The Phillips Curve and the Missing Disinflation from the Great Recession

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The Phillips Curve and the Missing Disinflation from the Great Recession

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Although inflation has run somewhat below the Federal Reserve’s 2 percent objective during the ongoing economic expansion, the “missing disinflation” during the Great Recession presents a much bigger puzzle for economists. During the recession, unemployment rose sharply, but core inflation declined only moderately. As a result, some economists have questioned whether the traditional inverse relationship between inflation and unemployment—known as the Phillips curve—still holds.

Willem Van Zandweghe estimates a Phillips curve model consistent with microdata on consumer prices. The model predicts stable inflation with a decline in unit labor costs during the recession, in line with the observed patterns in these macroeconomic variables. The model provides support for the view that inflation expectations shaped by monetary policy played an important role in preventing disinflation after the Great Recession. His results suggest Phillips curve models remain useful tools for central banks.

Capital Reallocation and Capital Investment

By David Rodziewicz and Nicholas Sly

Corporate debt levels have grown substantially during the 10-year recovery from the global financial crisis. This debt might be expected to finance investments that support firm expansion, as the U.S. economy has experienced strong growth over the last 10 years. However, much of the corporate debt has been used to reallocate capital through mergers and acquisitions rather than to fund investment activity. Perhaps as a result, some market watchers have expressed concerns that corporations are crowding out, rather than complementing, new investment.

David Rodziewicz and Nicholas Sly show that rising merger and acquisition activity does not fully crowd out new capital investment, as both sales of existing capital between firms and investment in new capital tend to rise and fall together. Moreover, they find that this relationship holds both in the aggregate and within most U.S. industries. Their results suggest that rising merger and acquisition activity complements investment growth by allowing firms to strategically position themselves and build their productive capacity.
As the global population ages, public spending on pensions has increased dramatically. As a result, policymakers have increasingly focused on pension retrenchment reforms to keep their systems solvent. These reforms usually involve long implementation delays to provide retirees time to adjust their retirement plans. However, long implementation delays also slow the rollback of governments’ pension spending, potentially raising long-run fiscal risks.

Huixin Bi, Kevin Hunt, and Sarah Zubairy collect a new data set that tracks implementation delays during pension retrenchment reforms for 12 countries from 1962 to 2017. They find that the average phase-in period for a pension retrenchment reform is about a decade. However, they also find that implementation delays are significantly longer for age-related pension reforms, which account for a large share of pension retrenchments since 2000.
The Phillips Curve and the Missing Disinflation from the Great Recession

By Willem Van Zandweghe

Although inflation has unexpectedly run somewhat below the Federal Reserve’s 2 percent objective during much of the ongoing economic expansion, the lack of deflation and limited disinflation during the Great Recession of 2007–09 presents a much bigger puzzle for economists. During the recession, unemployment rose to 10 percent, but core inflation declined less than 1.5 percentage points. As a result, some economists have questioned whether the traditional inverse relationship between inflation and unemployment—known as the Phillips curve—still holds.

Understanding the “missing disinflation” from the Great Recession is not just of historic interest. As policymakers at central banks around the world rely on macroeconomic models built around a Phillips curve, the ability of these models to explain the behavior of inflation during the recession and its aftermath is an important test of their usefulness.

Recent research has proposed various explanations for the missing disinflation. One popular model by Del Negro, Giannoni, and Schorfheide (2015) successfully accounted for the stable inflation after the Great Recession and convincingly attributed this stability to monetary policy’s anchoring of longer-term inflation expectations. However, this model also predicted stable unit labor costs during the Great Recession, a time when labor costs declined. A model that can explain both stable inflation and the cyclical decline in unit labor costs might provide a more complete account of the missing disinflation.

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In this article, I estimate a Phillips curve model that better reflects microdata on consumer prices than the model of Del Negro, Giannoni, and Schorfheide (2015). I find that the estimated model predicts stable inflation with a decline in unit labor costs during the recession, in line with observed patterns. In particular, the model assumes firms adjust their prices infrequently and face a positive trend inflation rate, which leads firms to make more forward-looking decisions when they adjust prices. The central role of expectations allows the estimated model to reconcile the observations of stable inflation and a decline in unit labor costs during the recession. Thus, the analysis supports the view of Del Negro, Giannoni, and Schorfheide (2015) that inflation expectations shaped by monetary policy played an important role in preventing a large disinflation in the wake of the Great Recession. Moreover, the model’s ability to account for the observed paths of inflation and unit labor costs suggests that Phillips curve models remain useful tools for central banks.

Section I discusses the evolution of inflation and unit labor costs during the Great Recession and its aftermath and reviews previous research on the missing disinflation. Section II presents the Phillips curve model and the econometric methodology for estimating it. Section III demonstrates that the estimated model predicts stable inflation with a decline in unit labor costs during the recession.

I. Inflation and Economic Activity in the Great Recession

The relationship between inflation and economic activity is well-documented and central to monetary policy. Phillips (1958) and Solow and Samuelson (1960) first documented a negative relationship between inflation and unemployment. Friedman (1968) and Phelps (1968) proposed that inflation is related to inflation expectations as well as economic activity. Research assuming those inflation expectations can be proxied by past inflation underpins the traditional, accelerationist Phillips curve, which predicts that inflation will continue to fall as long as the unemployment rate is above its natural rate. As Ball and Mazumder (2011) show, an accelerationist Phillips curve counterfactually predicts a period of deflation during and after the Great Recession.
The Great Recession did not leave a clear imprint on inflation, in seeming contradiction with the historical relationship between inflation and economic slack. Panel A of Chart 1 shows the output gap estimated by the Congressional Budget Office (CBO), which measures slack economic activity as the percentage deviation of gross domestic product from its potential level. At the end of 2008, the financial crisis led to a sharp drop in the output gap, which took about a decade to close. But inflation did not respond in kind. Panel B shows that inflation, as measured by the year-over-year inflation rate of the core personal consumption expenditures (PCE) price index, softened only modestly and briefly. In contrast with the relative stability of inflation during and after the Great Recession, inflation in earlier business cycles tended to fall during and after recessions and rise during expansions, although this cyclicality is partly obscured by the long-term rise and fall of inflation in the 1970s and 1980s.¹

Recent research explains the dynamics of inflation after the last recession using models based on a modern version of the Phillips curve.² This model framework, which is known as the New Keynesian Phillips curve (NKPC), is based on optimizing firm behavior and relates inflation to production costs, inflation expectations, and sometimes other factors (see Galí and Gertler 1999; Woodford 2003). The NKPC differs from the accelerationist Phillips curve in two important ways. First, expectations are not predetermined but are forward-looking. Whereas the accelerationist Phillips curve assumes past inflation proxies for inflation expectations, the NKPC is based on explicit assumptions of how economic agents form expectations about the future (usually agents are assumed to form rational expectations). Second, inflation is directly connected to the real marginal cost of production rather than economic activity. Although the marginal cost of production is determined by economic activity in such models—as wages are determined by labor market activity—economic activity only matters for inflation insofar it affects the real marginal cost. Intuitively, a higher marginal cost of production raises inflation because it leads firms to raise their prices to preserve their profit margins.

The marginal cost of production, as measured by real unit labor costs, declined during the recession. Panel C of Chart 1 shows real
Chart 1
Inflation and Real Activity

Panel A: Output Gap

Panel B: Inflation Rate

Panel C: Real Unit Labor Cost (Log Deviation from Trend)

Notes: Gray bars denote National Bureau of Economic Research (NBER)-defined recessions. Panel A shows the Congressional Budget Office’s output gap. Panel B shows the year-over-year percentage increase in the core PCE price index. Real unit labor cost is measured by the labor share of income in the nonfarm business sector. Panel C shows the residual of a regression of the logarithm of the labor share on a constant and a time trend for the sample period from 1960:Q1 to 2018:Q2.

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, NBER, and Congressional Budget Office. All data sources accessed through Haver Analytics.
unit labor costs—that is, the ratio of real wages to labor productivity—in the nonfarm business sector in logarithms and as a deviation from its linear trend. Under basic assumptions about the production technology, real unit labor costs are a proxy for firms’ real marginal cost of production. Like the output gap, real unit labor costs declined sharply at the end of 2008 and recovered very slowly. Indeed, they remained below trend in the second quarter of 2018.

A growing body of research proposes explanations for the missing disinflation that broadly fall into one of two groups. The first group points to temporary or structural factors that are not directly related to monetary policy. For example, Coibion and Gorodnichenko (2015) point to the temporary surge in oil prices, which reached a record high in mid-2008. They argue that high energy prices raised short-term inflation expectations, putting upward pressure on inflation that offset the downward pull from slack economic activity. Another temporary factor was financial market stress, which surged during the financial crisis in 2008, raising borrowing costs and curtailing access to credit for some firms. Gilchrist, Schoenle, Sim, and Zakrajšek (2017) show that firms with ample liquidity lowered prices in 2008 as would be expected in a recession, while those with limited liquidity raised prices to avoid costly external financing. Consistently, Christiano, Eichenbaum, and Trabandt (2015) argue that elevated interest rate spreads during the financial crisis put upward pressure on inflation.

