resource-rich peers could not jump-start growth (Figure 4.5, panels 1 and 2). Among dynamic LICs prior to 1990, resource-rich LICs tended to perform strongly in the first 10 years after takeoff but were overtaken after 10 years by other LICs (Figure 4.5, panel 3). Among past weak performers, resource-rich LICs in fact experienced the slowest growth (Figure 4.5, panel 4).[10] Manufacturing-oriented dynamic LICs among both the current and previous generation of takeoffs saw a 50 percent rise in GDP per capita after 10 years. But many of their manufacturing-oriented peers were unable to take off.

History tells a cautionary tale for LICs today. First, many currently dynamic LICs also belonged to the previous cohort of dynamic LICs, which raises questions about whether the vulnerabilities of these LICs have changed fundamentally. Second, close to one-third of previous takeoffs ended with a currency, debt, or banking crisis (Table 4.3). Although fewer of the recent takeoffs have ended with crises thus far (less than

[9]In Figure 4.4, the year before the start of each growth takeoff is centered at zero. The control group includes country-year pairs of LICs that did not experience a new or ongoing growth takeoff in the years in which the dynamic LICs took off.

[10]The poor performance of resource-rich economies in earlier decades confirms the conventional wisdom about the unintended consequences of resource abundance—the so-called resource curse manifested in Dutch disease, rent seeking, and extractive political regimes (IMF, 2012b; Iimi, 2007). What is most striking is that a group of resource-rich LICs was able to overcome the curse and take off.

Table 4.3. Crises and the Ends of Growth Takeoffs in Low-Income Countries, 1970–2011

Country	Takeoff Start	Takeoff End	Crisis[1]
Indonesia	1964	1981	1979 (currency)
Thailand	1973	1982	1983 (banking)
Mali	1975	1986	1987 (banking)
Vietnam	1975	1979	1981 (currency)
Republic of Congo	1978	1984	1986 (debt)
Zimbabwe	1978	1983	1983 (currency)
Lao P.D.R.	1980	1986	1997 (currency)
Sierra Leone	1981	1987	1989 (currency)
Indonesia	1983	1997	1997 (banking) 1998 (currency) 1999 (debt)
Tanzania	1985	1991	1990 (currency)
Uganda	1988	1994	1994 (banking)
Lao P.D.R.	1989	1997	1986 (currency)
Yemen	1992	1998	1996 (banking)
Nigeria	1996	2008	2009 (banking)
Zambia	2000	2008	2009 (currency)
Mongolia	2002	2008	2008 (banking)

Sources: Laeven and Valencia (2012); and IMF staff calculations.

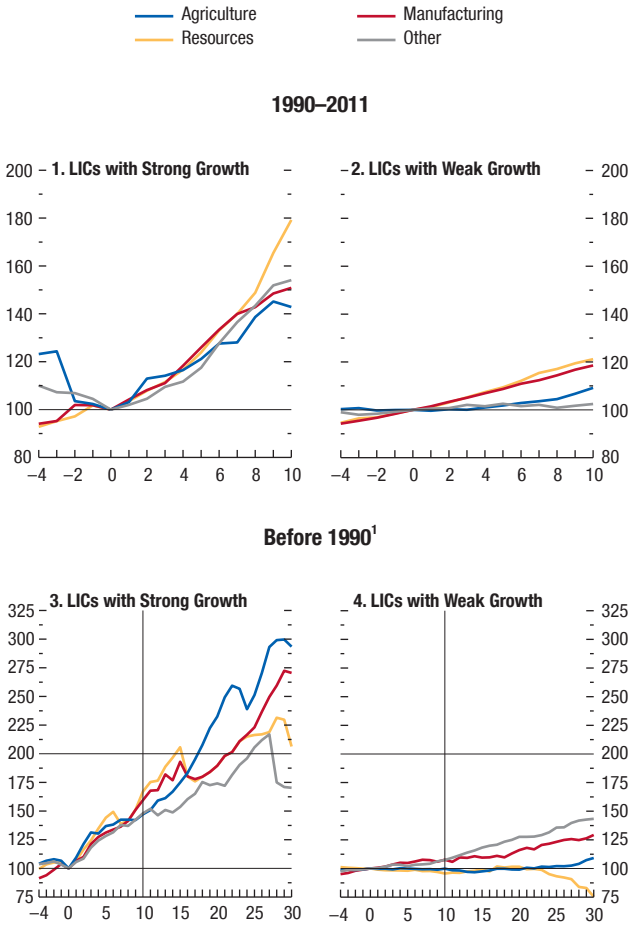
Note: Countries shown in red were experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See Appendix 4.1 for the definition of conflict and the source of the conflict data.

[1]Growth takeoffs are shown if their end year is coincident with a financial crisis, a financial crisis occurred in the previous two years, or a financial crisis occurred in the following two years. A financial crisis is a banking, currency, or sovereign debt crisis, taken from Laeven and Valencia (2012). Over the period 1970–89, 32 percent of growth takeoffs (either ended or ongoing) were associated with a financial crisis near their end. Over the period 1990–2011, the corresponding incidence was only 14 percent.

Figure 4.5. Economic Structure and Real Output per Capita after Takeoff in Low-Income Countries

(Median economy; normalized to 100 at t = 0, the year before the start of a strong or weak growth episode; years on x-axis)

Among the current generation of dynamic low-income countries (LICs) resource-rich LICs have typically grown faster than others. For the previous generation, although resource-rich economies were also among the strongest performers during the first 10 years after takeoff, they were eventually overtaken by other LICs. Among the weak performers, resource-rich LICs experienced the slowest growth.



Source: IMF staff calculations.

Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data.

[1]The vertical line indicates the 10-year horizon.

15 percent), their future prospects remain uncertain. Finally, Figure 4.4, panel 3, shows that the pace of growth in the previous generation of takeoffs slowed after 10 years, and that the output per capita of dynamic LICs in the bottom quartile of the distribution began to reverse its gains within 20 years after takeoff. Is the current generation of takeoffs vulnerable to similar reversals? The next section addresses this question.

What Lies within: The Role of Economic and Structural Policies and Institutions

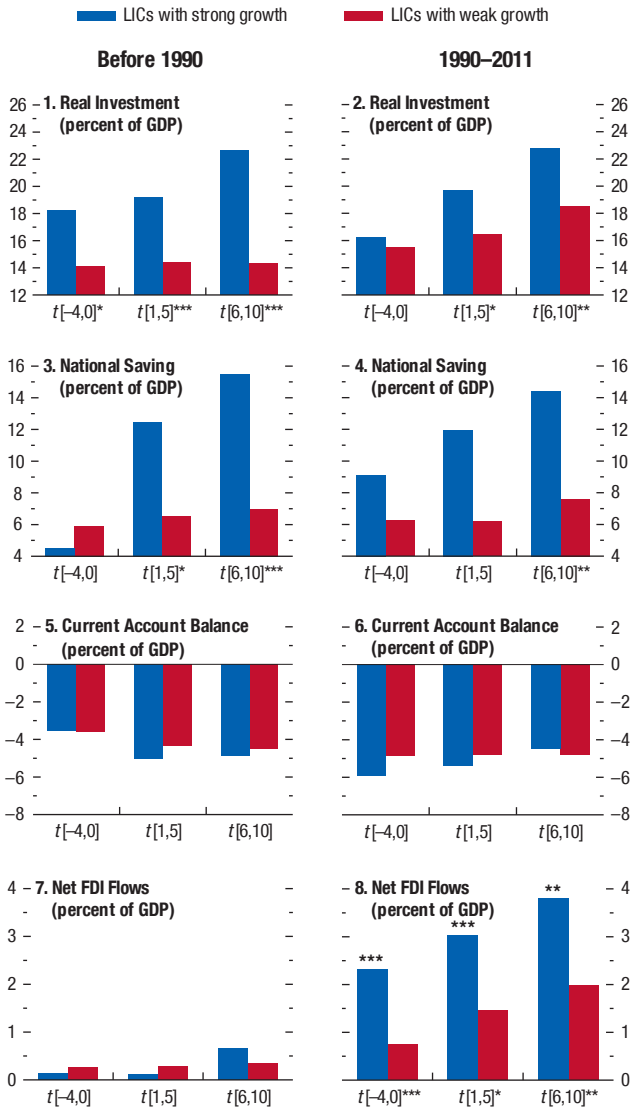
This section draws on the growth and development literature to address two key questions about the nature of LIC growth takeoffs. First, is takeoff associated with strong investment growth? The idea that investment is crucial to fostering growth in developing economies has a long history.[11] Second, is the growth strategy likely to endure? Even if investment were strong, growth could still fizzle if investment is not financed by sustainable means—giving rise to macroeconomic imbalances—or if it is not productive. Thus, to catalyze a takeoff and sustain it, strong investment

[11]See, for instance, Rostow (1956) and Rosenstein-Rodan (1943), among others.

Figure 4.6. Investment and Financing in Low-Income Countries

(Median economy; t = 1 in the first year of a strong or weak growth episode)

Dynamic low-income countries (LICs) from both generations tended to experience sharp increases in investment and saving rates during and after takeoffs. However, the current generation of dynamic LICs has tended to finance its current account deficits with a significantly higher share of foreign direct investment (FDI) flows than the weaker LICs and the previous generation of dynamic LICs.



Sources: IMF, Balance of Payments Statistics database; IMF, World Economic Outlook database (October 2012); Penn World Table 7.1; World Bank, World Development Indicators database (2012); and IMF staff calculations.

Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data. *, **, and *** denote statistically significant difference in distributions (based on the Kolmogorov-Smirnov test) at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance tests on the *x*-axis are for the difference in the distributions between the groups of strong and weak growth. Significance tests on the blue bars are for the difference in the distributions across 1990–2011 and before 1990 (not shown for red bars). A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel.

growth should be supported by policies that do not induce macroeconomic vulnerability and by reforms and institutions that foster productivity and competitiveness.[12] Against this premise, this section documents the differences in economic conditions in recent LIC growth takeoffs compared with those that occurred prior to the 1990s. However, all stylized facts are based on correlations and should be interpreted as associations with takeoffs rather than drivers of takeoffs.

Although both the current and previous generation of takeoffs coincided with strong investment growth, they differed significantly in how the saving-investment gaps were financed. Takeoffs in both generations were correlated with higher levels of investment and national saving rates compared with LICs that could not launch a growth takeoff (Figure 4.6, panels 1–4). In addition, current account deficits were broadly similar in both generations (Figure 4.6, panels 5 and 6). However, a larger share of the current account deficits was financed by FDI flows for the current generation of takeoffs compared with the previous generation. FDI flows also rose sharply after takeoff for the current generation of dynamic LICs compared with both the LICs with weak growth and the previous generation of dynamic LICs (Figure 4.6, panels 7 and 8).[13]

Recent LIC takeoffs were supported by sharp declines in public and external debt levels, in part as a result of their greater reliance on FDI, as well as by policy adjustments undertaken to qualify for debt relief (Figure 4.7, panels 1–4). Among the current-generation dynamic LICs, within 10 years after takeoff public debt decreased from more than 90 percent of GDP to 44 percent of GDP, and external debt fell from more than 70 percent of GDP to about 44 percent. Even if economies that received debt relief are excluded from the sample, the pattern of lower external and public debt within 10 years of takeoff still holds.[14]

More reliance on FDI and greater macroeconomic policy discipline have fostered similarly strong growth but lower inflation after takeoff relative to dynamic LICs in the previous generation (Figure 4.7, panels 5

[12]See Commission on Growth and Development (2008), Spence (2011), Lin (2012), and Rodrik (2003).

[13]The remarkable increase in FDI inflows to LICs has also been noted by others (Dabla-Norris and others, 2010). However, as shown below, for the manufacturing-oriented LICs, although FDI levels for the current generation exceeded those in previous generations, they did not increase sharply following takeoff. The share of foreign aid in GDP was also higher for the current generation of dynamic LICs than for the previous generation.

[14]See Appendix 4.2.

and 6). For the latter, public and external debt stood at 40 and 33 percent of GDP, respectively, before takeoff, but more than doubled within 10 to 20 years after takeoff, and inflation tended to increase as well.

There is no compelling evidence that recent takeoffs are accompanied by rising financial imbalances. The ratio of credit to GDP tended to increase gradually in recent takeoffs, corroborating the symbiotic relationship between financial intermediation and growth (Figure 4.7, panels 7 and 8). Still, credit-to-GDP ratios in current-generation dynamic LICs were lower than in LICs with weaker growth and in LICs that took off in the previous generation.[15]

Competitiveness and export growth are important for LIC takeoffs. Both today and in the previous generation, LICs with takeoffs experienced stronger export growth than LICs with weaker growth (Figure 4.8, panels 1 and 2). Today's LIC takeoffs tended to have more geographically diversified exports, which may be one reason they were able to sustain strong export growth—along with the fast growth in EMDEs such as China and India—despite anemic growth in advanced economies (Figure 4.8, panels 3 and 4).[16] However, greater trade exposure to other EMDEs also implies greater exposure to risks to growth in the latter and the related risks to commodity prices.

Related to the above, export structures were also more diversified in the dynamic LICs of both generations than in those with weak growth, but diversification reversed in the 10 years after takeoff for the current generation (Figure 4.8, panels 5 and 6). The greater concentration of exports after takeoff is partly related to increased specialization in commodity-related activity in LICs that discover natural resources. Given the potential risks from such product concentration, including increased exposure to adverse external shocks and limited scope for quality upgrading, continued economic and export diversification will be needed to improve the resilience of today's LIC takeoffs.[17]

[15]Owing to data constraints, we were unable to assess other dimensions of financial stability related to prudential supervision and regulation or the use of macroprudential policies.

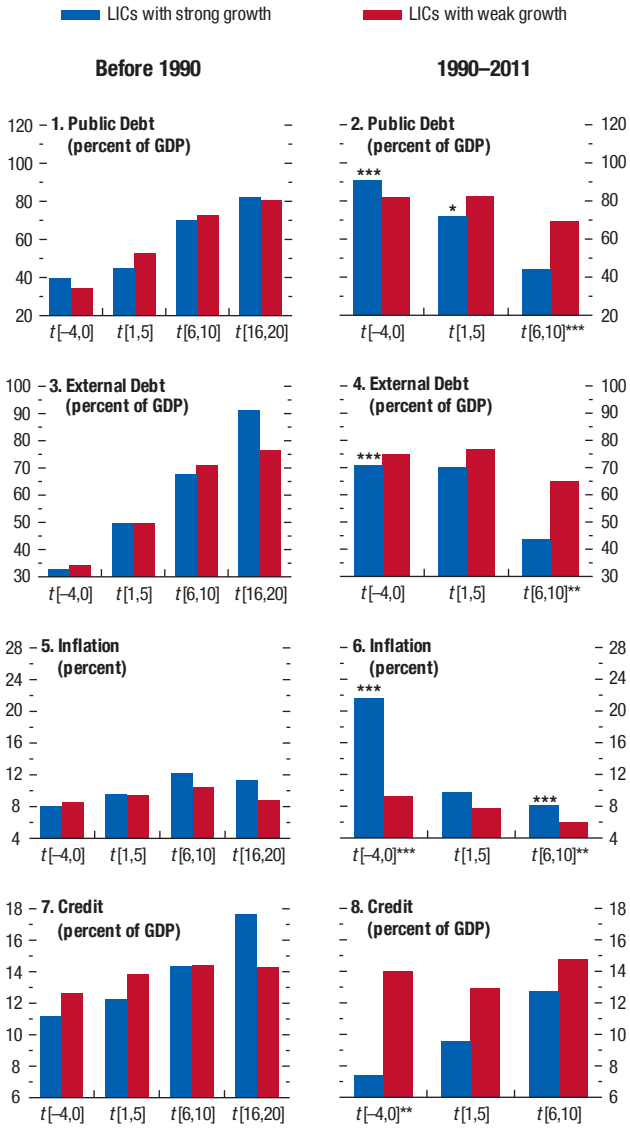
[16]Dabla-Norris, Espinoza, and Jahan (2012) find a sharp increase in LIC exports to emerging markets during the past three decades. They find that China and India have become significant destinations for LIC exports from all regions, whereas other emerging market economies, such as Brazil, Mexico, Russia, Saudi Arabia, South Africa, and Turkey, account for a large share of regional LIC exports.

[17]See, for example, Hausmann, Rodriguez, and Wagner (2006) and Papageorgiou and Spatafora (2012) for the benefits of economic diversification.

Figure 4.7. Macroeconomic Conditions in Low-Income Countries

(Median economy; t = 1 in the first year of a strong or weak growth episode)

Recent takeoffs were characterized by sharp reductions in public and external debt levels and inflation. In contrast, previous-generation takeoffs were characterized by generally worsening macroeconomic conditions.



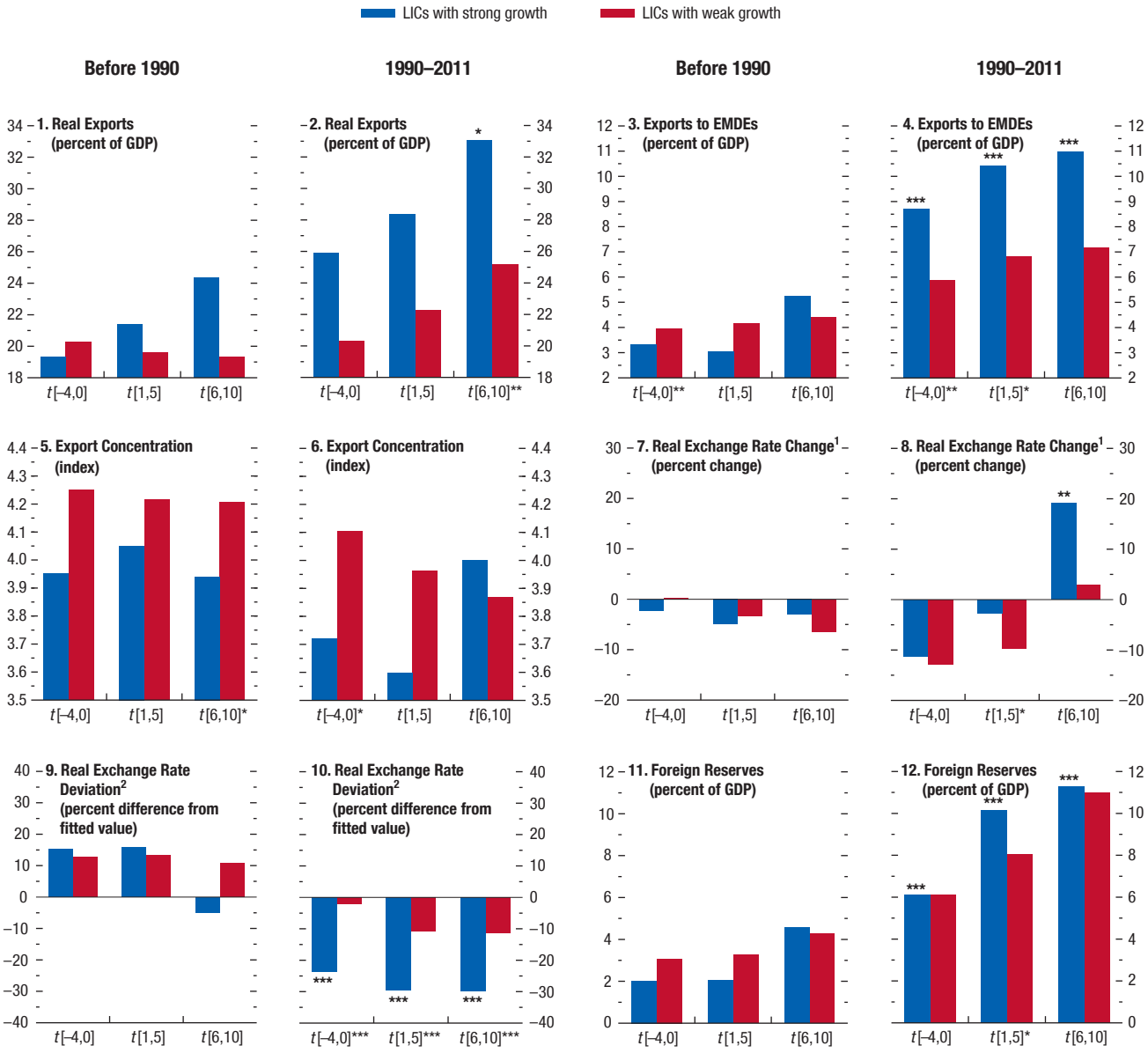
Sources: Abbas and others (2010); IMF, International Financial Statistics database; IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; World Bank, World Development Indicators database (2012); and IMF staff calculations.

Note: LICs = low-income countries. Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data. *, **, and *** denote statistically significant difference in distributions (based on the Kolmogorov-Smirnov test) at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance tests on the *x*-axis are for the difference in the distributions between the groups of strong and weak growth. Significance tests on the blue bars are for the difference in the distributions across 1990–2011 and before 1990 (not shown for red bars). A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel.

Figure 4.8. External Competitiveness, Export Growth, and Diversification in Low-Income Countries

(Median economy; t = 1 in the first year of a strong or weak growth episode)

In the current and previous generations of takeoffs, dynamic low-income countries (LICs) experienced stronger export growth than weakly performing LICs. Today's dynamic LICs tended to have deeper trade linkages with emerging market and developing economies (EMDEs) and took off with more diversified exports, although diversification tended to reverse later. Today's dynamic LICs also have more competitive real exchange rates and a greater accumulation of foreign reserves.



Sources: IMF, Direction of Trade Statistics database; IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; Papageorgiou and Spatafora (2012); Penn World Table 7.1; World Bank, World Development Indicators database (2012); and IMF staff calculations.

Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data. *, **, and *** denote statistically significant difference in distributions (based on the Kolmogorov-Smirnov test) at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance tests on the *x*-axis are for the difference in the distributions between the groups of strong and weak growth. Significance tests on the blue bars are for the difference in the distributions across 1990–2011 and before 1990 (not shown for red bars). A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel.

[1]The real exchange rate change is the percent change in the five-year average real exchange rate versus the United States over a five-year period.

[2]The real exchange rate deviation is the residual from a linear regression of the log real exchange rate versus the United States on the productivity differential of a country and the United States, as proxied by the income per capita differential.

The real exchange rate also seemed to help boost export performance for recent LIC takeoffs. Their real exchange rates versus the U.S. dollar typically depreciated during the five-year periods before and at the start of a takeoff, but there was appreciation pressure during the 6 to10 years after takeoff (Figure 4.8, panels 7 and 8).[18] However, the real exchange rate was typically some 25 to 30 percent weaker than its productivity-adjusted long-term level (Figure 4.8, panels 9 and 10), implying that these dynamic LICs were able to maintain price competitiveness.[19] A greater accumulation of foreign reserves (Figure 4.8, panels 11 and 12) may have helped in this regard. For takeoffs before 1990, the behavior of the real exchange rate was not that different during the periods before and after takeoff, but it was as much as 10 to 15 percent stronger than its productivity-adjusted long-term level until five years after takeoff. This may have been associated with weaker macroeconomic conditions combined with exchange rate pegs.[20]

LIC takeoffs tend to be complemented by improvements in the business climate and with productivity growth, but the record for the recent generation of takeoffs is much stronger than for the previous generation. Dynamic LICs in both generations tend to have smaller governments, lower regulatory barriers (proxied by the level of regulation in business, labor, and credit markets), better infrastructure, and higher human capital levels (proxied by the number of years of schooling) than LICs with weaker growth (Figure 4.9, panels 1–8). For recent takeoffs, the size of government and the level of regulatory barriers continued to decline after takeoff, and infrastructure and education continued to improve, whereas with the exception of education, these conditions remained the same or deteriorated for the previous generation.[21]

Turning to the role of social and political institutions in underpinning growth takeoffs, the findings suggest that today's dynamic LICs performed better on these institutional measures compared with both LICs with weak growth and dynamic LICs before the 1990s. The recent literature underscores the central role of economic and political institutions in determining why some economies are able to escape poverty and sustain strong growth, whereas others are not.[22] We analyze the evolution of economic and political inclusiveness, as proxied by the degree of income inequality and the degree of control over the executive, respectively (Figure 4.9, panels 9–12). Recent takeoffs display less income inequality, whereas income inequality was typically high in the previous generation of takeoffs. Political institutions are also stronger in the current generation of takeoffs—possibly reflecting the end of conflicts or greater democratization in many dynamic LICs in recent years.

Although the nature of takeoffs is broadly similar for dynamic LICs regardless of their economic structure, a few differences emerge in patterns of investment and its financing (Figure 4.10).[23] For resource-rich dynamic LICs, investment rates increased sharply around the time of takeoff for both generations (Figure 4.10, panels 1 and 2). Although saving rates rose as well, they fell short of investment rates, resulting in current account deficits for both generations (Figure 4.10, panels 3 and 4). This deficit was somewhat larger for the current generation, but it was more than fully offset by net FDI inflows (Figure 4.10, panels 5 and 6). FDI flows accounted for less than 50 percent of the current account deficit after takeoff for the previous generation. The current generation also received a sizably higher share of foreign aid (Figure 4.10, panels 7 and 8). Thus, these LICs were able to resist building

[18]The real effective exchange rate is not shown because fewer LICs have these data. For those that do, the observed pattern is similar to that based on the real exchange rate versus the U.S. dollar.

[19]The measure for the long-term real exchange rate level follows Rodrik (2008). It involves the regression of an economy's real exchange rate—measured by the price level relative to that of the United States—on its real GDP per capita relative to that of the United States. The predicted value of the real exchange rate from this regression provides the long-term level of the real exchange rate, whereas the difference between the predicted and actual real exchange rate is the degree of overvaluation. See also Johnson, Ostry, and Subramanian (2007).

[20]We also find a much lower share of fixed and hard pegs among dynamic LICs of the current generation relative both to LICs with weak growth and to dynamic LICs of the previous generation. For the latter it is possible that fixed exchange rate regimes, combined with other macroeconomic vulnerabilities, including rising inflation pressure, resulted in the observed overvaluation.

[21]Aiyar and others (2013) discuss the positive association between deterioration in these measures and economic deceleration in middle-income countries, suggesting that productivity-enhancing structural reforms are not just important for LICs.

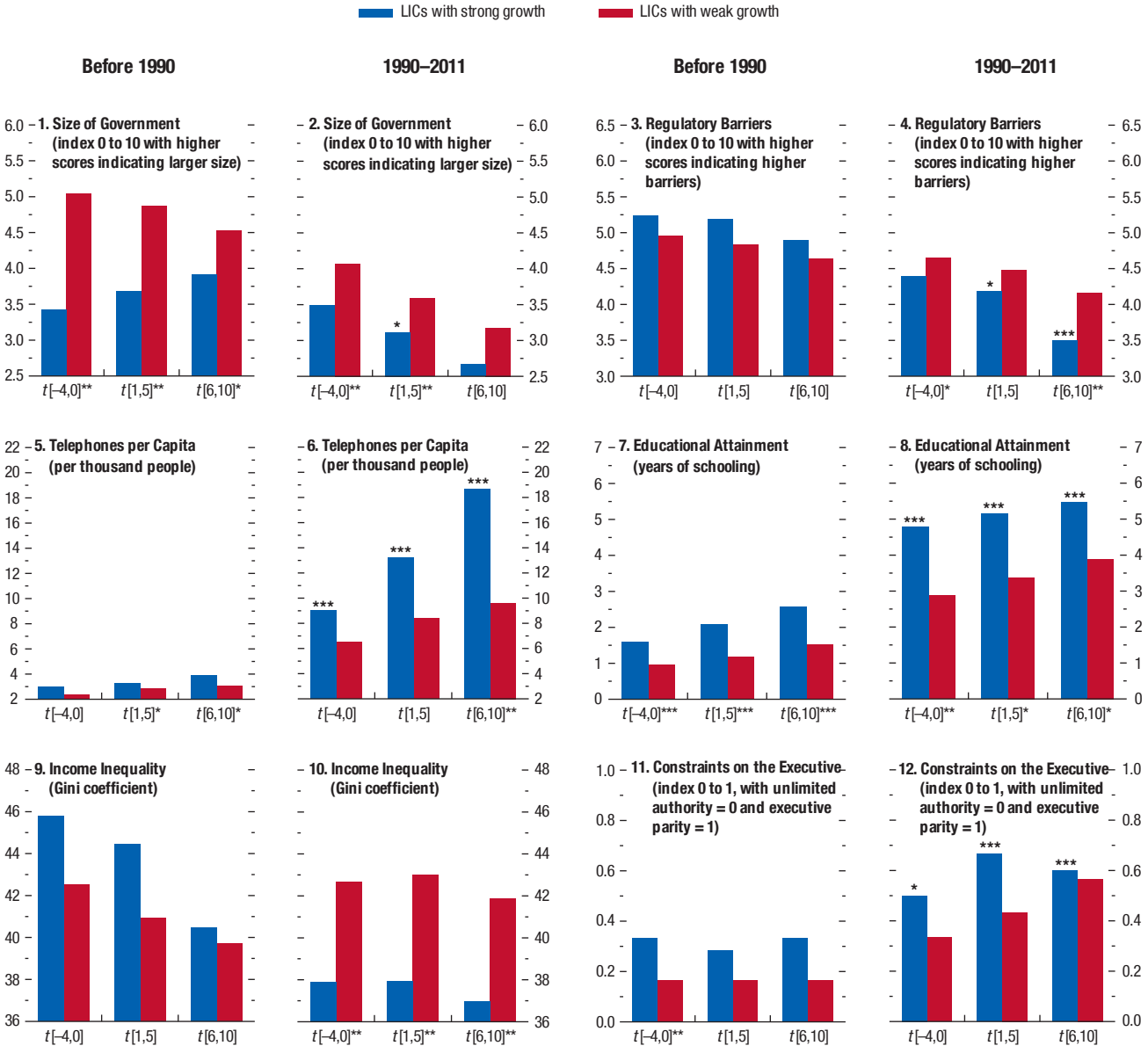
[22]See Acemoglu and Robinson (2012) and Johnson, Ostry, and Subramanian (2007) on the role of political institutions. See Berg, Ostry, and Zettelmeyer (2012); Hausmann, Pritchett, and Rodrik (2005); and Abiad and others (2012) on economic institutions as proxied by income inequality. Although not shown here, we found that recent takeoffs were positively correlated with greater life expectancy as well.