Structural factors cited as explanations for the missing disinflation include fiscal policy uncertainty in a policy regime of near-zero short-term interest rates and large fiscal deficits, downward rigidity in nominal wages that prevented the real marginal cost of production and thus inflation from falling, and nonlinearity in the Phillips curve leading the relationship between inflation and economic activity to differ depending on whether economic conditions are slack or tight (see, respectively, Bianchi and Melosi 2017; Mineyama 2018; Doser, Nunes, Rao, and Sheremirov 2018).

The second group of explanations emphasizes the stability of longer-term inflation expectations and the role of monetary policy in preventing a large disinflation. Bernanke (2010) assessed that “falling into deflation is not a significant risk for the United States
at this time, but that is true in part because the public understands that the Federal Reserve will be vigilant and proactive in addressing significant further disinflation.”

Del Negro, Giannoni, and Schorfheide (2015) provide formal support for the view that monetary policy, through its effect on longer-term expectations, played an important role in keeping inflation stable. Inflation according to the NKPC depends on current economic conditions—in particular, the current real marginal cost of production—and expectations of future inflation, which depend on expected future real marginal costs. The authors find that although the real marginal cost of production declined during the Great Recession, firms expected real marginal costs would recover in the future under appropriately expansionary monetary policy. Thus, inflation expectations remained stable and prevented a large decline in actual inflation. The authors estimate their model and obtain a small estimate for the slope of the Phillips curve, which is important for their explanation of why inflation remained stable. Indeed, they demonstrate using their estimated model that a smaller slope of the Phillips curve implies monetary policy has greater influence on expected future real marginal costs and thereby on inflation.

However, Del Negro, Giannoni, and Schorfheide (2015) find that their estimated model understates the observed drop in real marginal costs. As the marginal cost is a key driver of inflation in the NKPC, explaining both the stable inflation and the drop in the real marginal cost appears challenging. Nevertheless, a model that can account for the evolution of both variables—the observed stability of inflation and the decline in the real marginal cost—may provide a more compelling explanation for the missing disinflation.

To that end, I estimate a Phillips curve model that deviates in one key respect from those used in most previous research, including Del Negro, Giannoni, and Schorfheide (2015). A standard assumption in research based on the NKPC is that some firms set their prices optimally while others index their prices to the past or the trend inflation rate. The model I use instead assumes that firms either set their prices optimally or do not change their prices at all. This assumption is consistent with evidence on price changes from the microdata for the consumer price index, which indicate that individual prices change infrequently.
A firm with a fixed nominal output price will see inflation erode its real revenue, which is not the case if a firm can index its price to inflation. Therefore, if the trend inflation rate is positive, firms that are not able to continually adjust their prices will take more forward-looking decisions when they have the opportunity to adjust their prices. As a result, inflation expectations may play an even more important role for inflation dynamics in models that do not assume price indexation, while smooth dynamics of real marginal costs may play a smaller role.

II. Estimating Phillips Curve Models

To assess the role of firms’ price-setting behavior in accounting for the behavior of inflation and unit labor costs, I estimate two NKPCs. The first, a standard NKPC, features price indexation to past inflation. The second, known as a generalized NKPC (GNKPC), has no price indexation. Both models relate inflation to the real marginal cost of production, inflation expectations, and other variables. The models are derived from firms’ profit maximization in the face of rigidity in nominal prices, which limits how often firms can expect to reset prices to their optimal level. The standard NKPC relates inflation to the real marginal cost of production, expected future inflation, and past inflation as follows:

\[ \pi_t = \kappa mc_t + \frac{\beta}{1+\beta} E_t \pi_{t+1} + \frac{1}{1+\beta} \pi_{t-1}, \]

where \( \pi_t \) and \( mc_t \) denote inflation and the real marginal cost, respectively, in period \( t \), and \( \kappa \) denotes the slope of the Phillips curve and is a function of structural parameters including households’ subjective time discount factor, \( \beta \), and the degree of price rigidity, \( \alpha_p \).

The GNKPC is given by:

\[ \pi_t = \kappa_1 mc_t + \kappa_2 \Delta y_t + \lambda \sum_{i=1}^{\infty} (\rho_d)^{-1} \pi_{t-i} + BE_t \pi_{t+1} + \gamma (\varphi_t + \psi_t), \]

where inflation is related to the real marginal cost, output growth (\( \Delta y_t \)), past inflation, expected future inflation, and two additional forward-looking variables denoted by \( \varphi_t \) and \( \psi_t \) that capture expectations of future inflation, real marginal costs, and output growth over a long horizon. Here, too, the coefficients \( \kappa_1, \kappa_2, \lambda, \rho_d, B, \) and \( \gamma \) are functions of structural parameters in the model.
In addition, each model includes equations to describe the behavior of households, which make decisions about how much to work, consume, and save, as well as the behavior of the central bank, which sets the short term interest rate according to a simple interest rate rule. Appendix A provides these equations along with a more detailed description of each model.

The dynamic relationships between the variables of each model are determined by the values of the model’s structural parameters. For instance, the slope of the Phillips curve (κ or κ₁) affects the responsiveness of inflation to changes in the real marginal cost. The values of the structural parameters determine how well the model can describe the empirical relationships of key macroeconomic variables for the U.S. economy and are estimated to give the model empirical credibility.

The estimation methodology consists of two steps. In the first step, I estimate the empirical relationships between key macroeconomic variables using a structural vector autoregression (VAR), which captures how the variables respond over time to a surprise change in the stance of monetary policy. Specifically, I estimate a structural VAR on the inflation rate, a measure of the output gap, and the federal funds rate for the period from 1955:Q1 to 2008:Q4, which was the quarter with the most severe contraction in output during the last recession. The data are series typically used in the estimation of a structural VAR with monetary policy shocks and are different from the series displayed in Chart 1.11 By ending the sample in 2008:Q4, the estimated Phillips curve models will fit the empirical dynamics of the macroeconomic variables until the recession. Estimating the model on pre-recession data allows me to compare the model’s out-of-sample predictions to the actual post-recession data. Similar paths would indicate the empirical dynamics of the macroeconomic variables have not changed.

The dashed lines in Chart 2 display the empirical responses of the federal funds rate, the inflation rate, and the output gap—the three variables in the VAR—to a one standard deviation surprise cut in the federal funds rate. The federal funds rate drops on impact, inflation ticks down initially before rising gradually, and the output gap rises temporarily after a few quarters.
Chart 2
Empirical Impulse Responses to an Expansionary Monetary Policy Shock

Panel A: Federal Funds Rate

Panel B: Inflation Rate

Panel C: Output Gap

Notes: Dashed lines are impulse responses to a one standard deviation negative monetary policy shock from the structural VAR. Gray bands are 90 percent confidence intervals obtained from 1,000 bootstrap replications. Sources: Bureau of Economic Analysis and Board of Governors of the Federal Reserve System. All data sources accessed through Haver Analytics.
In the second step, I estimate the parameters of each Phillips curve model by selecting the parameter values that jointly minimize the distance between the empirical impulse responses from the VAR, displayed in Chart 2, and their counterparts generated by a monetary policy shock in the Phillips curve model. More formally, the estimation method entails finding the vector of model parameters, \( \mathbf{x} \), that minimizes the product \( (G(\mathbf{x})-\hat{G})'W(G(\mathbf{x})-\hat{G}) \), where \( G(\mathbf{x}) \) and \( \hat{G} \) denote, respectively, the stacked impulse response functions of 20 quarters obtained from the Phillips curve model and from the VAR model (excluding the initial quarter), and \( W \) is a weighting matrix.\(^{12}\)

Estimation results for each model are reported in Appendix B.

III. Accounting for the Missing Disinflation

To evaluate the estimated NKPC models’ predictions for inflation and the real marginal cost, I use the models to simulate the effects of a sudden, large decline in the output gap akin to the observed decline during the last recession.

Model with price indexation

Chart 3 compares the dynamics of the output gap, inflation, and real unit labor costs (the measure of the real marginal cost) predicted by the estimated model with price indexation to their evolution in the U.S. data since 2008. The blue lines in Panels A through C repeat the data from Chart 1—that is, the CBO’s estimate of the output gap, the year-over-year PCE inflation rate, and real unit labor costs as a deviation from their long-run trend. The green lines show the responses of the same variables in the model to a 6.6 percent decline in the output gap, which equals the decline in the CBO’s measure in 2008:Q4.\(^{13}\)

While the model with price indexation does not capture the high-frequency movements in the U.S. data, it successfully traces the slow recovery in the output gap, which does not close fully until 2018 (Panel A). The model also successfully predicts a stable inflation rate in the face of the deep recession. Panel B shows that inflation in the model temporarily slows to about 1 percent and returns to 2 percent by 2014.\(^{14}\)

However, Panel C shows that the model-predicted trajectory for the real marginal cost differs significantly from the observed data. Specifically, the model predicts a modest decline in the real marginal cost of
**Chart 3**
Actual and Predicted Inflation and Unit Labor Cost in the Model with Price Indexation

Panel A: Output Gap

Panel B: Inflation Rate

Panel C: Real Unit Labor Cost (Marginal Cost)

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and Congressional Budget Office. All data sources accessed through Haver Analytics.
1.3 percent below trend at its trough before returning to trend by 2012, while the actual data show real unit labor costs declined about 4 percent below trend before gradually rising by 2014. The model’s prediction of both stable inflation and a stable real marginal cost is consistent with the finding of Del Negro, Giannoni, and Schorfheide (2015).