[23]It was not possible to conduct tests for statistical significance across the groups owing to the small number of countries in each group.

Figure 4.9. Structural Reforms, Infrastructure, and Political Conditions in Low-Income Countries

(Median economy; t = 1 in the first year of a strong or weak growth episode)

Today's dynamic low-income countries (LICs) tend to have smaller governments, lower regulatory barriers, and better infrastructure than their weaker counterparts from the current generation and dynamic LICs of previous generations. In addition, growth takeoffs tended to occur in economies with higher human capital levels and, for the current generation, more equal income distributions. The current generation of LICs also tends to have better checks and balances on the executive branch of the government.



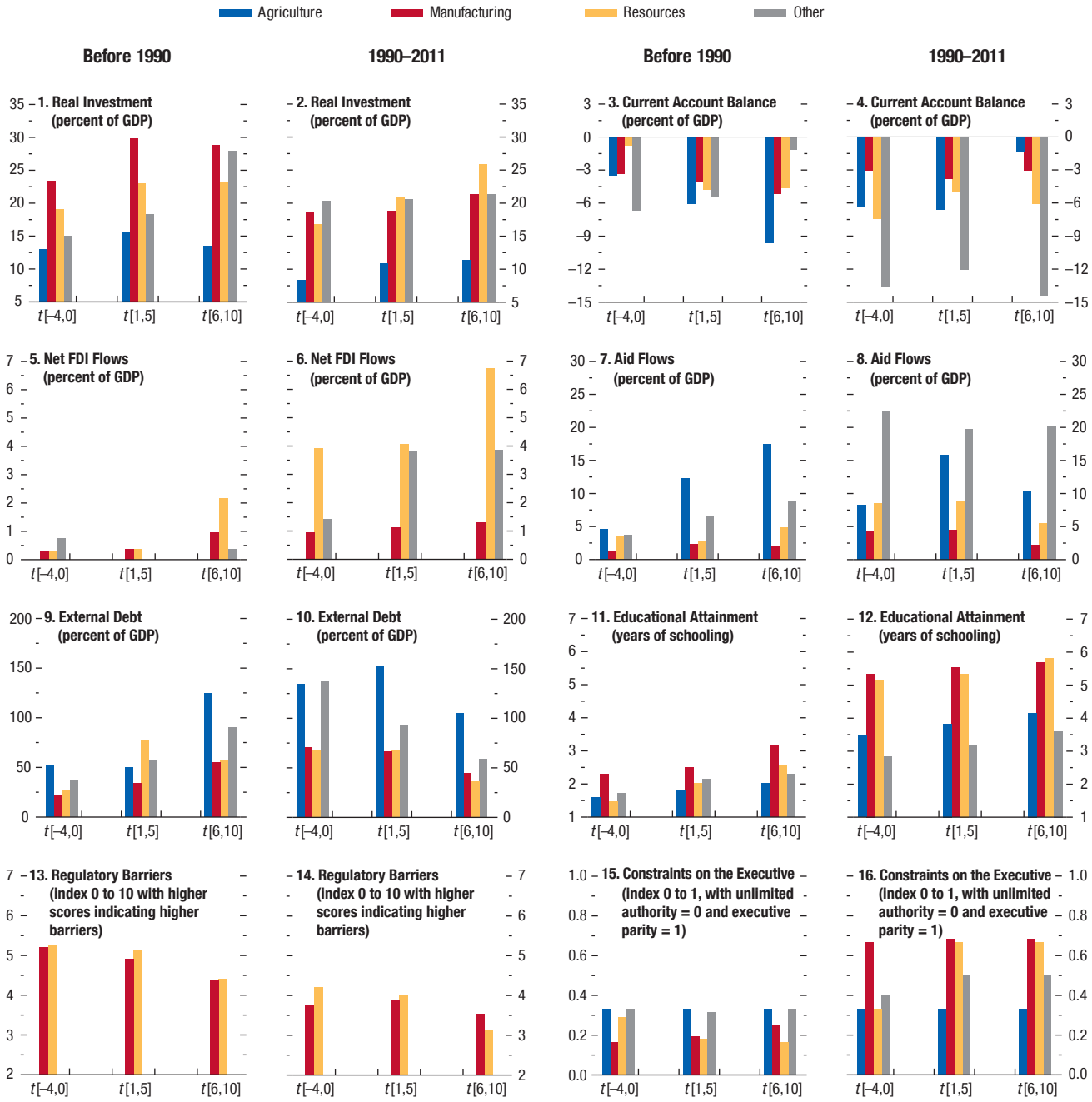
Sources: Banks and Wilson (2012); Barro and Lee (2010); Gwartney, Lawson, and Hall (2012); Political Regime Characteristics and Transitions database (2011); Solt (2009); World Bank, World Development Indicators database (2012); and IMF staff calculations.

Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data. *, **, and *** denote statistically significant difference in distributions (based on the Kolmogorov-Smirnov test) at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance tests on the *x*-axis are for the difference in the distributions between the groups of strong and weak growth. Significance tests on the blue bars are for the difference in the distributions across 1990–2011 and before 1990 (not shown for red bars). A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel.

Figure 4.10. Investment and Financing across the Spectrum of Today's Dynamic Low-Income Countries

(Median economy; t = 1 in the first year of a strong growth episode)

Investment rates were relatively high for both generations of dynamic low-income countries (LICs). However, external financing of this investment differed across groups. In the current generation, resource-oriented economies benefited most from foreign direct investment (FDI), while agriculture- and other-oriented economies benefited most from aid. Partly because of shifts in external financing, external debt eventually fell for all groups of today's dynamic LICs. Moreover, today's manufacturing- and resource-oriented economies helped to fuel their growth by reducing regulatory barriers while strengthening political institutions. At the same time, educational attainment improved for all groups.



Sources: Barro and Lee (2010); Gwartney, Lawson, and Hall (2012); IMF, Balance of Payments Statistics database; IMF, International Financial Statistics database; IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; Penn World Table 7.1; Political Regime Characteristics and Transitions database (2011); World Bank, World Development Indicators database; and IMF staff calculations.

Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for the definition of weak growth episodes (takeoffs). See Appendix 4.1 for the definition of conflict and the source of the conflict data. A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel. Bars are plotted only if there are at least three takeoffs.

up external debt after takeoff (Figure 4.10, panels 9 and 10). Resource-rich dynamic LICs from the current generation also outperformed their resource-rich peers of the previous generation in terms of stronger human capital levels, lower regulatory barriers, and stronger political institutions (Figure 4.10, panels 11–16). Such reforms, if sustained, will help these LICs engineer more broad-based growth over time (see the example of Indonesia below).

Takeoffs in today's manufacturing-oriented dynamic LICs were associated with lower investment than in the past (see Figure 4.10). However, this did not compromise their growth rates, GDP per capita increased 50 percent after 10 years for both generations (see Figure 4.5). This suggests that the current generation likely enjoyed greater productivity gains. Indeed, proxies for productivity-inducing structural conditions and institutions were much stronger for the current generation of LIC compared with their peers of the past. However, these LICs may still need to raise the rate of productive investment over time: manufacturing-oriented dynamic LICs in the past had stronger investment rates than did their resource-rich counterparts and eventually had stronger output per capita gains. Finally, the current generation of manufacturing-oriented LICs also had lower current account deficits than did the previous generation, and their net FDI and aid inflows were marginally higher. Some manufacturing-oriented dynamic LICs have recently experienced sharp increases in FDI, intended to raise investment and spur export growth and diversification (see the example of Cambodia below).

These stylized facts inspire more confidence in the strength of recent LIC growth takeoffs compared with those in the past. The correlations cannot answer whether there are one or more key drivers of these takeoffs, and in all likelihood the recent takeoffs were the result of a combination of several factors and their interplay with global conditions. Moreover, the policy improvements thus far may not be enough for sustained improvements in growth and income convergence. That said, the overall picture is promising. The strong investment-oriented and externally oriented growth in recent takeoffs relied less on foreign borrowing, which likely gave dynamic LICs more room for policy maneuver. Growth was also helped by a broad range of productivity-enhancing structural reforms, although further export diversification will be essential to improve their economic resilience. Finally, recent takeoffs have also occurred under more inclusive institutions. Many of these indicators are regarded as key determinants of sustained growth and bode well for today's dynamic LICs, particularly if they can maintain their policy momentum.[24]

Putting It All Together

To assess which conditions and policies are most strongly associated with growth takeoffs, the conditional probability of an LIC growth takeoff is estimated at an annual frequency. A logistic regression (logit) model allows the analysis to jointly consider a number of indicators identified as important in the stylized facts, depending on their data availability over the sample period. However, as in most statistical investigations, all estimated relationships should be interpreted solely as associational, rather than causal. Moreover, given the limited availability of data for many variables and the relative rarity of a takeoff, the model's results should be taken with a grain of salt.[25]

The overall picture suggests that a country's chances of a new growth takeoff are related both to the global economic environment and to the initial levels and changes in the LIC's domestic macroeconomic conditions and structural characteristics (Table 4.4). Some of these relationships have changed since 1990 (highlighted in bold in the table). In particular, the following have become more important: a more competitive exchange rate, deeper export links with other EMDEs, higher human capital levels, initial levels of income per capita, and overall economic size. Indeed, as global trade and competition increase, greater external competitiveness, export diversification, and productivity improvements may raise LICs' chances of takeoff relatively more than when the global economy is less integrated.

The baseline results suggest that the chances of takeoff more than tripled during the 2000s compared with the period before 1990 (Figure 4.11). The predicted

[24]See Berg, Ostry, and Zettelmeyer (2012); Hausmann, Pritchett, and Rodrik (2005); Jones and Olken (2008); and Abiad and others (2012).

[25]A number of variables that stood out as significantly different for the current generation of takeoffs could not be incorporated into the logit model because of limited data coverage. These include net FDI flows, external debt, foreign reserves, and income inequality, among others. For the robustness of the findings to the rare-events problem and alternative definitions of low income, criteria for identifying takeoff, and estimation methods, see Appendix 4.3.

annual probability of a new takeoff in any given year increased from less than 1 percent before 1990 to close to 3 percent during the 2000s. Improved structural conditions (particularly, more years of schooling) contributed most to this increase. Better macroeconomic conditions (higher investment growth, falling debt) are the next most important. Finally, stronger global conditions and more outward-oriented policies (a more competitive real exchange rate, more exports to EMDEs) equally boosted the chance of a new takeoff. Higher initial income per capita in the 2000s lowered the chance of a takeoff, reflecting convergence, whereas larger economic size raised it, suggesting gains from economies of scale. However, as noted, the results should be treated with caution because these are only associations and because data issues preclude a deeper analysis of some channels.

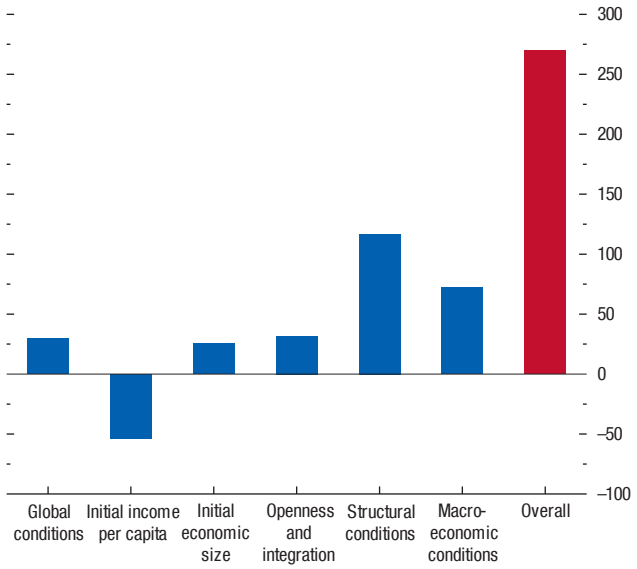
Lessons from History

This section looks at five individual experiences with growth takeoffs to provide more details on the specific policies and conditions that affected these countries' macroeconomic outcomes after takeoff. The cases include two economies that pursued industrial development with very different growth strategies (Brazil and Korea, 1960–80),[26] a resource-rich economy that diversified into manufacturing (Indonesia since the mid-1960s), an economy that is shifting into commodities (Mozambique since the mid-1990s), and an economy driven by manufacturing activity (Cambodia since the mid-1990s). Rather than a detailed discussion of the country experiences, which is already available for some of these cases in the development literature (see the references for each case study), the focus here is on drawing out differences in these countries' growth and investment strategies, the financing of their saving-investment gaps, and policy measures that affected productivity and competitiveness.

[26]Note that Brazil and Korea were not LICs at the time of their takeoffs, as determined by the chapter's baseline definition of a time-varying low-income threshold. However, their initial income levels were low in absolute terms, and their experiences portray efforts in structural transformation and development.

Figure 4.11. Contributors to the Changing Likelihood of a Growth Takeoff in Low-Income Countries
(Percent change in odds ratio; 2000s versus before 1990)

The predicted annual chance of a strong growth takeoff for an average low-income country was larger in the 2000s than it was before 1990. More favorable global conditions, greater economic size, a larger share of exports going to emerging market and developing economies, a more competitive real exchange rate, more years of schooling, higher investment, lower inflation, and lower public debt all contributed to this rise; higher initial income per capita lowered the chances.



Source: IMF staff calculations.
Note: The odds ratio is the probability of starting a takeoff divided by the probability of not starting one. The estimated contribution of the variables to the percent change in the predicted odds ratio is based on the logistic regression coefficient estimates in Table 4.4, for the full sample. The variable groups shown correspond to those in Table 4.4. The average values of the variables over either the period before 1990 or 2000–11 are used to calculate the predicted odds ratio. The associated predicted probabilities at these average values are 0.8 percent for the subsample before 1990 and 2.8 percent for the 2000–11 subsample. To calculate the overall change, the product of the contributions is used. See Appendix 4.3 for additional details on the model specification and estimation.