**Model without indexation**

Chart 4, analogous to Chart 3, shows the predictions of the NKPC model without indexation. This model assumes that a fraction of firms keeps their prices unchanged each period, which is consistent with the microdata on consumer prices. Once again, the model successfully traces the gradual closing of the output gap after its assumed drop of 6.6 percent in 2008:Q4 (Panel A). The model also successfully predicts stable inflation in the face of the deep output gap (Panel B). Inflation slows to 0.4 percent in the model, which is lower than in the model with price indexation. However, the model without indexation better reflects inflation’s gradual recovery. Specifically, the model shows inflation does not return to 2 percent until 2016, two years later than the model with price indexation—and closer to the actual core inflation rate, which remained below 2 percent during this period. Neither model predicts a period of deflation.

Comparing the models’ cumulative prediction errors for inflation (not shown) demonstrates that the model without indexation performs better over a longer horizon. Although the cumulative prediction error for inflation in the model without indexation is larger than in the model with price indexation from 2008:Q4 to 2014:Q4, it is smaller when the prediction is extended from 2008:Q4 to 2016:Q4. Specifically, the cumulative prediction error for the model without indexation is −5.4 percent for the 2008:Q4–2016:Q4 period, indicating the model underpredicts the price level by 5.4 percent by the end of 2016. In contrast, the model with price indexation overpredicts the price level by 6.4 percent by the end of 2016.

The main difference between the two models is their ability to capture the evolution of real unit labor costs. The model without indexation shows that the real marginal cost drops about 4 percent below trend by 2010, similar to the data for real unit labor costs. The model then predicts the real marginal cost recovers gradually to its trend level
Chart 4
Actual and Predicted Inflation and Unit Labor Cost in the Model without Indexation

Panel A: Output Gap

Panel B: Inflation Rate

Panel C: Real Unit Labor Cost (Marginal Cost)

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and Congressional Budget Office. All data sources accessed through Haver Analytics.
by 2014. Although the recovery is slower than in the model with price indexation, it is still faster than in the U.S. data, where the detrended real unit labor costs remained below trend in 2018.

To further quantify the performance of the two models, I compare their root mean square errors (RMSE), a measure of how far the model predictions differ from observed values. The RMSE of predicted inflation through 2016:Q4 is somewhat smaller for the model with price indexation (0.548) than the model without indexation (0.636), implying the model with price indexation generates a more accurate inflation forecast. However, the RMSE of predicted real unit labor costs is substantially smaller for the model without indexation (2.417) than for the model with price indexation (3.277), implying the model without indexation generates a more accurate forecast for real unit labor costs. Intuitively, as price-adjusting firms are more forward-looking when they cannot index prices, inflation dynamics are determined to a greater extent by expectations and to a lesser extent by smooth real marginal costs. More precisely, whereas inflation in the NKPC is determined solely by the current and discounted expected future real marginal costs, inflation in the GNKPC is also determined by the current and expected future values of other variables, as shown in Appendix A. As inflation is less tightly linked to current and expected future real marginal costs in the model without indexation, this model can reconcile the observations of stable inflation and a decline in real unit labor costs during the last recession.

**IV. Conclusion**

This article provides new evidence supporting the view previously formalized by Del Negro, Giannoni, and Schorfheide (2015) that stable inflation expectations prevented a sharp disinflation during the Great Recession despite the deep output gap and associated weak real unit labor costs. Using a Phillips curve model that better reflects microdata on consumer prices, I find that the estimated model predicts stable inflation with a decline in real unit labor costs during the recession, in line with the observed patterns. The evidence supports the view that inflation expectations and monetary policy were important in preventing a large disinflation. My results have two reassuring implications for monetary policy makers. First, the model’s ability to account for the
observed paths of inflation and real unit labor costs suggests that Phillips curve models remain useful tools for central bankers. Second, the evidence suggests that inflation expectations remained anchored in the face of a deep recession, which attests to the credibility of the Federal Reserve’s inflation objective.
Appendix A

New Keynesian Model Descriptions

Both New Keynesian models consist of a representative household, a representative composite-good producer, a continuum of firms, and a monetary authority. The monetary authority follows a Taylor type interest rate rule of the form:

\[ i_t = \left(1 - \rho_1 - \rho_2 \right) \left[ \varphi_\pi \pi_t + \varphi_y y_t + \varphi_{\Delta y} \Delta y_t \right] + \rho_1 i_{t-1} + \rho_2 i_{t-2} + u_t, \]

where \( i_t \) denotes the short-term interest rate, \( \pi_t \) is the inflation rate, \( y_t \) denotes the output level, \( \Delta y_t \) denotes output growth, and \( u_t \) is a white noise monetary policy shock. All variables are expressed as log deviations from their steady-state values and subscripts denote time periods.

In each model, the household decides how much to consume, how much to save in one-period bonds, and how much labor to supply. Household preferences are characterized by external habit formation for consumption \((b)\) and labor supply elasticity \((1/\sigma)\). Labor services are individually differentiated and subject to Calvo staggered wage setting, with a demand elasticity for individual labor services denoted by \( \theta_w \) and a fraction of wages that remains unchanged each period denoted by \( \alpha_w \). The households’ consumption Euler equation is:

\[ y_t = \frac{1}{1 + b} E_t y_{t+1} + \frac{b}{1 + b} y_{t-1} - \left( i_t - E_t \pi_{t+1} \right), \]

where \( E_t \) is the rational-expectations operator conditional on time-\( t \) information.

Firms use a labor-only technology to produce differentiated goods and are subject to Calvo price rigidity, where \( \alpha_p \) is the fraction of prices that is either adjusted by indexation or unchanged each period. The composite-good producer uses an aggregator with variable elasticity of demand as in Kimball (1995), in which two parameters, \( \theta_p \) and \( \varepsilon \), determine the shape of the demand curves.

The two models are distinguished by their assumptions about the behavior of firms unable to optimize their products’ prices. In the model with price indexation, these firms are assumed to index their prices to the past inflation rate, as is common in research using
New Keynesian models. The resulting NKPC is given by equation (1) in the text. In the model without indexation, these firms are assumed to leave their prices unchanged, leading the model’s dynamics to depend on the trend inflation rate. The resulting Phillips curve, known as the generalized NKPC (GNKPC) is given by:

$$\pi_t = \beta E_t \pi_{t+1} + \lambda_1 mc_t + \lambda_2 \Delta y_t + a_\pi d_t + \beta E_t d_{t+1} + d_{t-1} + \phi_t + \psi_t.$$  
Output growth appears in the case of habit formation (that is, $b > 0$). The variables $\phi_t$ and $\psi_t$ are auxiliary variables that capture expectations of future variables, as shown by their recursive formulation:

$$\phi_t = a_\phi E_t \pi_{t+1} + a_\phi mc E_t mc_{t+1} + a_\phi d E_t d_{t+1} + a_\phi \Delta y_t + \alpha \beta \pi^{\theta(1+\varepsilon)} E_t \phi_{t+1},$$

$$\psi_t = a_\psi E_t \pi_{t+1} + a_\psi \Delta y_t + \alpha \beta \pi^{-1} E_t \psi_{t+1}.$$  
The variables $d_t$ and $s_t$ are measures of price dispersion and demand dispersion, respectively. As emphasized by Kurozumi and Van Zandwegrhe (2018), lags of the dispersion measures are endogenous state variables. Their laws of motion are given by:

$$d_t = a_d \pi_t + \rho_d d_{t-1}$$

$$s_t = a_s (\pi_t + d_t - d_{t-1}) + \alpha \beta \pi^{\theta(1+\varepsilon)} s_{t-1}.$$  
With some further algebra, the GNKPC can be written as equation (2) in the text. The parameters $a_\phi, a_{\phi mc}, a_{\phi d}, a_{\phi \lambda}, a_{\phi \gamma}, a_{\phi \psi}, a_{\phi \lambda'}, a_{\phi \gamma'}, a_d, \rho_d, a, B, \gamma, k_1, k_2, \lambda, \lambda'$, and $\lambda_2$ are nonlinear functions of the structural parameters. Furthermore, aggregate output is given by:

$$y_t = n_t - \left( \frac{s}{s + \varepsilon} \right) s_t,$$
where $n_t$ denotes the labor input and the steady-state value $s$ is a nonlinear function of structural parameters.

To sharpen the intuition for the different results obtained with the two models, I write inflation in terms of infinite sums of the driving variables. The standard NKPC, denoted by equation (1) in Section II, can be rewritten to relate the change in inflation to the current and the discounted expected future real marginal costs as follows:
\[ \Delta \pi_t = (1 + \beta) \kappa \sum_{j=0}^{\infty} \beta^j mc_{t+j}. \]

Thus, the change in inflation is determined solely by firms’ current and expected future real marginal costs. Likewise, the GNKPC above can be rewritten to relate inflation to the current and discounted expected future real marginal costs, output growth (in the case of habit formation), price dispersions, and auxiliary variables, as follows:

\[ \pi_t = \sum_{j=0}^{\infty} \beta^j X_{t+j}, \]  

where

\[ X_t \equiv \lambda_1 mc_t + \lambda_2 \Delta y_t + a_\pi d_t + \beta E_t d_{t+1} + d_{t-1} + \varphi_t + \psi_t. \]

This demonstrates that inflation in the GNKPC is not determined solely by the current and discounted expected future real marginal costs but also by other variables. As a result, the model can account for the divergent post-recession paths of inflation and the real marginal cost.
Appendix B

Estimation Results

This appendix presents the estimation results of the New Keynesian models with price indexation and without indexation.

Model with price indexation

The minimum distance estimation yields estimates for the structural parameters of the New Keynesian model with price indexation. Three parameters are fixed before estimation: the subjective discount factor, $\beta$, is set to 0.99, and the parameters governing the elasticity of demand for differentiated goods and labor services, $\theta_p$ and $\theta_w$, are set equal to 10. Table B-1 reports the estimated values of the remaining model parameters. The degree of price rigidity and the parameter governing the curvature of the goods demand curves are not identified individually, but the slope of the NKPC, $\kappa$, is estimated at 0.0038. The estimated degree of wage rigidity is 0.5918, implying wages remain unchanged for about 2.5 quarters on average.

The impulse responses of the estimated New Keynesian model with price indexation can be compared with the empirical impulse responses of the VAR (displayed in Chart 2). Chart B-1 plots the impulse responses of the short-term interest rate, the inflation rate, and the output gap (solid lines) along with their empirical counterparts (dashed lines). The impulse responses of the New Keynesian model capture the gradual rise in the short term interest rate and the hump-shaped responses of inflation and the output gap, although the latter two are less persistent than the impulse responses of the VAR.

Model without indexation

Table B-2 reports the results of the minimum distance estimation for the New Keynesian model without indexation. Four parameters are fixed before estimation: $\beta = 0.99$, $\theta_p = \theta_w = 10$, and the trend inflation rate, $\pi_t$, is set to 2.5 percent annually. The model without indexation allows identifying the degree of price rigidity ($\alpha_p$) and the parameter that governs the curvature in demand curves ($\delta$). The estimated degree of price rigidity implies that prices change on
### Table B-1
Estimated Coefficients of the Model with Price Indexation

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Description</th>
<th>Point estimate</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>κ</td>
<td>Slope of the Phillips curve</td>
<td>0.0038</td>
<td>0.0042</td>
</tr>
<tr>
<td>α&lt;sub&gt;p&lt;/sub&gt;</td>
<td>Degree of price rigidity</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>α&lt;sub&gt;ω&lt;/sub&gt;</td>
<td>Degree of wage rigidity</td>
<td>0.5918</td>
<td>0.0001</td>
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<tr>
<td>b</td>
<td>Degree of habit persistence</td>
<td>0.9382</td>
<td>0.0009</td>
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<tr>
<td>σ&lt;sub&gt;n&lt;/sub&gt;</td>
<td>Inverse labor supply elasticity</td>
<td>1.7626</td>
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<tr>
<td>ε</td>
<td>Curvature in demand curves</td>
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<td>–</td>
</tr>
<tr>
<td>φ&lt;sub&gt;π&lt;/sub&gt;</td>
<td>Policy response to inflation</td>
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<tr>
<td>φ&lt;sub&gt;y&lt;/sub&gt;</td>
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<tr>
<td>φ&lt;sub&gt;dy&lt;/sub&gt;</td>
<td>Policy response to output growth</td>
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<tr>
<td>ρ&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Policy response to first lag of interest rate</td>
<td>1.0722</td>
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</tr>
<tr>
<td>ρ&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Policy response to second lag of interest rate</td>
<td>-0.1309</td>
<td>0.0022</td>
</tr>
</tbody>
</table>

Note: Standard errors are computed using the asymptotic delta method.
Sources: Bureau of Economic Analysis, Board of Governors of the Federal Reserve System, and author’s calculations. All data sources accessed through Haver Analytics.
Chart B-1
Impulse Responses of the Model with Price Indexation

Sources: Bureau of Economic Analysis, Board of Governors of the Federal Reserve System, and author’s calculations. All data sources accessed through Haver Analytics.
average about once per six quarters, which is a low frequency of price change similar to the estimate of Del Negro, Giannoni, and Schorfheide (2015). The degree of wage rigidity, at 0.3911, is lower than for the model with price indexation, allowing for less smooth real marginal cost dynamics. The estimated value of the curvature parameter implies a curvature of $-\theta p \varepsilon = 93.7$, which exceeds micro estimates but is in line with the values used in other macro research. The estimated values of the remaining model parameters are in line with the values obtained for the model with price indexation. The estimated parameters imply that the slope of the generalized NKPC, $\kappa_y$, equals 0.0073.

Chart B-2 plots the impulse responses of the short-term interest rate, the inflation rate, and the output gap generated by the estimated model without indexation (solid lines), along with the empirical impulse responses generated by the structural VAR (dashed lines). The impulse responses of this model once again capture the gradual rise in the short term interest rate and the hump-shaped responses of inflation and the output gap, although the latter two are less persistent than their empirical counterparts.

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<th>Coefficient</th>
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<tr>
<td>$\alpha_w$</td>
<td>Degree of wage rigidity</td>
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<td>0.0001</td>
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<td>$b$</td>
<td>Degree of habit persistence</td>
<td>0.9290</td>
<td>0.0003</td>
</tr>
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<td>$\sigma_v$</td>
<td>Inverse labor supply elasticity</td>
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</tr>
<tr>
<td>$\varepsilon$</td>
<td>Degree of curvature in demand curves</td>
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<td>0.0001</td>
</tr>
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<td>$\varphi_y$</td>
<td>Policy response to inflation</td>
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<td>0.0001</td>
</tr>
<tr>
<td>$\varphi_y$</td>
<td>Policy response to output gap</td>
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<td>0.0001</td>
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<td>Policy response to output growth</td>
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<td>$\varphi_y$</td>
<td>Policy response to second lag of interest rate</td>
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<td>0.0007</td>
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<td>$\rho_1$</td>
<td>Policy response to interest rate</td>
<td>0.2490</td>
<td>0.0007</td>
</tr>
</tbody>
</table>

Note: Standard errors are computed using the asymptotic delta method.
Sources: Bureau of Economic Analysis, Board of Governors of the Federal Reserve System, and author’s calculations. All data sources accessed through Haver Analytics.
Chart B-2
Impulse Responses of the Model without Indexation

Sources: Bureau of Economic Analysis, Board of Governors of the Federal Reserve System, and author’s calculations. All data sources accessed through Haver Analytics.
Endnotes

1 Empirical studies find that the association between inflation and unemployment—the so-called slope of the Phillips curve—strengthened in the 1960s, plateaued in the 1970s, and weakened again in the 1980s (Ball and Mazumder 2011; Matheson and Stavrev 2013; Blanchard 2016).

2 Hall (2011) spurred this research by arguing provocatively that “the dominant model of inflation embedded in practical macro models today… cannot explain the stabilization of inflation at positive rates in the presence of long-lasting slack.” Other research has addressed the issue of the missing disinflation using statistical Phillips curve models, which pay less attention to microeconomic foundations, including Stock and Watson (2010), Gordon (2013), and the references in endnote 1.

3 A linear trend has been removed from real unit labor costs in the chart to separate the cyclical fluctuations in the series from its secular downward trend. Elsby, Hobijn, and Şahin (2013) analyze the sources of the secular decline in real unit labor costs.

4 Kim (2018) finds that firms whose credit was curtailed in the recession actually lowered their prices and highlights firms’ inventory management to explain the missing disinflation.

5 In addition to higher interest rate spreads, Christiano, Eichenbaum, and Trabandt (2015) also emphasize the role of sluggish productivity growth in accounting for the small decline in inflation. Other research has examined the effect of the financial crisis on productivity growth; see, for example, Redmond and Van Zandweghe (2016).

6 Lindé and Trabandt (2018) propose an explanation for the missing disinflation based on other nonlinearities.

7 Consistently, the empirical evidence of Matheson and Stavrev (2013) and Blanchard (2016) indicates that inflation expectations have become steadily better anchored since the 1980s.