Table 4.4. Explaining Growth Takeoffs in Dynamic Developing Economies

	Full Sample		Before 1990		1990–2011	
Explanatory Variable	Logit Coef.	Aver. Marg. Eff.	Logit Coef.	Aver. Marg. Eff.	Logit Coef.	Aver. Marg. Eff.
Global Conditions						
Contemporaneous World Real	0.800**	2.250**	0.859**	2.450**	1.866***	4.200***
GDP Growth	(0.323)	(1.060)	(0.420)	(1.210)	(0.567)	(1.480)
Contemporaneous U.S. Three-Month Treasury	0.032	0.091	0.110	0.313	0.433	0.973
Bill Real Rate	(0.220)	(0.621)	(0.381)	(1.110)	(0.330)	(0.764)
Contemporaneous Terms-of-Trade Growth	0.008	0.024	0.031	0.088	0.002	0.005
	(0.018)	(0.052)	(0.019)	(0.063)	(0.028)	(0.062)
Income per Capita and Size						
Initial Log Real GDP per Capita	–2.439***	–6.880***	**–1.543**	–4.400	**–7.095*** **	–16.000***
	(0.724)	(2.160)	(1.361)	(3.900)	(2.073)	(4.820)
Initial Log Real GDP Level	0.538*	1.520*	**0.363**	1.030	**1.707*** **	3.840***
	(0.290)	(0.903)	(0.566)	(1.630)	(0.417)	(1.160)
Openness and Integration						
Initial Real Exchange Rate vs. U.S. Deviation	–0.013*	–0.038*	**0.005**	0.015	**–0.069*** **	–0.154***
	(0.007)	(0.020)	(0.010)	(0.029)	(0.015)	(0.040)
Change in Real Exchange Rate vs. U.S.	–0.021*	–0.058*	**–0.004**	–0.010	**–0.087*** **	–0.195***
	(0.011)	(0.032)	(0.017)	(0.050)	(0.025)	(0.063)
Initial Trade Openness	0.001	0.003	–0.005	–0.015	0.036	0.080
	(0.013)	(0.035)	(0.022)	(0.063)	(0.042)	(0.092)
Initial Exports to EMDEs[1]	0.027	0.075	**–0.298****	–0.851*	**0.012**	0.026
Divided by GDP	(0.016)	(0.046)	(0.137)	(0.435)	(0.058)	(0.131)
Structural Conditions						
Initial Indicator for	0.063	0.176	1.470	4.190	–2.472	–5.560
Constraint on Executive	(0.820)	(2.310)	(1.663)	(5.030)	(1.833)	(4.560)
Initial Life Expectancy	0.012	0.033	0.059	0.170	0.044	0.099
	(0.046)	(0.129)	(0.071)	(0.188)	(0.065)	(0.147)
Initial Educational Attainment	0.301*	0.848*	**0.048**	0.137	**0.903****	2.030*
	(0.163)	(0.484)	(0.270)	(0.773)	(0.422)	(1.060)
Initial Real Investment	0.066	0.186	0.160***	0.456***	0.010	0.023
Divided by GDP	(0.041)	(0.123)	(0.045)	(0.126)	(0.132)	(0.299)
Macroeconomic Conditions						
Change in Real Investment	0.149***	0.420***	0.234***	0.668***	0.177***	0.397***
Divided by GDP	(0.045)	(0.148)	(0.082)	(0.245)	(0.053)	(0.125)
Change in Inflation	–0.002	–0.006	–0.004	–0.012	0.019	0.043
	(0.006)	(0.018)	(0.071)	(0.202)	(0.013)	(0.029)
Change in Public Debt	–0.003	–0.009	–0.019	–0.055	–0.014***	–0.031**
Divided by GDP	(0.004)	(0.012)	(0.030)	(0.088)	(0.005)	(0.012)
Observations	892		383		509	
Pseudo *R* Squared	0.171		0.259		0.386	
Number of Cases	28		13		15	
Log Likelihood	–103.2		–42.1		–41.5	
AUC[2]	0.818		0.845		0.940	
90% Lower Bound for AUC[2]	0.750		0.752		0.906	
90% Upper Bound for AUC[2]	0.886		0.938		0.973	
Optimal Youden Cutoff	0.025		0.125		0.045	
True Positive Rate (%)	89		62		87	
False Positive Rate (%)	35		5		13	

Source: IMF staff calculations.

Note: The dependent variable is a dummy variable for the start of a new growth takeoff. Indicators (variables) are defined in Appendix 4.1. Heteroscedasticity and autocorrelation within country robust standard errors are in parentheses under the logistic (logit) regression coefficient estimates. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Statistically significantly different coefficient estimates across the subsamples before 1990 and for 1990–2011 are shown in bold (at the 10 percent level or lower). The average marginal effects by variable on the chances of a new growth takeoff are shown in the column next to the corresponding sample's logit coefficients. The marginal effect shows the average impact of a one-unit change in the explanatory variable on the probability of a growth takeoff (scaled to range from zero to 100).

[1]EMDEs = emerging market and developing economies.

[2]AUC = area under the receiver operating characteristic curve.

Brazil and Korea, 1960–80: Strong Takeoffs but Diverging Trajectories[27]

These two experiences emphasize the importance of mobilizing sustainable finances for an investment-driven growth strategy. Although both these economies focused on industrialization, Brazil increasingly relied on external debt to finance its saving-investment gap, with the situation exacerbated by large public dissaving. Korea started with a much worse current account position than Brazil, but strengthened its external balances with greater fiscal discipline, higher domestic saving rates, and strong export growth.

Both Brazil and Korea experienced strong growth between 1960 and 1980, but their post-1980 experiences were diametrically opposite (Figure 4.12, panel 1). In Brazil, output per capita stagnated for more than two decades after a debt crisis in the early 1980s. In Korea, after a recession in 1980, the economy regained momentum.

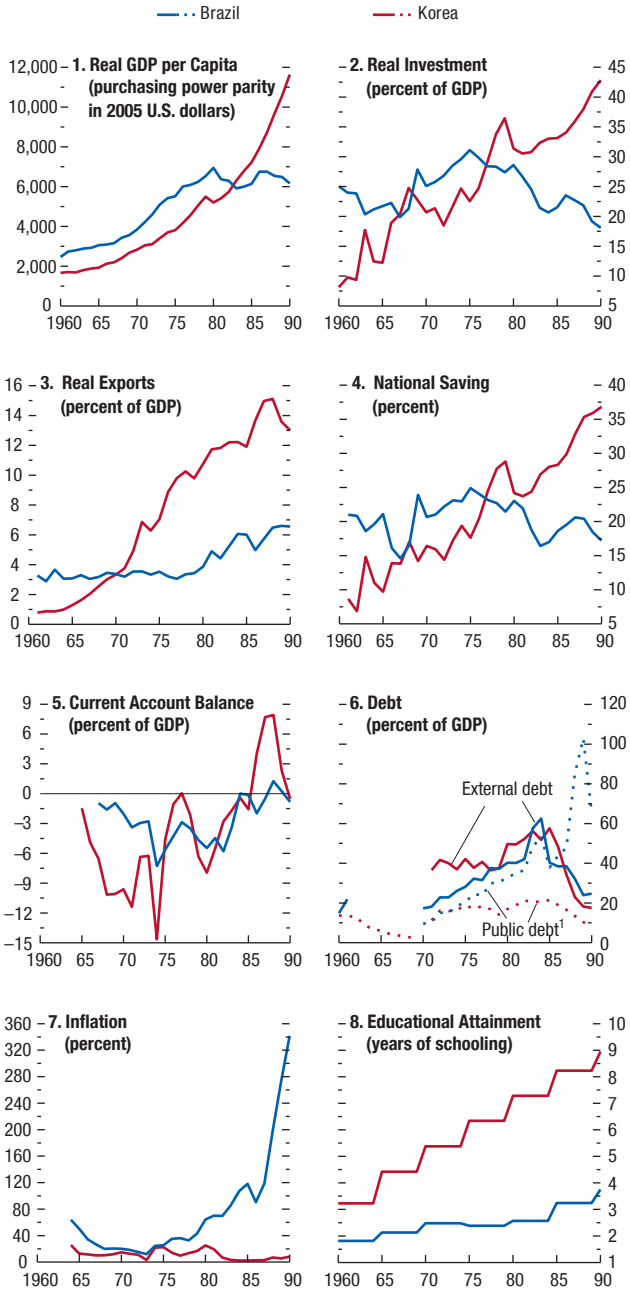
Although both economies pursued industrial development policies, they had markedly different growth strategies. Brazil's growth model was oriented inward, with production geared toward its large domestic market. Import substitution—which discouraged imports and subsidized domestic producers—was the cornerstone of the strategy. Growth was driven mainly by domestic demand, and export growth was slow (Figure 4.12, panels 2 and 3). In contrast, Korea began to shift away from import-substitution policies beginning in the 1960s and became increasingly export oriented. Initially, the government promoted labor-intensive industrial exports, but in the face of increased protectionism for labor-intensive industries in advanced economies, the focus shifted to promoting higher-value-added industries. Large-scale investment in shipbuilding, steel, and petrochemicals helped Korea become a leading producer and exporter in these sectors.

The ways in which Brazil and Korea financed investment, particularly after the first oil price shock in the early 1970s, also help explain the differences in their macroeconomic outcomes. Although Brazil's national saving rate was high, it did not keep pace with investment. The rising current account deficit was increasingly financed by external borrowing. Public debt also rose beginning in the 1970s (Figure 4.12, panels 4–6).

[27]The Brazil case study draws on Baer (2001), Coes (1995), Pinheiro and others (2004), and World Bank (1983). The Korea case draws on Collins (1991), Dornbusch and Park (1987), Kim (2008), Kwon (1990), and Song (2003).

Figure 4.12. Brazil's and Korea's Growth Experiences during 1960–90

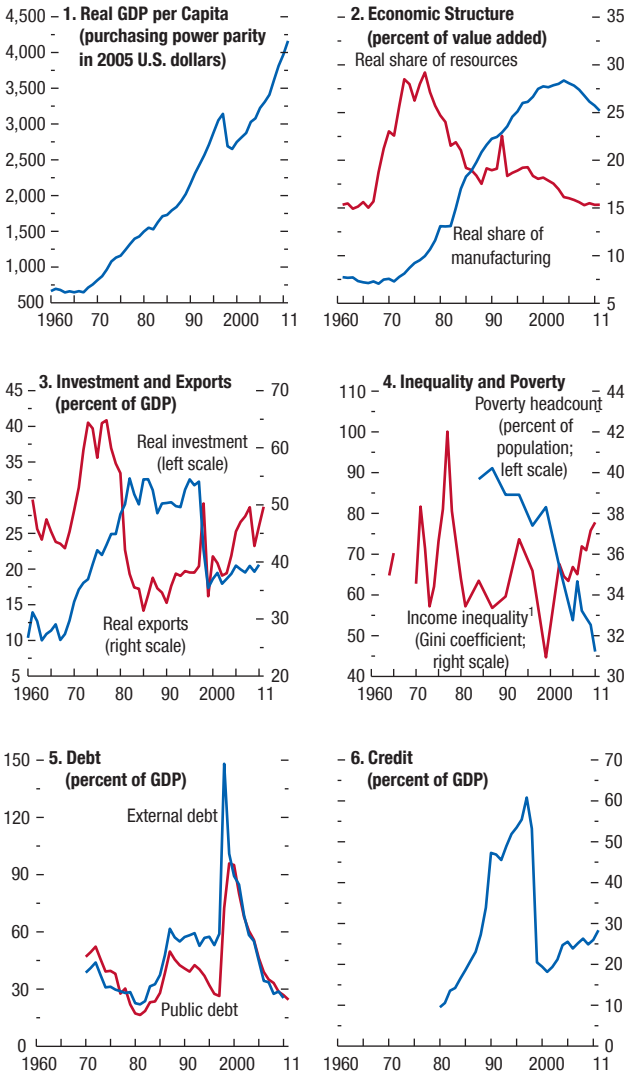
These two experiences emphasize the importance of mobilizing sustainable finance for an investment-driven growth strategy. Although both economies focused on industrialization, Brazil increasingly relied on external debt to finance its saving-investment gap, and the situation was exacerbated by growing public debt. Korea started out with a much worse current account position than Brazil, but strengthened its external balances with greater fiscal discipline, higher domestic saving rates, and strong export growth.



Sources: Abbas and others (2010); Barro and Lee (2010); IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; Penn World Table 7.1; World Bank, World Development Indicators database (2012); and IMF staff calculations.
Note: Indicators are defined in Appendix 4.1.
[1]Public debt data for Brazil are missing from 1962 to 1969, and for Korea for 1970.

Figure 4.13. Indonesia's Growth Experience since the 1960s

Indonesia's experience stands out not only because growth was remarkably strong over a long period, but also because the economy was able to achieve a structural shift from commodities into the manufacturing sector. The use of oil windfalls to develop infrastructure, and strengthen health and education, and the continued focus on rural development and agricultural productivity, also allowed growth to be more inclusive.



Sources: Abbas and others (2010); IMF, International Financial Statistics database; IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; Penn World Table 7.1; Solt (2009); World Bank, World Development Indicators database (2012); and IMF staff calculations.
Note: Indicators are defined in Appendix 4.1.
[1]Income inequality data are missing from 1966 to 1969.

Overheating pressure intensified when policies to push growth were not adjusted after the first oil shock (Figure 4.12, panel 7). Debt became unsustainable after the economy was hit by the second oil price shock, combined with significantly higher world interest rates, culminating in the debt crisis. Korea also had a large current account deficit until the early 1970s, which was financed with foreign aid and external borrowing. However, the saving rate grew rapidly over time: the budget deficit stayed relatively low and the government encouraged both personal saving, through mandatory long-term saving for civil servants and other employees, and corporate saving, through a policy mandating low dividends. This helped narrow the current account deficit in the 1970s. Although it rose again after the second oil shock, it fell soon thereafter on the back of strong export growth. Fiscal discipline and strict monetary targeting helped keep inflation under control.

Policies in Korea were better aligned with maintaining external competitiveness and sustaining investment productivity, and these in turn were helped by macroeconomic policies to contain internal imbalances. The real exchange rate was maintained at a relatively depreciated level (using step devaluations within an implicit crawling peg), exporters received a variety of incentives, and labor skills in key sectors were upgraded via vocational and in-plant training. The government put a high priority on increasing overall education levels (Figure 4.12, panel 8). In the 1960s, when policy promoted labor-intensive industries, the emphasis was on general education. Later, when high-value-added industries were targeted, the emphasis was on strengthening engineering education and establishing specialized research institutes. Income inequality remained relatively low in Korea even after takeoff, whereas Brazil experienced persistently high income inequality and slow educational advancements.

Indonesia, Mid-1960s to Present: Growth with Shared Prosperity[28]

Indonesia's experience stands out not only because growth remained remarkably strong over a long period but also because the structure of the economy successfully shifted from commodities to manufacturing (Figure 4.13). The development strategy put a priority on rural and agricultural development, and oil windfalls were used to develop infrastructure and strengthen health and

[28]This case study draws on Temple (2003), Timmer (2007), and World Bank (2005).

education. Thus, growth was both strong and relatively inclusive.

Indonesia's takeoff started out with commodities and became more broad based over time. Growth was led by the energy sector until the early 1980s and increasingly by the manufacturing sector afterward (Figure 4.13, panels 1 and 2). In the 1960s and 1970s, a large share of the government's revenue from commodity windfall gains was directed toward public investment in rural infrastructure, agriculture, health, and education.[29] When the oil boom ended in the early 1980s, the government supported a shift toward manufacturing. Private investment and export growth were encouraged through industrial deregulation and through trade, capital account, and financial liberalization (Figure 4.13, panel 3). At the same time, growth in the agricultural sector was supported by efforts to improve agricultural productivity, including through the adoption of high-yield seeds and increased use of fertilizers and irrigation—so-called Green Revolution technologies. Strong growth during this period was accompanied by sharp declines in poverty levels and relatively low income inequality (Figure 4.13, panel 4).