8 The flat Phillips curve reflects a high degree of nominal price rigidity. As firms expect to optimize their products’ prices infrequently, their price-setting behavior becomes more attuned to expected future real marginal costs, which are greatly influenced by monetary policy, rather than to current marginal costs, which are heavily affected by shocks to the economy.

9 The GNKPC is a variant of the model proposed by Kurozumi and Van Zandweghe (2018). It assumes a positive trend inflation rate, in line with positive average inflation observed in the United States. If the assumed trend inflation rate is zero, then both models coincide. Ascari and Sbordone (2014) review the literature related to the GNKPC, which is characterized by positive trend inflation and no price indexation.
The lags of inflation appear endogenously in this Phillips curve even though price-setting is purely forward-looking. Output growth only appears in the case of habit formation in consumption preferences.

The inflation rate is the quarterly change in the logarithm of the GDP deflator, and the output gap is measured as one-half times the capacity utilization rate in the manufacturing sector, following Giordani (2004). The lag length of the VAR is four quarters. Monetary policy shocks are identified by assuming that only the federal funds rate responds contemporaneously to such a shock. Real unit labor costs are not used in the estimation. King and Watson (2012) point out challenges of using real unit labor costs to estimate Phillips curve models.

The weighting matrix $W$ is a diagonal matrix that contains the inverse variances of the elements of $\hat{G}$, following Christiano, Eichenbaum, and Evans (2005), Giannoni and Woodford (2005), and Boivin and Giannoni (2006).

Specifically, I assume the output gap declines an annualized 6.6 percent in the initial period (2008:Q4) and use the equilibrium decision rules of the estimated model to trace the dynamics of the output gap, the year-over-year inflation rate, and the real marginal cost.

The model’s forecast for the short-term interest rate remains positive, so the forecast of a small decline in inflation is not due to implausibly large policy accommodation in the model.

More precisely, the ratio of RMSEs equals $0.548/0.636 = 0.86$ for inflation and $2.417/3.277 = 0.74$ for real unit labor costs.

The model without indexation is a variant of the model of Kurozumi and Van Zandweghe (2018), who highlight the implications for inflation persistence of the interaction between positive trend inflation, staggered price setting, and the variable elasticity of demand. The model used in this article allows for habit formation in consumption preferences, from which Kurozumi and Van Zandweghe (2018) abstract.
References


Capital Reallocation and Capital Investment

By David Rodziewicz and Nicholas Sly

Corporate debt levels have grown substantially during the 10-year recovery from the global financial crisis. Even excluding the financial sector of the U.S. economy, the value of corporate bonds outstanding grew from approximately $3 trillion in 2008 to nearly $6 trillion in 2018. These bonds might be expected to fund investments that support firm expansion, as the U.S. economy has experienced strong growth over the last 10 years. However, much of the corporate debt has been used to reallocate capital through mergers and acquisitions rather than to fund new investment activity. In syndicated lending markets alone, approximately 20 percent of the credit extended to the corporate sector—$2 trillion over the last decade—financed acquisitions. Perhaps as a result, some market watchers have expressed concerns that corporations are taking on risky debt and not investing in new plants and equipment.

Crucial in weighing these concerns is identifying whether capital reallocation is a substitute for or complement to new investment. For example, firms may purchase equipment or structures from other businesses in place of investing in new capital. Consolidation within industries may also limit competition, diminishing firms’ incentives to invest. In these cases, mergers and acquisitions may substitute for new investment, and when acquisition activity surges, the level of investment might be low. However, firms may also supplement their

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strategic merger and acquisition activity by purchasing new equipment, structures, or intellectual property. In this case, mergers and acquisitions may complement new capital investment, and when funding for mergers and acquisitions surges, the level of investment might be high. In reality, both substitution and complementary economic channels are likely to be at play. A key question is which channel dominates.

In this article, we show rising levels of merger and acquisition activity do not fully crowd out new capital investment, as both sales of existing capital between firms and investment in new capital tend to rise and fall together in the aggregate and within the majority of U.S. industries. Although measures of capital reallocation generally have limited detail about the value of capital exchanged or the method of financing, these measures still show that the ebb and flow of capital reallocation is substantial in magnitude. That investment and capital reallocation move together within most industries suggests that no single sector is driving the positive relationship observed in the aggregate. Moreover, the pervasive relationship between capital reallocation and investment suggests that a latent factor may be driving capital expenditures by firms broadly. We estimate this factor and find that it exhibits persistence over time, suggesting indicators of capital reallocation can be helpful in measuring the state of U.S. investment cycles.

Section I discusses several ways in which capital reallocation might be linked to real investment. Section II shows that capital reallocation and investment tend to co-move for the U.S. economy as a whole. Section III takes a narrower perspective and shows that this relationship holds within specific industries. Section IV estimates an underlying factor that drives both capital reallocation and investment.

I. The Link between Merger and Acquisition Activity and Investment

Assessing the relationship between investment and capital reallocation can be challenging, because this relationship is subject to many, sometimes offsetting economic forces. The strategic behavior of firms might lead to either more or less investment following merger and acquisition activity. For example, Arnold and Javorcik (2009) find that acquisitions cause investment outlays to rise at acquired plants soon after a merger has taken place. However, Blonigen and Peirce (2016)
show that acquisition activity leads to rising markups among firms; this greater competitive pressure may deter other firms from undertaking some investments projects. Indeed, Philippon (2018) argues that consolidation and a rising concentration of activity among a few firms within industries have created shortfalls in U.S. investment. While acquired firms exhibit investment growth, suggesting a positive relationship between investment and capital reallocation, the subsequent effects on other competitors within an industry suggest widespread capital reallocation crowds out investment.

Investment and capital reallocation might be related for reasons other than the strategic behavior of firms. Some of the same underlying factors that encourage firms to invest might also encourage them to acquire other firms and subsume their capital. Jovanovic and Rousseau (2002) argue that firms with high book values relative to their costs of capital are simultaneously those most likely to invest and those most likely to engage in acquisitions, suggesting complementarity between the two activities. In addition, Lanteri (2018) shows that the prices of certain capital goods (aircrafts, ships, vehicles, and construction equipment) tend to fall in secondary markets during economic downturns, limiting firms’ incentives to sell used capital goods during recessions. Since investment also tends to fall during recessions, this view suggests that underlying macroeconomic shocks would generate a positive relationship between capital reallocation and investment over time. In contrast, Eisfeldt and Rampini (2006) argue that the motives for capital reallocation are strongest during a recession: some firms are more adversely struck by a downturn than others, and these firms may sell used capital to relatively less affected firms at a time when investment is low.

Capital reallocation and investment are linked in several ways, and it is unclear which link dominates. As a result, it is difficult to know from economic theory whether investment and capital reallocation move together or in opposing directions over time. Given the large amount of credit issued to fund capital reallocation activities, identifying this relationship seems crucial. Thus, we examine whether these economic activities have tended to co-move in the U.S. economy over the last three decades.
II. An Aggregate View of Funding for Mergers and Acquisitions and Investment

To assess whether U.S. capital reallocation and investment are largely substitutes or complements, we first consider the aggregate relationship between the two. We measure capital reallocation using the volume of merger and acquisition (M&A) activity in the U.S. economy. As discussed in Jovanovic and Rousseau (2002), a merger or acquisition is a particular form of capital reallocation in which the capital goods of a target firm are sold as a bundle, rather than sold individually on secondary markets. In this sense, M&A activity captures only a slice of total capital reallocation, albeit an important one.

We measure U.S. M&A activity in two ways. Our first measure is a simple count of the number of M&A transactions among U.S. firms each quarter from 1990 to the end of 2018, available from Thomson Reuters Eikon. These data contain a listing of publicly disclosed mergers and acquisitions among U.S. firms. Although this measure is comprehensive in that it includes acquisitions financed through a variety of methods, it does not provide details on the monetary values of most M&As. As a result, we also use a second measure—the volume of syndicated lending for the express purpose of funding acquisitions over the same time period. These data are from Thomson Reuters’ Loan Pricing Corporation Deal Scan database, generally referred to as “DealScan.” Syndicated loan volumes are measured on a quarterly basis beginning in 1990, with dollar values measured on a historical basis (that is, measured in nominal dollars).

To smooth out seasonal fluctuations and other idiosyncratic volatility, we calculate four-quarter rolling sums of each measure so that each quarter has a measure of M&A activity accumulated over the previous year. For both the number of M&A transactions and the syndicated loan volumes for M&As, we observe the two-digit Global Industry Classification Standard (GICS) code for the firms involved.

At the aggregate level, we obtain data on new capital investment in both equipment and structures from the National Income and Product Accounts (NIPA). Charts 1 and 2 use these data to plot four-quarter rolling sums of structures and equipment investment, respectively, against four-quarter rolling sums of both of our measures—the total number of U.S. M&As and the volume of syndicated funding for
Chart 1
Aggregate Structures Investment

Note: Gray bars denote National Bureau of Economic Research (NBER)-defined recessions at a monthly frequency.
Sources: Bureau of Economic Analysis (Haver Analytics), LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).