Growth was also accompanied by macroeconomic policy discipline. The government used strict monetary targets to reduce inflation from triple digits in the mid-1960s to less than 15 percent by the end of that decade. Fiscal targets adopted in the late 1970s kept public debt relatively low (Figure 4.13, panel 5). However, strong growth and macroeconomic stability masked some latent financial and corporate sector imbalances, whereby financial deregulation in the absence of adequate prudential regulation and supervision fueled a credit boom centered in the property sector beginning in the 1980s (Figure 4.13, panel 6). The boom was financed by short-term capital flows in the context of a pegged exchange rate regime. In 1998, after the economy was hit by contagion from Thailand, Indonesia experienced a banking and balance of payments crisis. The economy rebounded again in 2000, based on stronger macroeconomic policies and structural reforms. Annual growth in per capita real GDP averaged 3¾ percent in the 2000s, and Indonesia remained resilient through the Great Recession.

[29]The contribution of the oil boom to economic development in other sectors also reduced the risk of Dutch disease effects. Moreover, the pro-poor growth focus contrasts sharply with the behavior often associated with resource-rich economies—namely, risky investment of resource windfalls.

Mozambique, 1990s to Present: How Will History See It?[30]

Mozambique's experience highlights the benefits of undertaking policies and measures that attract FDI to finance private investment. It also reveals the challenges arising from commodity-based growth, specifically the need for durable structural reforms that support broad-based improvements in productivity, growth, and living standards.

Peace and political stability have supported vibrant growth in Mozambique for nearly two decades. By the end of the civil war in 1992, Mozambique had endured nearly 30 years of conflict and was the second poorest country in our sample of LICs.[31] However, the economy rebounded in 1996, and annual growth in per capita real GDP averaged 5¾ percent over the next 16 years (Figure 4.14, panel 1).

Growth was driven by a surge in investment, supported by improvements in the business climate. Investment before the takeoff largely reflected aid-financed reconstruction (Figure 4.14, panels 2 and 3). After takeoff, investment included public-private initiatives for infrastructure building to develop the resource sector. The government took several steps to make the economy more investment friendly, including establishing a one-stop investment center, improving investor property rights and contract enforcement, and providing generous tax incentives.[32] Although investment declined after the completion of major infrastructure projects, growth was sustained with a commensurate rise in resource exports, particularly aluminum. Investment in the resource sector accelerated again in recent years, particularly in coal mining and

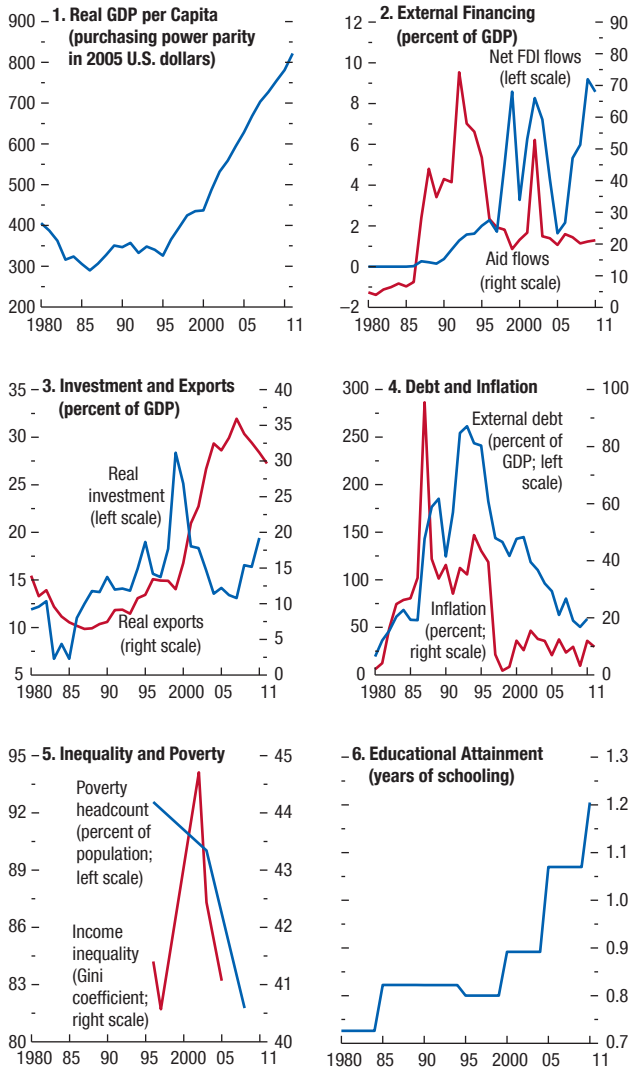
[30]This study draws on: African Development Bank (2012); Banco Português de Investimento (2012); Batley (2005); Brück (1997, 2006); Brück, FitzGerald, and Grigsby (2000); Canning (1998); Clément and Peiris (2008); Economic Commission for Africa (2004); Hall and Young (1997); Hoeffler (2000); Lledó and Garcia-Verdu (2011); Pretorius (2000); Schwartz, Hahn, and Bannon (2004); United Nations (2012); United Nations Development Program (2011); Vitek (2009); and Wiles, Selvester, and Fidalgo (2005).

[31]Mozambique's war of independence against Portugal started in 1964 and came to an unexpected end with the military coup in Portugal in April 1974. The civil war began in 1977 and lasted until 1992.

[32]Specifically, the government supported establishment of "development corridors," which created industrial clusters along major highways and connected these clusters to a port. A key project focused on processing imported bauxite into aluminum for export. Note that although we highlight the role of domestic policies, other factors also played a role in investment growth, including the country's vast natural resources, favorable global commodity prices, and continued donor support, as well as proximity to South Africa and recent alliances with other EMDEs.

Figure 4.14. Mozambique's Growth Experience since the 1990s

Mozambique's experience highlights the benefits of undertaking policies and measures that attract private investment financed by foreign direct investment (FDI). It also reveals the challenges arising from commodity-based growth, whereby lasting structural reforms will be needed for broad-based improvements in productivity, growth, and living standards.



Sources: Barro and Lee (2010); IMF, Balance of Payments Statistics database; IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; Penn World Table 7.1; Solt (2009); World Bank, World Development Indicators database (2012); and IMF staff calculations.
Note: Indicators are defined in Appendix 4.1.

natural gas exploration (the existence of vast offshore gas fields was confirmed in 2011).

Given its own limited savings, the government sought to attract FDI to fund its public-private investment projects. Improved macroeconomic policies—relatively low inflation and reduction in fiscal deficits—helped provide a stable economic environment for such FDI (Figure 4.14, panel 4). Mozambique qualified for debt relief under the Heavily Indebted Poor Country Initiative and Multilateral Debt Relief Initiative, which freed up fiscal space for the government's contributions for the infrastructure projects.

Nonetheless, Mozambique's growth experience has been capital intensive and focused on resources. As such, its investment projects have generated employment only to a limited extent. It has also allowed only limited fiscal gains, given the tax exemptions for these projects. Furthermore, there have been only modest declines in poverty and income inequality, and slow improvement in health and education, despite donor support (Figure 4.14, panels 5 and 6). The country ranks among the poorest performers in the United Nations Development Program's *Human Development Report*. Moreover, although the FDI- and aid-financed growth strategy has reduced vulnerabilities related to external borrowing, it has raised the risks of Dutch disease effects that will need to be addressed.

Thus, the economy faces an unfinished policy agenda. In this context, the experience of Indonesia in the 1960s and 1970s in reorienting investment toward rural and agricultural development is illuminating. Key policy priorities for Mozambique include developing transport and energy infrastructures, continuing to enhance human capital, ensuring access to financing more broadly to attract domestic private investment, and expanding the use of agricultural land to enhance agricultural productivity.

Cambodia, 1990s to Present: Remarkable Strides, but Far to Go[33]

Cambodia's experience underscores the importance of peace and stability as well as that of recent government efforts toward investment and development. It also illustrates the benefits of tapping into a vibrant regional production chain. However, Cambodia still needs to make

[33]This study draws on Coe (2006), IMF (2011, 2012a, 2013, forthcoming), and Rungcharoenkitkul (2012).

significant improvements to its infrastructure and business climate to attract private investment and further diversify its economy.

Real GDP per capita gained momentum in the mid-1990s when reconstruction, macroeconomic adjustments, and structural reform bore fruit after years of conflict and political tension. Rapid growth has continued for nearly two decades, and output per capita has grown at an average annual rate of 6 percent over the past decade (Figure 4.15, panel 1). This suggests that Cambodia's takeoff is more than a postconflict recovery story.

Growth has been supported by a steady rise in investment related to the export-oriented textile industry, although more recently also to investment in infrastructure (Figure 4.15, panels 2 and 3). The growth takeoff was catalyzed by Cambodia's preferential access to the United States under the Multi-Fiber Arrangement (MFA).[34] Investment growth decelerated in the early 2000s in part because of concerns about a burdensome regulatory environment, but it picked up again recently, after a concerted government effort to improve the business climate.[35] Recent public-private initiatives have focused on power generation and rural development. Rice exports have increased sharply since 2010, largely as the result of measures to boost yields, storage capacity, and trade.

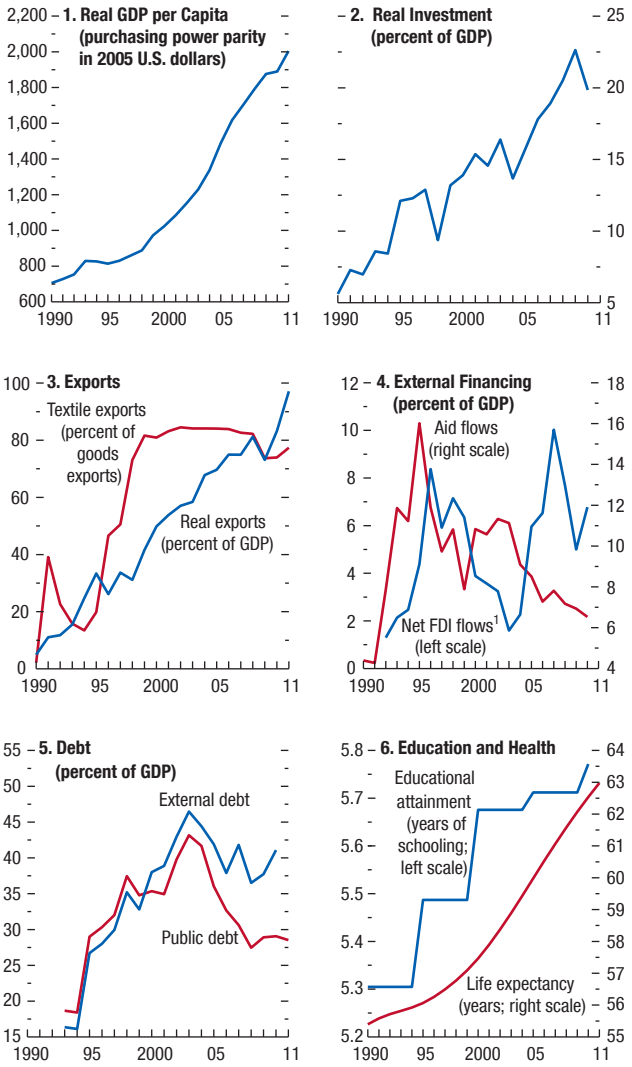
Cambodia has relied heavily on FDI to finance its saving-investment gap (Figure 4.15, panel 4). Recent FDI flows have been harnessed into public-private initiatives to improve power generation. The economy's relatively open trade and investment regimes, combined with Cambodia's proximity to some of the most dynamic economies in the world, have also attracted FDI in the manufacturing sector recently. In fact, there have been promising signs of diversification in the manufacturing sector, particularly through outsourcing efforts by multinational companies that are responding to rising wages elsewhere in Asia, and these will likely increase with improved power generation. Thus far, the textile sector continues to dominate the economy—accounting for three-quarters of total exports of goods—followed by tourism and agricultural products.

[34]Although the MFA ended in 2005, Cambodia has continued to enjoy preferential access to markets in the European Union.

[35]Cambodia's rank in the World Bank's *Doing Business* indicators moved up by eight places in 2012, to 133rd out of 185 countries, for several measures to reduce the regulatory burden and improve the business climate. The government also strengthened enforcement of the anticorruption law in 2011.

Figure 4.15. Cambodia's Growth Experience since the 1990s

Cambodia's experience underscores the importance of peace and stability and recent government efforts for investment and development. It also illustrates the benefits of proximity to dynamic economies and joining the regional production chain. However, efforts are needed to improve the economy's infrastructure and business climate to attract private investment and accomplish further diversification.



Sources: Abbas and others (2010); Barro and Lee (2010); IMF, Balance of Payments Statistics database; IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; Penn World Table 7.1; UN Comtrade Statistics; World Bank, World Development Indicators database (2012); and IMF staff calculations.
Note: Indicators are defined in Appendix 4.1.
[1]FDI = foreign direct investment.

Sustaining strong growth in Cambodia will require further economic diversification and strengthened macroeconomic policies. Removing infrastructure bottlenecks and improving the business climate will remain critical for attracting private investment and for further diversification. Financial intermediation must continue to deepen, and financial stability must be maintained through strong prudential supervision and regulation—the credit-to-GDP ratio has quadrupled to 35 percent in less than 10 years and continues to rise unabated. Improved public debt management will lower risks arising from the potentially large contingent fiscal liabilities inherent in substantial public-private initiatives. Mobilizing fiscal revenue will help build fiscal buffers to meet the country's development needs, including human capital development through improved health and education (Figure 4.15, panels 5 and 6).

Takeaways from the Case Studies

The case studies echo the development literature in emphasizing that growth takeoffs are feasible under a variety of development strategies. Growth was strong in all five of these economies despite their different economic structures and strategies. Cambodia, Indonesia, Korea, and Mozambique took the standard route of promoting growth through investment and exports; in Brazil, investment was geared toward the domestic market. The degree of government involvement also varied among these countries. In Mozambique and Cambodia in the 1990s, the government focused on maintaining political stability in the postwar era—the key prerequisite for growth—and developing an investment-friendly environment. There was much heavier public sector involvement in Brazil and Korea in the 1960s, with varying macroeconomic effects.

However, a key lesson from these countries' experiences is that sustaining strong growth requires continued effort to reduce external and internal imbalances. For all five economies, the growth takeoff was accompanied by some narrowing of fiscal and external current account deficits, but not all were able to sustain this momentum. Where imbalances grew or where growth was excessively reliant on foreign borrowing, the takeoffs ended disruptively or were interrupted even after decades of strong growth (Brazil in 1982, Indonesia in 1997). These experiences suggest that today's dynamic LICs, now only 9 to 12 years into their takeoffs, should avoid financing investment by excessive debt. Further reductions in their debt levels—which are still relatively high at more than 40 percent of GDP—are needed to build the fiscal space required for higher public investment.

A second lesson is that structural reforms can be instrumental in raising productivity and ensuring broad-based growth. In Korea, labor training in the export-oriented sectors helped sustain growth by moving the manufacturing sector up the value chain. In both Korea and Indonesia in the 1960s, measures were taken to upgrade agricultural productivity, infrastructure, and human capital, and these raised living standards on a broad scale. In contrast, growth from infrastructure projects and import substitution in Brazil in the 1960s did not alleviate income inequality. Similarly, the capital-intensive growth under way in Mozambique, with limited employment generation, may increase social vulnerabilities unless emphasis continues on improving productivity, education, and health. In addition, although Mozambique's FDI-financed growth strategy produces less debt, it could produce Dutch disease challenges as the economy broadens its growth strategy.

Finally, these countries' experiences demonstrate that policies need to adjust to changing global conditions. Strong global growth, low interest rates, and terms-of-trade gains or preferential access to larger markets benefited all five economies at different times. Indonesia's timely shift from natural resources helped it maintain strong growth even after the end of the oil price boom in the 1980s and underscores the significance of further economic diversification for many of today's dynamic LICs. Brazil's struggle to adjust domestic demand to the oil price shocks of the 1970s exacerbated its external imbalances. The important lesson for today's LICs is to avoid procyclical policies despite the prevalence of ultralow global interest rates.

Policy Conclusions

The turn of the 21st century has brought new hope for many LICs. This chapter finds that growth in a significant number of LICs has taken off—defined as an expansion in income per capita for at least five years averaging at least 3½ percent—since the 1990s. These takeoffs have already lasted 9 to 12 years on average, and more than half of these dynamic LICs continued

to expand at strong rates through the Great Recession. Compared with major LIC growth takeoffs during the 1960s and early 1970s, the post-1990 period has seen more and longer-lasting takeoffs.

The post-1990 LIC growth takeoffs resemble those in previous decades in important ways. A striking similarity is that both recent and earlier takeoffs were based on higher investment and national saving rates and greater trade integration, which sets apart dynamic LICs of both generations from LICs that failed to take off. This is consistent with the literature, which has long emphasized the key role of capital accumulation and trade integration in economic development. Export growth rose faster in dynamic LICs than in LICs that were unable to take off, and it was higher in recent takeoffs than in earlier ones.

However, the current generation of takeoffs stands apart from those in the previous generation in two key dimensions. First, today's dynamic LICs achieved strong growth without building obvious macroeconomic imbalances. For the resource-rich dynamic LICs, this was due to a much greater reliance on FDI than in the previous generation. For the others, strong growth was achieved despite lower levels of investment than in the previous generation. The more sustainable nature of recent takeoffs is reflected in lower inflation, more competitive exchange rates, and appreciably lower public and external debt accumulation. Second, the post-1990 takeoffs were also associated with faster-paced implementation of productivity-enhancing structural reforms and institution building. These include lower regulatory burdens, stronger infrastructure, higher education levels, and greater political stability. The greater effort toward lowering macroeconomic imbalances and implementing structural reforms bodes well for the future of today's dynamic LICs and highlights priorities for LICs that have yet to jump-start growth.

Despite their achievements, today's dynamic LICs have much left to accomplish. With their per capita income level still a fraction of that in advanced economies, they face a long journey toward income convergence. Moreover, these economies' greater reliance on FDI flows could lead to familiar Dutch disease challenges, which would need to be addressed. A related challenge for LICs that have relied on resource-intensive growth is to diversify their economies to raise growth, employment, and living standards on a broader scale. In sum, dynamic LICs cannot afford to lose sight of the need to sustain the pace of reforms, avoid major macroeconomic imbalances, and maintain external competitiveness.

Appendix 4.1. Data Definitions, Sources, and Country Groupings

Data Definitions and Sources

The primary data sources for this chapter are the IMF's World Economic Outlook (WEO), Penn World Table version 7.1 (PWT; Heston, Summers, and Aten, 2012), and the World Bank's World Development Indicators (WDI) databases. All the data sources used in the analysis are listed in Table 4.5. For indicators with multiple sources, the sources are listed in the order in which they are spliced (which entails extending the level of a primary series using the growth rate of a secondary series). For example, aggregate real GDP and real GDP per capita in constant 2005 purchasing-power-parity-adjusted U.S. dollars are from the PWT, and where missing, are extended with data from the WEO and WDI.

Domestic Shocks

Bank, currency, and debt crises are from Laeven and Valencia (2012). *Conflict* indicates whether a country is involved in a serious internal or external conflict in a given year in which the country's output per capita falls by more than 3 percent. This measure is derived from information on external and internal state conflicts from the Correlates of War (COW) database (The New COW War Data, 1816–2007 v. 4.0) and the measure of real output per capita detailed earlier. In the analysis, low-income country (LIC) episodes of strong or weak growth are excluded if they occur in the year after a conflict to avoid confounding a growth takeoff with a bounce back from a war.

Economic Structure

Export concentration is from Papageorgiou and Spatafora (2012) and corresponds to the Theil index on an updated version of the UN-NBER data set, which harmonizes Comtrade bilateral trade flow data at the four-digit Standard International Trade Classification (Rev. 1) level. *Exports to emerging and developing economies* are from the IMF's Direction of Trade Statistics database. It is calculated by taking the sum of the bilateral merchandise exports data across all EMDEs (see Table 4.6 for country groupings) for a given coun-

Table 4.5. Data Sources

Indicator	Source
Global Conditions	
Global Growth (percent)	IMF, World Economic Outlook Database (2012); Penn World Table 7.1 (2012)
U.S. Real Interest Rate (three-month treasury bill rate minus realized inflation rate; annualized percent)	Haver Analytics
Country-Specific Variables	
Aid Flows (millions of current U.S. dollars)	World Bank, World Development Indicators Database (2012)
Bank Crises	Laeven and Valencia (2012)
Conflict	The New COW War Data, 1816–2007 v. 4.0 (2011)
Currency Crises	Laeven and Valencia (2012)
Current Account Balance (percent of GDP)	World Bank, World Development Indicators Database (2012); IMF, World Economic Outlook Database (2012)
Credit (percent of GDP)	IMF, International Financial Statistics Database
Debt Crises	Laeven and Valencia (2012)
Educational Attainment (years of schooling)	Barro and Lee (2010)
Constraints on the Executive (index 0 to 1; unlimited authority = 0 and executive parity = 1)	Political Regime Characteristics and Transitions Database (2011)
Export Concentration	Papageorgiou and Spatafora (2012)
Exports to EMDEs (percent of GDP)	IMF, Direction of Trade Statistics Database
External Debt (percent of GDP)	Lane and Milesi-Ferretti (2007) updated to 2011
Foreign Reserves (percent of GDP)	Lane and Milesi-Ferretti (2007) updated to 2011
Income Inequality (Gini coefficient)	Standardized World Income Inequality Database v. 3.1 (Solt, 2009)
Inflation (percent)	World Bank, World Development Indicators Database (2012); IMF, World Economic Outlook Database (2012)
Life Expectancy (years)	World Bank, World Development Indicators Database (2012)
National Saving (percent of GDP)	Penn World Table 7.1 (2012); IMF, World Development Indicators Database (2012)
Net FDI Flows (percent of GDP)	IMF, Balance of Payments Statistics Database; IMF, World Economic Outlook Database (2012)
Poverty Headcount (percent of population)	World Bank, World Development Indicators Database (2012)
Public Debt (percent of GDP)	Abbas and others (2010); Lane and Milesi-Ferretti (2007) updated to 2011
Real Exchange Rate Change (percent change)	Penn World Table 7.1 (2012)
Real Exchange Rate Deviation (percent difference from fitted value)	Penn World Table 7.1 (2012)
Real Exports (percent of GDP)	World Bank, World Development Indicators Database (2012); IMF, World Economic Outlook Database (2012)
Real GDP (billions of purchasing-power-parity-adjusted 2005 U.S. dollars)	Penn World Table 7.1 (2012); IMF, World Economic Outlook Database (2012); World Bank, World Development Indicators Database (2012)
Real GDP per Capita (purchasing-power-parity-adjusted 2005 U.S. dollars)	Penn World Table 7.1 (2012); IMF, World Economic Outlook Database (2012); World Bank, World Development Indicators Database (2012)
Real Investment (percent of GDP)	Penn World Table 7.1 (2012)
Real Share of Manufacturing (percent of value added)	World Bank, World Development Indicators Database (2012)
Real Share of Resources (percent of value added)	World Bank, World Development Indicators Database (2012)
Regulatory Barriers (index 0 to 10 with higher scores indicating higher barriers)	Gwartney, Lawson, and Hall (2012)
Size of Government (index 0 to 10 with higher scores indicating larger size)	Gwartney, Lawson, and Hall (2012)
Telephones per Capita (per thousand people)	Banks and Wilson (2012)
Textile Exports (percent of goods exports)	United Nations, Comtrade Statistics
Trade Openness	World Bank, World Development Indicators Database (2012); IMF, World Economic Outlook Database (2012)
Trade-Weighted Terms-of-Trade Growth (percent)	World Bank, World Development Indicators Database (2012); IMF, World Economic Outlook Database (2012)

Note: EMDEs = emerging market and developing economies; FDI = foreign direct investment.

try. It is expressed as a percent of nominal GDP in U.S. dollars from the WDI, extended with the WEO. *National saving* to GDP is derived as the share of real gross national product in real GDP from the WDI minus the share of private and public consumption in real GDP from the PWT. *Real exports* to GDP is real exports of goods and services as a percent of GDP, from the WDI, extended with the WEO. *Real investment* in percent of GDP is from the PWT. *Real share of manufacturing* and *real share of resources in value added* are from the WDI. Resources are calculated as the contribution of industry in value added minus the contribution of manufacturing in value added. Total value added is the sum of value added from agriculture, industry, and services. *Textile exports* as a percent of goods exports is from the United Nations Comtrade Statistics database.

External policies

Aid flows is from the WDI and is deflated by the U.S. consumer price index to obtain *real aid flows*. The *current account balance* in percent of GDP is from the WDI, extended with the WEO. *Foreign reserves* to GDP is from the External Wealth of Nations Mark II Database (Lane and Milesi-Ferretti, 2007). *Net FDI Flows* as a percent of GDP is from the IMF Balance of Payments Statistics database (line 4500), extended with the WEO. *Trade openness* is measured as the sum of imports and exports of goods and services divided by GDP. The individual components are from the WDI, extended with the WEO.

Table 4.6. Economy Groups

Advanced Economies (AEs)	Emerging Market and Developing Economies (EMDEs)		
Australia	Afghanistan*+	Guinea*+	Pakistan*
Austria	Albania*	Haiti*+	Panama
Belgium	Algeria	Honduras*+	Papua New Guinea*
Canada	Angola*	Hong Kong SAR	Paraguay*
Denmark	Argentina	Hungary	Peru
Finland	Armenia*	India	Philippines*
France	Azerbaijan*	Indonesia*	Poland
Germany	Bangladesh*	Iran	Republic of Congo*+
Greece	Belarus	Iraq*	Romania
Ireland	Benin*+	Israel	Russia
Italy	Bolivia*+	Jamaica	Rwanda*+
Japan	Bosnia and Herzegovina*	Jordan	Saudi Arabia
Netherlands	Botswana	Kazakhstan	Senegal*+
New Zealand	Brazil	Kenya*	Serbia
Norway	Bulgaria	Korea	Sierra Leone*+
Portugal	Burkina Faso*+	Kuwait	Singapore
Spain	Burundi*+	Kyrgyz Republic*	Slovak Republic
Sweden	Cambodia*	Lao P.D.R.*	Slovenia
Switzerland	Cameroon*+	Latvia	Somalia*+
United Kingdom	Central African Republic*+	Lebanon	South Africa
United States	Chad*+	Lesotho*	Sri Lanka*
	Chile	Liberia*+	Sudan*+
	China	Libya	Syrian Arab Republic*
	Colombia	Lithuania	Taiwan Province of China
	Costa Rica	Madagascar*+	Tajikistan*
	Côte d'Ivoire*+	Malawi*+	Tanzania*+
	Croatia	Malaysia	Thailand
	Czech Republic	Mali*+	Togo*+
	Democratic Republic of the Congo*+	Mauritania*+	Tunisia
		Mexico	Turkey
	Dominican Republic	Moldova*	Turkmenistan
	Ecuador	Mongolia*	Uganda*+
	Egypt*	Morocco*	Ukraine
	El Salvador	Mozambique*+	United Arab Emirates
	Eritrea*+	Namibia	Uruguay
	Estonia	Nepal*	Uzbekistan*
	Ethiopia*+	Nicaragua*+	Venezuela
	FYR Macedonia	Niger*+	Vietnam*
	Georgia*	Nigeria*	Yemen*
	Ghana*+	Oman	Zambia*+
	Guatemala		Zimbabwe*

Note: * denotes low-income countries (LICs) anytime from 1990 onward based on a time-varying threshold for low-income output per capita. The definition of LICs is given in Appendix 4.1. The sample of countries excludes economies that had an average population less than 1 million. The group of LICs also excludes China and India. + denotes countries eligible for the Heavily Indebted Poor Countries (HIPC) Initiative.

Global environment

Global growth is the world GDP growth aggregate from the WEO, weighted by purchasing-power-parity (PPP) GDP. It is then extended by the growth of the aggregate PPP GDP levels from the PWT. The *U.S. real interest rate* is the U.S. three-month treasury bill rate (secondary market, annual average) minus the realized U.S. inflation rate, expressed in annualized percent. Both the interest rate and the inflation rate are from Haver Analytics.

International relative prices

The *real exchange rate* comes from the PWT and is the price level of GDP versus that of the United States. The *real exchange rate deviation* is the residual from a linear regression of the log real exchange rate on the productivity differential of the country with the United States, as proxied by the difference in log real GDP per capita with the United States. The *real exchange rate change* is the percent change over a five-year period in the five-year average of the real exchange rate. The *trade-weighted terms of trade* is the percent change of the terms-of-trade index constructed using the deflators of exports and imports of goods and services and the series of GDP, exports, and imports of goods and services in nominal terms—all from the WDI and WEO. In particular, the terms-of-trade index is calculated as the ratio of the export price deflator exponentiated by the share of exports in GDP to the import price deflator exponentiated by the share of imports in GDP.

Monetary and fiscal policies

Credit as a percent of GDP is from the IMF's *International Financial Statistics* publication and refers to bank credit to the private sector (line 22D). *External debt* to GDP is from the External Wealth of Nations

Mark II database (Lane and Milesi-Ferretti, 2007). *Inflation* is calculated as the log difference of the consumer price index (CPI). CPI data are from the WDI, extended with WEO data. *Public debt* is from Abbas and others (2010) taken as a ratio to GDP; the GDP data are from the WDI, extended with WEO data. The public-debt-to-GDP ratio is then extended using the change in external debt to GDP.

Structural and political conditions

Constraints on the executive is from the Political Regime Characteristics and Transitions database (2011) but rescaled to zero to 1(from 1 to 7): unlimited authority equals zero and executive parity equals 1. *Educational attainment* is measured by years of schooling from Barro and Lee (2010). *Income inequality* is the Gini coefficient of household disposable income from Solt (2009). *Life expectancy* is from the WDI and refers to life expectancy at birth, in years. *Poverty headcount* is also from the WDI and is the percent of the population living on $2 a day in PPP terms. *Regulatory barriers* and *size of government* are from the Economic Freedom Network's *Economic Freedom of the World 2012 Annual Report* (Gwartney, Lawson, and Hall, 2012). These indices are from zero to 10 with 10 indicating the most freedom (lower barriers and smaller government size, respectively) but are positively transformed (10 minus the original values) so that higher scores indicate more restraints and larger size, respectively. For poverty headcount, regulatory restraints, and size of government, missing data in intervening years are linearly interpolated to obtain a time series. *Telephones per capita* is from the Banks and Wilson Cross-National Time-Series Data Archive (2012). The data are expressed in units of telephones per thousand people.