Chart 2
Aggregate Equipment Investment

Note: Gray bars denote NBER-defined recessions at a monthly frequency.
Sources: Bureau of Economic Analysis (Haver Analytics), LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).
acquisitions. To facilitate comparisons, the dollar values for each investment series and for syndicated loans are expressed in historical prices and indexed to their respective levels in 2006:Q4.

Chart 1 shows that the run-up in M&A activity during the last three economic expansions coincided with growth in structures investment. Both the volume of corporate lending for acquisitions (blue line) and the actual number of mergers (green line) rose ahead of actual investment activity (orange line) during the dot-com bubble of the late 1990s, in the early 2000s, and during the recovery from the financial crisis. For example, during the late 1990s, the number of M&A transactions in the U.S. peaked at a historical high of nearly 10,000 in 1998:Q3 (not shown). Over the same period, structures investment continued to increase, peaking in 2000:Q4.

As the volume of M&A activity plummeted ahead of the last two recessions, so, too, did structures investment several quarters later. Following the burst of the dot-com bubble, M&A activity declined and hit a trough in 2002:Q2. Three quarters later, in 2003:Q1, structures investment reached its nadir.

Chart 2 shows a similar pattern between changes in M&A activity and changes in equipment investment. After funding for M&As peaked in 1998 (blue line), borrowing in syndicated lending markets began to decline, bottoming out in June 2002. One year later, the level of equipment investment (orange line) reversed its upward trend and hit a trough in March 2003. While total equipment investment has been trending higher over the last 30 years, the ebbs and flows have roughly coincided with fluctuations in the amount of syndicated lending to corporations for M&As.

The volume of capital reallocation within the U.S. economy illustrated in the charts is large. Due to data limitations, we can observe only the number of U.S. mergers and a proxy for the amount of financial activity associated with M&As. Syndicated lending markets account for a small subset of the total amount of credit issued for M&As (single banks, for example, may provide loans to acquirers outside of the syndicated lending market). Indeed, comparing our two data sources shows that only about 5 percent of M&As in the United States are financed on syndicated lending markets. Furthermore, the DealScan data may understate the value of an M&A transaction if the M&A is partially...
financed by exchanges of equity, the issuance of commercial paper, or stipulations for future purchases of outstanding shares. As a result, our measures underestimate the total amount of capital reallocation that occurs in the U.S. economy at any given point in time.

Even when considering only the fraction of M&A activity that occurs with financing from syndicated lending markets, the measured volume of capital reallocation in 2018 comprised approximately 18 percent of the total volume of investment outside the financial and real estate sectors. Given that this figure incorporates roughly 5 percent of M&A transactions (with presumably only the largest transactions requiring syndicated funding), existing assets held by other firms are clearly vital sources of capital purchases for U.S. producers.

III. Industry-Specific Borrowing, M&A Activity, and Capital Expenditures

The evidence in Charts 1 and 2 suggests investment and capital reallocation are complementary in the aggregate. However, the charts alone cannot show the extent to which the relationship is widespread across industries or present in a handful of specific industries. To address this concern, we next examine the relationship between investment and capital reallocation within specific industries.

To measure investment within specific industries, we aggregate firm-specific capital expenditures reported in S&P Global Market Intelligence’s Compustat data for U.S. publicly traded firms. These data provide quarterly measures of capital expenditures within individual sectors but are combed from public filings and so excludes investment by private firms in the U.S. economy at a given point in time. Previous research such as Asker, Farre-Mensa, and Ljungqvist (2014) shows that capital expenditures from U.S. public firms account for approximately 50 percent of total nonresidential investment spending. Moreover, the variation in measured capital expenditures closely matches changes in aggregate investment recorded in NIPA, as shown in Rodziewicz (2018). Thus, the capital expenditures data in Compustat proxy for investment within industries over the last three decades.

We focus on sectors categorized by two-digit GICS codes, excluding the finance and real estate sectors. The consumer staples sector is
primarily composed of food and beverage companies and accounts for roughly 5 percent of investment. The consumer discretionary sector comprises household durable goods (such as automobiles and apparel) as well as services (such as hotels and haircuts) and accounts for approximately 10 percent of investment. The industrial sector includes producers of capital goods (such as heavy manufacturing and building products), commercial and professional services, and transportation, and makes up 13 percent of investment. The materials sector mainly comprises metals and mining (excluding energy), chemicals, packaging, and paper products, and totals 4 percent of investment. The energy sector (oil, gas, coal, and consumable fuels) and associated supply chains account for roughly 27 percent of investment. Finally, the telecommunications, information technology, healthcare, and utilities sectors account for 10 percent, 7 percent, 4 percent, and 20 percent of total investment, respectively.  

Consumer discretionary and consumer staples sectors

Capital expenditures in consumer-oriented sectors closely track the ebb and flow of merger waves. Chart 3 shows that the rise and fall of capital reallocation among firms in the consumer discretionary sector over the last 30 years—as measured by transaction volumes (green line) and syndicated lending for M&As (blue line)—coincides with increases and declines in capital expenditures during the same period (orange line). The peaks in capital expenditures in this sector occur at nearly the same time as the peaks in capital reallocation, as is evident in 1998 and in 2007. The timing of these peaks differs from the economy as a whole, as capital reallocation tends to precede capital investment in the aggregate (see Charts 1 and 2).

Chart 4 shows that capital expenditures in the consumer staples sector follow a similar pattern, rising and falling along with M&A activity. However, the syndicated lending market appears to be a less important source of financing for M&As within this sector. As a result, the typical amount of lending for M&A activity (blue line) looks more volatile due to the fact that at many points in time, no transactions are observed. Nevertheless, the peaks in the total number of M&A transactions in 1999 and 2007 coincide closely with the peaks in capital expenditures.
Chart 3
Consumer Discretionary

Note: Gray bars denote NBER-defined recessions at a monthly frequency.
Sources: Compustat, LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).

Chart 4
Consumer Staples

Note: Gray bars denote NBER-defined recessions at a monthly frequency.
Sources: Compustat, LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).
In both of these consumer-oriented sectors, the number of M&A transactions and recent levels of financing for acquisitions are somewhat above historical averages. If the typical positive relationship between capital investment and capital reallocation holds for these sectors, the momentum in M&A activity suggests modest growth in investment in 2019.

**Industrials and materials sectors**

Chart 5 illustrates the same complementary relationship between capital reallocation and capital expenditures within the industrials sector. However, the association between them more closely resembles the U.S. economy as a whole in that the ebbs and flows of M&A activity tend to precede the rises and falls in capital expenditures by industrial firms. For example, the number of M&A transactions peaked in 1998, two years prior to the peak in capital expenditures. As the number of M&A transactions declined around the turn of the century, the level of capital expenditures fell as well. During the current economic expansion, both M&As and investment have been rising together in the industrial sector.

Chart 6 shows that this relationship holds for the materials sector as well. Over the last two years, the flow of credit from syndicated lending markets to finance M&A activities fell precipitously in the materials sector. Around the same time, the level of capital expenditures also fell, even though both have been rising in other sectors.

**Energy sector**

The amount of M&A activity and investment in the energy sector does not closely track the rest of the U.S. economy. Chart 7 shows that the level of both M&A activity and capital expenditures were relatively stable during the late 1990s, a time when most other sectors experienced surges in M&As. After 2005, the shale boom led to increased energy production in the United States, and accordingly, capital reallocation and investment both increased. In 2015, crude oil prices declined sharply and incentives to invest in oil production declined in the United States. Correspondingly, both M&As and capital expenditures fell and have remained below their 2015 peaks. The changes within the energy sector since 2015 are distinct from the much of the U.S. economy as a whole: although M&A activity has been steady or rising
Chart 5
Industrials

Note: Gray bars denote NBER-defined recessions at a monthly frequency.
Sources: Compustat, LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).

Chart 6
Materials

Note: Gray bars denote NBER-defined recessions at a monthly frequency.
Sources: Compustat, LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).
in most sectors, it has fallen over the last three years within the energy sector. However, the relationship between M&A activity and capital expenditures in the energy sector remains consistent with the aggregate economy. The industry-specific decline in both M&A activity and capital expenditures further confirms that capital reallocation indeed complements, rather than substitutes for, new investment.

**Telecommunication and information technology sectors**

M&A activity and capital expenditures in the telecommunication services sector were closely related before the global financial crisis; however, that relationship has become more tenuous in recent years. Chart 8 shows that throughout the 1990s, the number of M&A transactions rose steadily each year, as did the level of capital expenditures. Both series peaked in 2000, then fell precipitously in the early 2000s. But over the last 10 years, the level of capital expenditures has risen steadily while the number of M&A transactions has continued to fall. With the exception of a couple of large loans issued to finance acquisitions in the last two years, syndicated lending for M&As has fluctuated near its historic norm. The emergence of wireless communication technologies has likely kept capital expenditures rising steadily, and so
the co-movement between capital reallocation and investment is less evident in the telecommunication sector than it used to be.