Methodology to identify upswings in per capita real GDP

Following Chapter 4 of the October 2012 *World Economic Outlook,* we use the Harding and Pagan (2002) algorithm to identify turning points in LIC real GDP per capita. The algorithm searches for local maximums (peaks) and minimums (troughs) that meet specified conditions for the length of cycles and their phases (upswings and downswings). The only condition we impose is that the cycle (comprising a contiguous upswing and downswing) be at least five years long.

Transformations for the logistic regression

Variables used in the logistic regression appear in one of three forms: (1) initial—the once-lagged, backward-looking five-year average, which captures the average behavior of the variable in the five years before a potential takeoff; (2) contemporaneous—the current year, forward-looking five-year average, which captures the average behavior of the variable in the first five years of a potential takeoff; and (3) change—the difference between the contemporaneous and initial values of a variable as defined here, capturing the average trajectory of the variable from before the takeoff during the first years of a potential takeoff. The moving average in each case is calculated only if there are at least two nonmissing observations for the indicated variable during the window.

Country Groups

Advanced economies comprise the member economies of the Organization for Economic Cooperation and Development before 1990, with the exception of Turkey. The other economies are classified as EMDEs. At any given time, LICs are defined as economies in which output per capita, averaged over the previous five years, is lower than the corresponding low-income threshold, which is time varying. The low-income output per capita threshold represents the bottom 45th percentile of EMDEs' output per capita in 1990 ($2,600 in 2005 U.S. dollar PPP terms). This threshold is then spliced back for the pre-1990 period and forward for the post-1990 period using the average growth rate of global output per capita during 1950–2011 (about 2.3 percent a year) to obtain the low-income thresholds for the whole sample period. The group of other EMDEs corresponds to the group of EMDEs excluding LICs. To ensure that the results are unaffected by very small economies, the analysis excludes economies whose average 1950–2011 population was less than 1 million. Also, China and India are included in the group of EMDEs but not LICs. See Table 4.6 for the country composition of each of these analytical groupings. For each of the bar charts comparing cases and referents from Figure 4.3 onward, a constant composition sample underlies each of the panels to ensure comparability within the group of cases or referents across time.

The sample of country episodes is divided into four nonexclusive groups according to their economic struc-

ture. In particular, the analysis uses data from the WDI on sectoral value added in local currency at constant prices to classify the country episodes as predominantly agricultural, manufacturing oriented, resource rich, or "other." The exercise starts by constructing the shares of each sector—agriculture, manufacturing, resources, and other—in total value added and considers nonmanufacturing industry to be resources.[36] The 10-year average of these shares is then calculated from the start of a growth episode or from the first year for which a country episode is considered a valid LIC. A country episode is classified as predominantly agricultural if its 10-year average agriculture share is in the 70th percentile for the whole sample of country episodes between 1960 and 2011. Similarly, a country episode is classified as manufacturing oriented (or resource rich) if its 10-year average share of manufacturing (or resources) value added is higher than the 70th percentile for the whole sample of country episodes between 1960 and 2011. The group "other" includes all country episodes that were not classified either as predominantly agricultural, manufacturing oriented, or resource rich.

For country episodes with insufficient data, the grouping is complemented with WDI data on rents from resources. There were a few cases for which data for an industry were available but not their decomposition between manufacturing and nonmanufacturing. In these cases, a country episode was classified as resource rich if its 10-year average resource rents as a percent of GDP were in the 70th percentile for all country episodes between 1960 and 2011.[37] A country episode was classified as manufacturing oriented if the 10-year average of its industry sector value-added share was in the 70th percentile of all country episodes between 1960 and 2011 and the 10-year average of its resource rents as a percent of GDP was not in the 70th percentile of all country episodes between 1960 and 2011. Tables 4.1 and 4.2 present the list of LIC takeoffs grouped according to their underlying economic structure.

[36]Nonmanufacturing industry value added is a proxy for resource-related value added, because this sector includes not only mining and quarrying but also construction and utilities.

[37]The WDI resource rents are defined as the difference between the value of production at world prices and total costs of production for oil, natural gas, coal, minerals, and forestry. These series are calculated at current prices and are thus affected by changes in international resource prices.

Appendix 4.2. Additional Results and Alternative Measures of Takeoffs

Investment Financing and Macroeconomic Policy in Non-HIPC-Eligible Countries

Two key findings in this chapter are that today's dynamic low-income countries (LICs) achieve sharp reductions in inflation and public and external debt and that they finance their investment growth with a higher share of external non-debt-creating flows. This behavior is in sharp contrast to the previous generation of dynamic LICs, in which inflation and debt levels increased after takeoff, suggesting that the means to finance investment raised macroeconomic vulnerabilities. This section of the appendix assesses whether the improvements in macroeconomic outcomes and investment financing in today's dynamic LICs are broad-based—that is, not limited to the dynamic LICs benefiting from the Heavily Indebted Poor Country (HIPC) Initiative.[38]

Figure 4.16 suggests that the sharp decrease in inflation and debt levels in today's dynamic LICs is broad-based. The dynamic LICs that did not receive HIPC assistance also experienced sharp drops in inflation and debt within 10 years after takeoff. The higher level of foreign direct investment (FDI) flows for dynamic LICs relative to LICs with weaker growth is also seen for LICs that did not receive HIPC assistance (Figure 4.17). Moreover, recent takeoffs are associated with higher FDI flows compared with takeoffs before the 1990s and relative to LICs that did not take off. Recent takeoffs are also associated with higher aid flows than takeoffs in previous generations, but not relative to the LICs that did not take off.

Alternative Samples of LICs

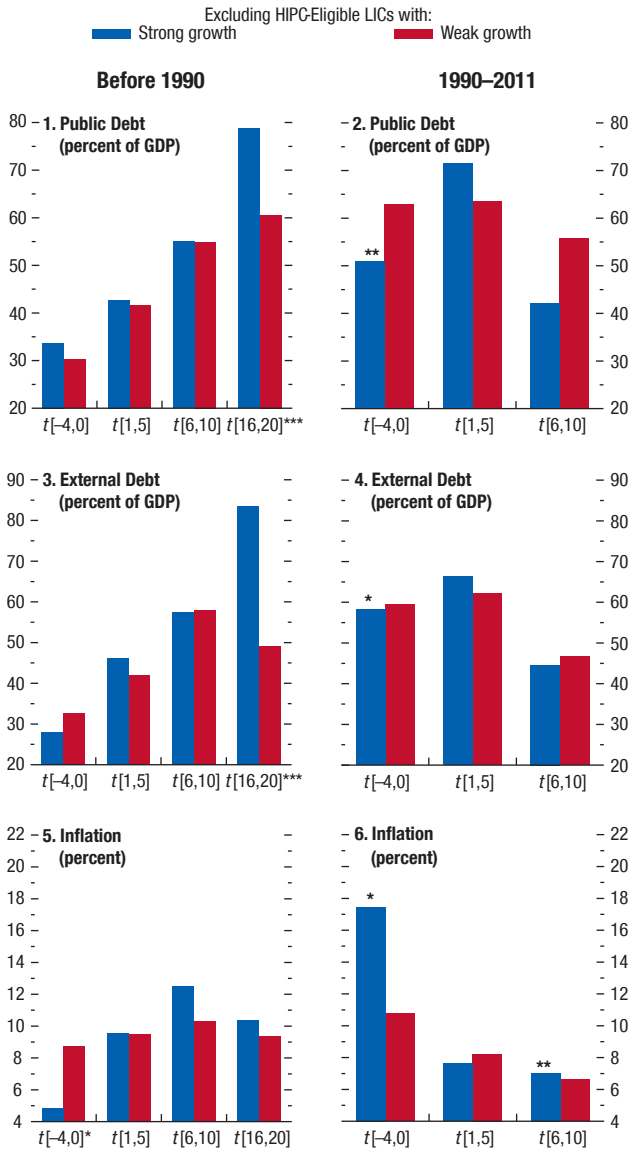
This appendix also explores whether the chapter's findings are robust to alternative samples of LICs. The baseline sample considers a time-varying income threshold, in which a country is defined as an LIC if its average real output per capita during the previous five years is below that threshold. In addition, the baseline sample excludes LICs experiencing or recovering

[38]The HIPC Initiative was launched in 1996 by the IMF and the World Bank, with the aim of ensuring that no poor country faces a debt burden it cannot manage. To be considered for HIPC assistance, a country must be facing an unsustainable debt burden that cannot be addressed through traditional debt-relief mechanisms and must have established a track record of reform and sound policies through IMF- and World Bank–supported programs. In this chapter, the sample of non-HIPC-eligible countries excludes LICs that were eligible for HIPC assistance at any time.

Figure 4.16. Macroeconomic Conditions for Non-HIPC-Eligible Low-Income Countries

(Median economy; t = 1 in the first year of a strong or weak growth episode)

The improvements in macroeconomic stability in today's low-income countries (LICs) are not limited to countries benefiting from the Heavily Indebted Poor Countries (HIPC) Initiative.



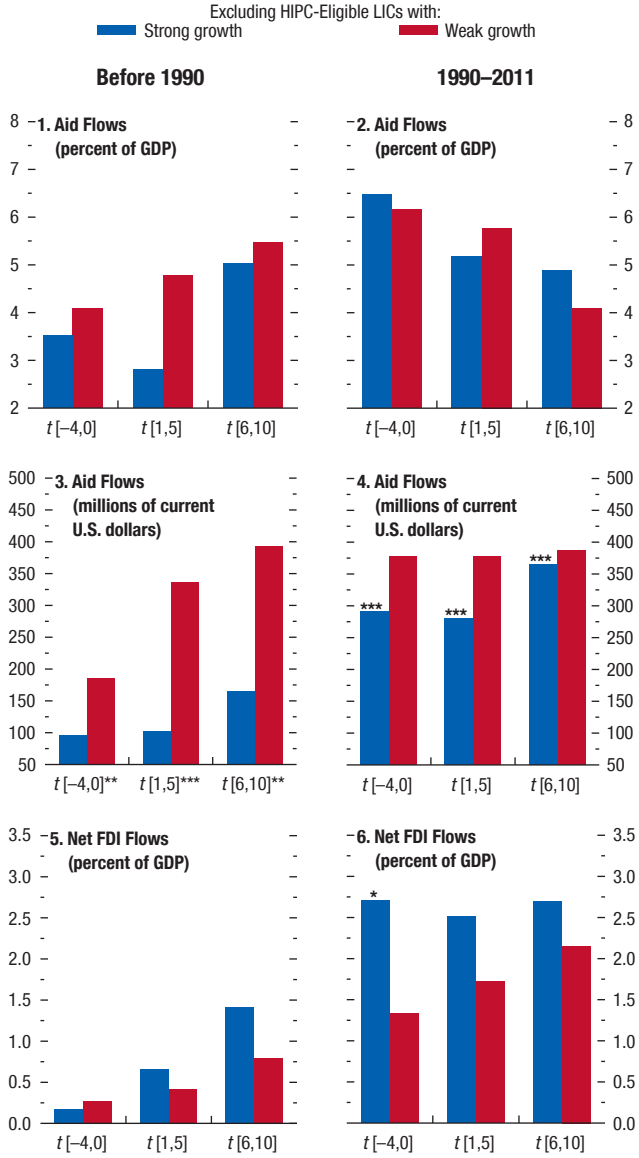
Sources: Abbas and others (2010); IMF, World Economic Outlook database (October 2012); Lane and Milesi-Ferretti (2007) updated to 2011; World Bank, World Development Indicators database (2012); and IMF staff calculations.

Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data. *, **, and *** denote statistically significant difference in distributions (based on the Kolmogorov-Smirnov test) at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance tests on the *x*-axis are for the difference in the distributions between the groups of strong and weak growth. Significance tests on the blue bars are for the difference in the distributions across 1990–2011 and before 1990 (not shown for red bars). A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel.

Figure 4.17. Aid and FDI Flows to Non-HIPC-Eligible Low-Income Countries

(Median economy; t = 1 in the first year of a strong or weak growth episode)

Financing by foreign direct investment (FDI) and aid has also increased for low-income countries (LICs) that were not eligible for debt relief under the Heavily Indebted Poor Countries (HIPC) Initiative.



Sources: IMF, Balance of Payments Statistics database; IMF, World Economic Outlook database (October 2012); World Bank, World Development Indicators database (2012); and IMF staff calculations.

Note: Economy groups and indicators are defined in Appendix 4.1. LICs exclude countries experiencing or recovering from a serious external or internal conflict at the start of their takeoffs. See the text for definitions of strong and weak growth episodes (takeoffs are strong growth episodes). See Appendix 4.1 for the definition of conflict and the source of the conflict data. *, **, and *** denote statistically significant difference in distributions (based on the Kolmogorov-Smirnov test) at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance tests on the *x*-axis are for the difference in the distributions between the groups of strong and weak growth. Significance tests on the blue bars are for the difference in the distributions across 1990–2011 and before 1990 (not shown for red bars). A constant composition sample underlies each of the panels to ensure comparability within the group of strong and weak growth episodes across time for that panel.

from a serious external or internal conflict at the start of their takeoffs. This section considers two alternative samples: (1) the baseline sample including LICs experiencing or recovering from a serious conflict; and (2) an alternative sample built with a time-invariant income threshold, in which a country is considered an LIC if its average real output per capita over the previous five years is below $2,600 in purchasing-power-parity-adjusted constant 2005 U.S. dollars. This threshold corresponds to the 45th percentile of per capita real GDP output for the entire sample of emerging market and developing economies as of 1990. This sample excludes LICs experiencing or recovering from conflict. The chapter's key stylized facts broadly hold for these alternative samples of LICs.

Alternative Measures of Takeoffs

As a robustness check for the baseline results, three alternative measures of takeoffs are considered. First, a growth acceleration, as measured by Hausmann, Pritchett, and Rodrik (2005), is defined as a growth episode that is at least eight years long, during which GDP per capita growth averages at least 3.5 percent, average growth during the episode is at least 2 percentage points higher than during the eight years before the takeoff, and output at the end of the episode exceeds its peak before the takeoff. Second, exclusion of temporary delays corresponds to the baseline sample excluding all growth episodes that start within five years of the end of a previous episode for the same country. Instead of considering those as new episodes, they are considered to be a continuation of the previous episode. Third, a faster growth episode is defined as a cyclical upswing in LIC output per capita that lasts at least five years, with average annual output per capita growth during the upswing of at least 5 percent.

Applying the Hausmann, Pritchett, and Rodrik (2005) algorithm to the sample of LICs results in 55 growth accelerations (31 during 1990–2011 and 24 prior to the 1990s), with a significant overlap with the baseline sample. Excluding temporary delays from the baseline sample reduces the number of episodes from 29 to 24 during 1990–2011 and from 41 to 31 during the period prior to the 1990s. If the cutoff for qualification as a takeoff is raised to 5 percent, the number of takeoffs falls to 17 from 29 during 1990–2011 and to 20 from 41 during 1950–89.