Similar to the telecommunications sector, the number of M&A transactions in the information technology sector coincided with the level of capital expenditures from 1990 through the global financial crisis (Chart 9). However, since 2010, the number of acquisitions has remained flat while capital expenditures have increased substantially. From 2011 to 2015, the level of syndicated lending for M&As was also fairly stable. In sum, the positive relationship between investment and capital reallocation does not appear to be as relevant for the telecommunications and information technology sectors as it was 20 years ago.

Health-care and utilities sectors

The health-care and utilities sectors exhibit no discernable relationship between capital reallocation and investment. Chart 10 shows that capital expenditures within the health-care sector have been trending upward over the last 30 years. However, in the early 1990s, when the volume of M&A activity surged above its historical average, the pace of investment increased only slightly. The number of acquisitions began to decline in 1996, and capital expenditures kept growing at a
**Chart 9**

Information Technology

![Graph showing M&A syndicated loan volume (L), M&A transaction volume (R), and Capital expenditure (R).]

Note: Gray bars denote NBER-defined recessions at a monthly frequency.
Sources: Compustat, LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).

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**Chart 10**

Health Care

![Graph showing M&A syndicated loan volume (L), M&A transaction volume (R), and Capital expenditure (R).]

Note: Gray bars denote NBER-defined recessions at a monthly frequency.
Sources: Compustat, LPC DealScan, Thomson Reuters, and NBER (Haver Analytics).
steady pace. In addition, increases in the number of M&A transactions and the volume of financing for M&As during the early 2000s did not coincide with faster growth in capital expenditures. For the large health-care sector, capital reallocation and investment do not seem to go hand-in-hand.

Capital reallocation and investment do not appear to be related in the utilities sector, either. Chart 11 shows that capital expenditures in the utilities sector were essentially flat until the early 2000s even as the amount of capital reallocation ebbed and flowed. Since the early 2000s, capital expenditures have risen steadily but with little relation to the amount of M&A financing or transactions. Despite the absence of a link in the health-care and utilities sectors, capital reallocation and investment move together for the overwhelming majority of U.S. industries.

IV. Latent Factors Supporting Investment Activities

One possible explanation for the pervasive co-movement between capital reallocation and investment is that common factors are driving changes in firms’ capital deployment strategies. A plausible mechanism for the common factor comes from the \( Q \) theory of investment, which...
suggests the same macroeconomic conditions that promote investment also promote acquisitions.

To test this explanation, we estimate a coincident index using a simple dynamic factor model that allows us to measure an underlying factor driving investment cycles in the U.S. economy. Specifically, we follow the standard approach in Stock and Watson (1989, 1991) and model the aggregate series of (log) equipment investment, structures investment, the volume of credit supplied in syndicated lending markets to finance M&As, and the number of M&A transactions as having a single common factor. We then model that factor in a second-order autoregressive process. We take first-differences for each series to ensure stationarity and standardize each observation according to the mean and standard deviation of its respective series. We estimate the model using maximum likelihood for the period 1990:Q1 through 2018:Q4.

The underlying factor loads positively on each type of capital investment and each measure of capital reallocation for the U.S. economy, suggesting that both new investment and capital reallocation tend to move in tandem with the underlying factor. Table 1 contains the factor loadings for each series. The estimated factor loading for the number of

Table 1
Factor Loadings onto Investment and Capital Reallocation Series

<table>
<thead>
<tr>
<th>Investment series</th>
<th>Factor loadings</th>
</tr>
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<td>Structures investment</td>
<td>0.263***</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
</tr>
<tr>
<td>Equipment investment</td>
<td>0.127***</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
</tr>
<tr>
<td>M&amp;A syndicated loan volume</td>
<td>0.064***</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
</tr>
<tr>
<td>M&amp;A transaction volume</td>
<td>0.047*</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
</tr>
<tr>
<td>Loglikelihood</td>
<td>−508.41</td>
</tr>
<tr>
<td>Factor AR coefficients</td>
<td></td>
</tr>
<tr>
<td>First lag</td>
<td>1.59***</td>
</tr>
<tr>
<td>Second lag</td>
<td>−0.731***</td>
</tr>
<tr>
<td>Observations</td>
<td>115</td>
</tr>
</tbody>
</table>

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Note: Standard errors are in parentheses.
M&A transactions is positive but only marginally significant. In other words, the volumes of investment and lending for M&A activity tend to move closely with an underlying factor, but the simple number of M&A transactions has a more tenuous relationship with that common factor. This is likely due to the fact that the number of transactions is too coarse of a measure (lacking any information on the size of M&A transactions) to precisely estimate its connection with any underlying factor. Chart 12 plots the (smoothed) estimates of the common factor over our sample period. The latest estimate of the underlying factor for the end of 2018 is modestly above zero. Given the positive loadings of the factor to investment activity and the persistence of the factor, the current estimates from the end of 2018 suggest that investment growth may remain slightly above its average over the coming months.

V. Discussion

Recent growth in the volume of corporate debt used to finance acquisitions has raised questions about how this credit issuance is associated with real economic activity. This article demonstrates a simple fact about acquisition activity and investment—capital expenditures
tend to rise in parts of the U.S. economy where funding for acquisitions tends to flow. Put differently, large volumes of capital reallocation do not fully crowd out new investment by firms; instead, increases in M&A activity tend to complement growth in investment.

Market watchers often pay close attention to movements of workers between firms or between cities as indicators of the overall health and activity in labor markets. Our results suggest flows of capital between firms can similarly be useful in assessing the overall conditions that drive U.S. investment. While acquisitions of other firms do not constitute new investment activity, they do allow acquiring firms to strategically position themselves and build their productive capacity, subsequently influencing overall growth in the U.S. economy.
Endnotes

1 We include only those merger transactions where both the acquirer and target are U.S. firms. Including acquisitions of U.S. entities by foreign firms has little implications for overall M&A activity and no effect on our main conclusions.

2 Monetary values are available for a fraction of the observed transactions in the Thomson Reuters database but missing for the majority of observations.

3 Characteristics on each loan include details of maturity, size, pricing and purpose of the loan at the date of origination. One or more “facilities” are reported in terms of the syndicated “package” identification, or deal, between the borrower and lender(s). The base unit of observation is by individual “facility” or loan. We restrict our sample to include loans used for M&A purposes from 1990 to 2017 that originated in the United States, with 53,677 reported “facilities” and 37,838 “packages.” Quarterly estimates of M&A syndicated loans are reported by aggregating loan value for each quarter.

4 For each M&A series, we observe the three-digit Standard Industrial Classification code for each transaction, which we convert to a two-digit GICS code to facilitate the match with Compustat data.

5 U.S. publicly traded firms are identified as companies incorporated in the United States. Compustat data are used with permission and are copyright © 2018, S&P Global Market Intelligence. Reproduction of any information, data or material, including ratings (“Content”) in any form is prohibited except with the prior written permission of the relevant party. Such party, its affiliates and suppliers (“Content Providers”) do not guarantee the accuracy, adequacy, completeness, timeliness or availability of any Content and are not responsible for any errors or omissions (negligent or otherwise), regardless of the cause, or for the results obtained from the use of such Content. In no event shall Content Providers be liable for any damages, costs, expenses, legal fees, or losses (including lost income or lost profit and opportunity costs) in connection with any use of the Content.

6 Capital expenditures are firms’ total investment expenditures on the purchase of, upgrades to, and maintenance of physical assets within a given quarter measured in nominal U.S. dollars. Capital expenditures exclude M&A activity. We use GICS codes to classify firms into distinct industries and exclude financial and real estate sectors from the analysis. The financial and real estate sectors are outliers in both their use and levels of debt and M&A activity, which are tenuously linked to real economic activities.

7 The shares of investment within each sector are estimated based on five-year trailing averages of total capital expenditures by firms in each industry.
References


Implementation Delays in Pension Retrenchment Reforms

By Huixin Bi, Kevin Hunt, and Sarah Zubairy

As the global population ages, public spending on pensions has increased dramatically. According to the Organisation for Economic Co-operation and Development (OECD), spending on public pensions for OECD countries as a whole rose by 2.5 percent of GDP from 1990 to 2017. Pension spending is likely to rise even more rapidly in the future, with the ratio of the elderly population to the working-age population set to double in the next three decades. As a result, policymakers have increasingly focused on pension retrenchment reforms to keep their pension systems solvent.

Pension retrenchment reforms usually involve prolonged phase-in periods or implementation delays. These phase-in periods ease the effects of pension reforms by providing retirees time to adjust their retirement plans. However, phase-in periods also slow the process of scaling back governments’ pension spending, possibly raising long-run fiscal risks. Understanding the effects of these phase-in periods may be critical to governments contemplating pension reforms. But quantitative measures on implementation delays are lacking, as it is challenging to systematically collect such data over a long period of time.