The chapter's findings generally hold for these alternative definitions of growth takeoffs. As in the baseline, both current- and previous-generation dynamic LICs experienced high investment and national saving rates compared with other LICs. The current account deficits were broadly similar for both generations of dynamic LICs, but a larger share of the deficit was financed by FDI flows for the current generation. Recent LIC takeoffs were also supported by sharp decreases in inflation and public and external debt, which contrasts with the increases in these indicators in the previous generation. Moreover, both current- and previous-generation takeoffs involved stronger export growth, although today's LIC takeoffs have more geographically diversified exports and more competitive exchange rates. Finally, dynamic LICs, especially the current generation, have smaller governments, better infrastructure, and higher human capital levels than LICs with weaker growth.

However, there are two differences between the results using the baseline criteria and those with the alternative criteria using the Hausmann, Pritchett, and Rodrik (2005) methodology. Although income inequality is still lower in dynamic LICs than in LICs with lower growth, current-generation dynamic LICs do not have lower income inequality than those before 1990. Second, the current-generation dynamic LICs do not have stronger political institutions, as measured by the constraints on the executive, than the previous-generation dynamic LICs or the LICs with low growth. There are also two differences between the baseline results and the ones using a higher threshold for takeoff (at 5 percent growth in GDP per capita). We found that recent takeoffs have lower income inequality and stronger political institutions than takeoffs prior to the 1990s, but not relative to the LICs that did not take off. All other stylized facts are broadly similar to those with the baseline criteria.

Appendix 4.3. Logistic Regression and Robustness of the Baseline Results

To simultaneously investigate multiple covariates of the start of strong growth takeoffs in low-income countries (LICs), a logistic regression (logit) model is used. The binary dependent variable is an indicator for a strong growth takeoff:

$$g_{i,t} = \left\{ \begin{array}{l} 1, \text{ if economy } i \text{ starts a strong growth takeoff at time } t \\ 0, \text{ if not starting or not in a strong growth takeoff at time } t \end{array} \right\},$$

in which $i = 1,\ldots,N$ indexes countries and $t = 1,\ldots,T$ indexes time (years). The logit model assumes that the conditional probability of an event ($g_{i,t} = 1$) takes the form

$$P(g_{i,t} = 1 \mid x_{j,i,t}\ \forall j \in \{1, \ldots K\}) = \frac{1}{exp[-(\alpha + \sum_{j=1}^{K} \beta_j x_{j,i,t})] + 1},$$

in which j indexes the set of K potential covariates, β_j is the coefficient on variable x_j, and α is a constant term (the constant is not reported in results tables to save space). The models are estimated by maximum likelihood.

To help assess the performance of the logit models, statistics from the receiver operating characteristic (ROC) curve defined by the estimates are shown. The ROC curve summarizes how well the model is able to explain the occurrence of a success (takeoff) and a failure (no takeoff). See Berge and Jordà (2011) for an in-depth discussion of the interpretation of ROC statistics. In brief, the ROC captures the relationship between the true positive rate, TPR(π), or share of correctly classified takeoffs for the threshold probability π, and the false positive rate, FPR(π), or share of incorrectly classified nontakeoffs. The area under the ROC curve (AUC) is a global measure of the performance of different logit models—the most accurate model shows the largest AUC and the least accurate shows an AUC close to one-half. To make the classification using the model practicable, an optimal threshold probability needs to be selected from the large set of possible thresholds characterized by the ROC curve. Because of its simplicity, the so-called Youden index and its associated cutoff threshold, π^*, are used. The Youden index (J) is the difference between the true positive rate and the false positive rate. Then π^* is the value of π that maximizes $J = \{TPR(\pi) - FPR(\pi)\}$.

Robustness to Alternative Specification and Definition of Takeoff

The analysis considers a specification that adds decadal dummies to the baseline and two alternative definitions of takeoff, one drawing on the Hausmann, Pritchett, and Rodrik (HPR) definition of growth acceleration (2005) and the second using a fixed income per capita threshold below which a country is classified as an LIC set at $2,600 purchasing-power-parity-adjusted 2005 constant U.S. dollars, which is roughly the 45th percentile of income per capita in 1990 among emerging market and developing economies (see Appendix 4.2 for further details). As shown in Table 4.7, the baseline findings are robust to the alternative specification and definition. When the HPR-derived definition of takeoff is used, the same general pattern of coefficient signs is seen, although they are statistically insignificant for the structural conditions. This insignificance may reflect the lower incidence of HPR growth accelerations in the full sample and their greater concentration in the sample since 1990. The model based on the HPR definition is not estimable before 1990 because of the paucity of growth accelerations among LICs during that period.

In other checks (not shown), we also found our baseline results to be robust to including serious conflict cases and to merging takeoff episodes that are within five years of each other. The latter check reduced the number of takeoffs in the logit sample to 17 from 28, so the results should be interpreted with caution.

Robustness to Alternative Estimation Methods

Because growth takeoffs are comparatively rare events (with a less than 5 percent unconditional probability of occurrence in a year), alternative estimators that are more robust to the problems associated with rare events in the logit model (for example, attenuation bias in small samples) were also tried. In particular, the baseline model was also estimated using: (1) Firth's (1993) bias-reducing transformation of the log likelihood; (2) King and Zeng's (2001) procedure for the generation of approximately unbiased coefficients in logit modeling; (3) the complementary log-log transformation, which helps account for skew in the distribution of the dependent variable; and (4) the random effects logit model. As seen in Table 4.8, the signs and magnitudes of the logit coefficients are similar across estimation methods (full sample shown).

Table 4.7. Logistic Regression Robustness to Alternative Specifications and Definition

	Decadal Dummies			HPR Growth Acceleration		Fixed Income—LIC Threshold		
Explanatory Variable	Full Sample	Before 1990	1990–2011	Full Sample	1990–2011	Full Sample	Before 1990	1990–2011
Global Conditions								
Contemporaneous World Real	0.640*	0.561	1.392*	0.788**	1.896***	0.509*	0.403	2.191*
GDP Growth	(0.346)	(0.463)	(0.727)	(0.360)	(0.567)	(0.285)	(0.429)	(1.247)
Contemporaneous U.S. Three-Month Treasury	0.099	–0.081	1.124	–0.277*	–0.592	–0.002	–0.086	0.585
Bill Real Rate	(0.289)	(0.531)	(0.859)	(0.158)	(0.415)	(0.195)	(0.328)	(0.364)
Contemporaneous Terms-of-Trade Growth	0.011	0.033*	0.001	0.007	–0.013	–0.003	0.011	0.024
	(0.018)	(0.019)	(0.028)	(0.010)	(0.018)	(0.016)	(0.018)	(0.031)
Income per Capita and Size								
Initial Log Real GDP per Capita	–2.691***	–1.642	–7.016***	–0.010	–0.382	–1.551**	–1.445	–9.854***
	(0.786)	(1.413)	(2.014)	(0.623)	(0.944)	(0.656)	(1.052)	(2.698)
Initial Log Real GDP Level	0.582**	0.391	1.687***	0.301	0.612*	0.128	–0.005	1.966**
	(0.286)	(0.636)	(0.406)	(0.240)	(0.316)	(0.313)	(0.512)	(0.872)
Openness and Integration								
Initial Real Exchange Rate vs. U.S. Deviation	–0.017**	0.006	–0.072***	–0.014*	–0.033***	–0.012*	–0.003	–0.088***
	(0.007)	(0.012)	(0.016)	(0.007)	(0.013)	(0.006)	(0.009)	(0.027)
Change in Real Exchange Rate vs. U.S.	–0.027**	–0.004	–0.091***	–0.022**	–0.046***	–0.016	–0.017	–0.099**
	(0.012)	(0.019)	(0.025)	(0.010)	(0.015)	(0.011)	(0.015)	(0.040)
Initial Trade Openness	0.008	–0.006	0.036	0.007	0.000	–0.009	0.003	0.077
	(0.011)	(0.024)	(0.044)	(0.011)	(0.020)	(0.012)	(0.020)	(0.065)
Initial Exports to EMDEs[1]	0.025	–0.321**	0.014	–0.027	–0.031	0.040**	–0.030	–0.054
Divided by GDP	(0.017)	(0.163)	(0.061)	(0.023)	(0.042)	(0.017)	(0.100)	(0.063)
Structural Conditions								
Initial Indicator for	–0.371	1.615	–2.454	–0.471	–1.517	0.510	1.155	–0.984
Constraint on Executive	(1.095)	(1.685)	(1.811)	(0.802)	(1.604)	(0.739)	(1.189)	(1.886)
Initial Life Expectancy	0.019	0.062	0.041	–0.019	–0.039	0.022	0.117	0.057
	(0.046)	(0.078)	(0.065)	(0.037)	(0.057)	(0.041)	(0.077)	(0.069)
Initial Educational Attainment	0.417***	0.017	0.882**	0.212	0.330	0.144	–0.335	0.975***
	(0.159)	(0.251)	(0.420)	(0.168)	(0.250)	(0.158)	(0.233)	(0.348)
Initial Real Investment	0.044	0.170***	0.016	0.001	0.050	0.096***	0.128***	–0.131
Divided by GDP	(0.036)	(0.052)	(0.138)	(0.030)	(0.064)	(0.037)	(0.037)	(0.166)
Macroeconomic Conditions								
Change in Real Investment	0.145***	0.241***	0.181***	0.054	0.151**	0.152***	0.190***	0.217***
Divided by GDP	(0.042)	(0.082)	(0.055)	(0.043)	(0.069)	(0.046)	(0.068)	(0.061)
Change in Inflation	0.000	–0.001	0.021	–0.006	–0.015	–0.004	–0.004	0.029**
	(0.007)	(0.071)	(0.013)	(0.009)	(0.012)	(0.007)	(0.077)	(0.013)
Change in Public Debt	–0.006	–0.018	–0.013**	–0.006**	–0.008**	–0.001	–0.017	–0.019***
Divided by GDP	(0.004)	(0.032)	(0.005)	(0.003)	(0.004)	(0.004)	(0.018)	(0.007)
Observations	892	383	509	1,008	560	926	452	474
Pseudo *R* Squared	0.202	0.262	0.394	0.139	0.305	0.155	0.248	0.458
Number of Cases	28	13	15	25	18	30	17	13
Log Likelihood	–99.3	–41.9	–41.0	–100.8	–55.3	–111.9	–54.5	–32.3
AUC[2]	0.845	0.847	0.939	0.785	0.904	0.797	0.819	0.958
90% Lower Bound for AUC[2]	0.784	0.751	0.909	0.689	0.859	0.724	0.714	0.928
90% Upper Bound for AUC[2]	0.907	0.942	0.968	0.880	0.949	0.870	0.923	0.989
Optimal Youden Cutoff	0.050	0.170	0.034	0.032	0.014	0.054	0.089	0.057
True Positive Rate (%)	79	62	93	76	94	60	65	85
False Positive Rate (%)	16	3	15	22	32	15	8	9

Source: IMF staff calculations.

Note: The dependent variable is the indicator for a new takeoff in growth. Heteroscedasticity and autocorrelation within country robust standard errors are in parentheses under the logistic (logit) regression coefficient estimates. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The last two columns show results using the Hausmann, Pritchett, and Rodrik (HPR, 2005) definition of growth accelerations as the binary dependent variable. The subsample before 1990 is not shown because of the exceedingly low incidence of takeoffs as defined by HPR during the period.

[1]EMDEs = emerging market and developing economies.

[2]AUC = area under the receiver operating characteristic curve.

Table 4.8. Logistic Regression Robustness to Alternative Estimation Methods, Full Sample

Explanatory Variable	Baseline	Firth (1993) Correction	King and Zeng (2001) Correction	Complementary Log-Log Transformation	Random Effects
Global Conditions					
Contemporaneous World Real	0.800**	0.760**	0.765**	0.754**	0.927**
GDP Growth	(0.323)	(0.349)	(0.334)	(0.301)	(0.415)
Contemporaneous U.S. Three-Month Treasury	0.032	0.034	0.034	0.017	–0.006
Bill Real Rate	(0.220)	(0.166)	(0.221)	(0.219)	(0.186)
Contemporaneous Terms-of-Trade Growth	0.008	0.010	0.009	0.005	0.019
	(0.018)	(0.016)	(0.016)	(0.017)	(0.020)
Income per Capita and Size					
Initial Log Real GDP per Capita	–2.439***	–2.252***	–2.258***	–2.441***	–2.989***
	(0.724)	(0.679)	(0.775)	(0.720)	(0.988)
Initial Log Real GDP Level	0.538*	0.499**	0.498**	0.533*	0.766**
	(0.290)	(0.224)	(0.227)	(0.280)	(0.338)
Openness and Integration					
Initial Real Exchange Rate vs. U.S. Deviation	–0.013*	–0.011	–0.010	–0.013*	–0.018**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)
Change in Real Exchange Rate vs. U.S.	–0.021*	–0.019*	–0.019	–0.020*	–0.027**
	(0.011)	(0.010)	(0.012)	(0.011)	(0.012)
Initial Trade Openness	0.001	0.002	0.002	0.001	0.011
	(0.013)	(0.011)	(0.012)	(0.012)	(0.016)
Initial Exports to EMDEs[1]	0.027	0.026	0.025	0.026*	0.007
Divided by GDP	(0.016)	(0.022)	(0.022)	(0.015)	(0.034)
Structural Conditions					
Initial Indicator for	0.063	0.024	0.001	0.102	–0.003
Constraint on Executive	(0.820)	(0.795)	(0.799)	(0.769)	(1.020)
Initial Life Expectancy	0.012	0.010	0.011	0.013	0.013
	(0.046)	(0.048)	(0.047)	(0.045)	(0.062)
Initial Educational Attainment	0.301*	0.291**	0.293**	0.295*	0.255
	(0.163)	(0.148)	(0.140)	(0.163)	(0.197)
Initial Real Investment	0.066	0.063**	0.063	0.063	0.047
Divided by GDP	(0.041)	(0.031)	(0.038)	(0.041)	(0.041)
Macroeconomic Conditions					
Change in Real Investment	0.149***	0.138***	0.138***	0.139***	0.171***
Divided by GDP	(0.045)	(0.039)	(0.042)	(0.037)	(0.050)
Change in Inflation	–0.002	–0.005	–0.005	–0.002	–0.003
	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)
Change in Public Debt	–0.003	–0.004	–0.004	–0.003	–0.005
Divided by GDP	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Observations	892	892	892	892	892
Number of Cases	28	28	28	28	28
AUC[2]	0.818	0.818	0.818	0.814	0.817
90% Lower Bound for AUC[2]	0.750	0.749	0.750	0.743	0.752
90% Upper Bound for AUC[2]	0.886	0.886	0.887	0.884	0.882

Source: IMF staff calculations.

Note: The dependent variable is a dummy variable for the start of a new growth takeoff. Indicators (variables) are defined in Appendix 4.1. Heteroscedasticity and autocorrelation within country robust standard errors are in parentheses under the logistic regression coefficient estimates. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

[1]EMDEs = emerging market and developing economies.

[2]AUC = area under the receiver operating characteristic curve.

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