In this article, we collect a new data set that tracks implementation delays during pension retrenchment reforms for 12 OECD countries from 1962 to 2017. We find that the average phase-in period associated
with pension retrenchment reforms is about a decade. However, imple-
mentation delays can be significantly longer for age-related pension re-
forms, which account for a large share of pension retrenchments since
2000. In addition, the distribution of phase-in periods is quite diffuse:
implementation delays are often prolonged for far-reaching reforms but
short for reforms with limited scope. Finally, we examine implementa-
tion delays for reforms in three OECD countries—Japan, Italy, and Bel-
gium—as case studies for future Social Security reforms in the United
States, where large-scale changes to the Social Security system have been
few and far between.

Section I describes past pension reforms in OECD countries. Sec-
tion II explains how we compile the data set. Section III presents the
new data set and shows that pension reforms have significant imple-
mentation delays. Section IV reviews historical Social Security reforms
in the United States.

I. Demographic Changes and Pension Systems

The populations of many advanced economies are rapidly aging due
to declining fertility and increasing longevity. Chart 1 shows that the
average fertility rate across OECD countries declined from 3.2 percent
in 1960 to 1.7 percent in 2015, which is below the level required to
replace the population. This rate is expected to remain largely flat for
the next 40 years. Over the same period, overall life expectancy has
risen and is projected to increase further by about a year per decade in
OECD countries. As a result, the dependency ratio—the ratio of the
elderly population (age 65 and older) to the working-age population
(age 15–64)—is projected to nearly double in the next 35 years, from
0.28 in 2015 to 0.54 in 2050 (Chart 2).

The effects of aging populations on pension systems depend on
whether pensions are fully funded or financed on a pay-as-you-go
(PAYG) basis. Under a fully funded pension system, workers’ contribu-
tions are invested, and their accumulated contributions and investment
returns pay for their pension benefits. As a result, an aging population
has limited effects on a fully funded pension system. Under a PAYG
pension system, however, current workers’ contributions pay for cur-
rent retirees’ benefits, which redistributes resources across generations.
When a country’s population is young and growing, PAYG financing
Chart 1
Average Fertility Rate for OECD Countries

Note: Bars for 2030 and 2060 are projections.

Chart 2
Average Dependency Ratio for OECD Countries

Note: Bars for 2025, 2050, and 2075 are projections.
is attractive, because each generation is larger than the last and thus able to fund previous generations’ pensions. However, when a country’s population ages, the dependency ratio rises. Unless governments change retirees’ benefits or workers’ contributions, higher dependency ratios directly translate into higher levels of unfunded liabilities, raising fiscal stress.

Since most countries have PAYG pension systems, aging populations are likely to have significant effects on pension spending. The sharpest effects on government budgets may be felt over the next two to three decades, when baby boomers reach retirement age. As fiscal stress looms, countries with PAYG systems may have to adopt pension retrenchment reforms that attempt to reduce pension spending.

Governments face trade-offs when deciding how rapidly to implement pension retrenchment reforms. The sooner governments enact policy changes, the bigger the budgetary savings will be. However, rapid policy changes may have serious consequences for current retirees who depend on their pensions for income. According to the OECD (2013), earnings-related or resource-tested benefits account on average for nearly 60 percent of retirees’ incomes in the OECD countries. Longer phase-in periods may provide these retirees more time to prepare for the reforms and adjust their retirement plans accordingly.

II. Compiling a Data Set of Pension Reforms

Understanding phase-in periods or implementation delays associated with pension retrenchment reforms is crucial for both policymakers and the public. However, quantitative measures on implementation delays are lacking, as systematically collecting this data over a long period of time can be challenging. To fill this information gap, we collect a new data set that tracks implementation delays during pension retrenchment reforms.

We document changes in pension policy for 12 OECD countries—Australia, Belgium, Denmark, Finland, France, Ireland, Italy, Japan, New Zealand, Spain, the United Kingdom, and the United States—from 1962 to 2017. This list includes both countries that have successfully implemented far-reaching pension reforms (such as Belgium) and countries that still face challenges in reducing their pension spending despite repeated effort on pension reforms (such as Italy). In collecting
our data set, we primarily rely on country-specific OECD Economic Surveys published at an annual or bi-annual frequency.\textsuperscript{1} These surveys discuss key economic challenges, policy changes that address these challenges, and, more recently, policy recommendations from the OECD to the targeted country.

One complication in identifying policy changes from these surveys is that the format of the surveys has changed over the years. Before 1973, the surveys provided only general discussions on fiscal policy. From 1973 to 2002, the surveys provided chronologies of major economic policy events, including changes in pension policy. Since 2003, the surveys have provided in-depth discussions on economic challenges and policy recommendations. We extract changes in pension policy by focusing on discussions related to subjects such as pensions, retirement, and Social Security. This approach is similar to that of Romer and Romer (2010, 2016) for tax policy changes and Ramey (2011) for defense spending changes. We then identify whether these policy changes increase pension spending (expansionary pension changes), or decrease spending (contractionary pension changes).

To assess whether different kinds of pension reforms take longer to implement than others, we also collect information on the policy tools associated with each reform. Although the specific tools vary, they can largely be categorized into one of four types: changes in pension coverage, changes in benefit formulas, changes in pension payment indexation, and changes in pension eligibility age.

Changes in pension coverage include changes in the number of service years required for retirement or changes in regulations related to means or assets test. For instance, in 2006, Belgium announced a plan to increase the number of service years required to qualify for early retirement from 25 to 30 years by 2008 and from 30 to 35 years by 2012. And in 1975, Australia abolished its means test for retirees age 70 to 74.

Changes in pension benefit formulas include direct changes to pension payments or changes in the number of years that form the calculation basis for pension payments. For example, in 1972, pension benefits in Japan were increased from 2,300 to 3,300 Yen per month.

Changes in pension payment indexation involve moving away from indexing benefits to wages or earnings and toward indexing benefits to prices. For instance, in 1992, the Italian government announced a switch in the indexation of pensions from wages to prices.
Finally, changes in pension eligibility age affect the age at which most workers can retire. For example, in 2005, Finland decided to phase out the individual early retirement pension for workers age 60 to 64 and raise the minimum retirement age for part-time workers. And in 2015, Denmark decided to limit the average time individuals spend in retirement to 14.5 years, and therefore it would adjust the retirement age in response to changes in life expectancy every five years.

This new data set reveals that pension reforms have come in waves: many countries that expanded their pension systems prior to the 1970s have scaled them back since the 1990s. Chart 3 shows that all 12 OECD countries in our data set expanded their pension systems in the 1970s. From 1970 to 1979, these countries passed 63 acts that expanded pension systems by lowering the retirement age, broadening pension coverage, providing more favorable indexation, or raising benefit payments. The great expansion has since petered out, and countries began pension retrenchments in the 1980s. The pace of these retrenchments peaked in the 1990s: together, the countries in our data set adopted 52 contractionary policy changes from 1990 to 1999, driven largely by European countries forced to meet certain fiscal conditions to join the European Union. More recently, the pace of pension retrenchments has slowed but remains steady amid ongoing demographic challenges.
The data set also reveals that age-related pension reforms are playing an increasingly important role in pension retrenchment. Chart 4 shows that in the 1980s, only 10 percent of pension retrenchments involved raising the eligibility age, while the rest involved scaling back benefits or changing indexation methods. Since then, age-related pension reforms have gained momentum. From 2010 to 2017, 60 percent of pension retrenchments involved raising the retirement age.

III. Implementation Delays in Pension Retrenchment

Our main focus in constructing the data set is to identify the implementation delays from pension reforms. Specifically, we track implementation details for 50 pension retrenchment reforms in 12 OECD countries over the past 55 years. We identify implementation delays as the time elapsed between when a policy change is initially enacted and when it is fully phased in.

Our data set shows that the average phase-in period for pension retrenchment reforms is about a decade, but the range is wide. Chart 5 shows the distribution of pension reforms by the length of implementation delays. Although 18 reforms took less than five years to phase in, 17 reforms took more than 15 years to phase in.
Chart 5
Distribution of Implementation Delays for Pension Retrenchment Reforms, 1962–2017

Sources: OECD and authors’ calculations.

Chart 6
Distribution of Implementation Delays for Age-Related Pension Retrenchment Reforms, 1962–2017

Sources: OECD and authors’ calculations.
The range of phase-in periods is even wider for age-related pension reforms. Chart 6 shows that age-related reforms have a bimodal distribution: close to one-third of the 31 reforms were implemented over 15 to 20 years, while another third were implemented within five years.

This distribution may be associated with the scope of the reforms. In our data set, far-reaching age-related pension reforms often had significantly longer phase-in periods; however, age-related pension retrenchments that were implemented within five years generally had a much more limited scope.

Most of the age-related pension retrenchments with short implementation delays had one of three characteristics: the reforms were simultaneously accompanied by measures that expanded pension systems (Spain in 1996, Denmark in 1998, Italy in 2004, France in 2008), the reforms were part of a plan on which countries had reached political agreement well in advance (Belgium in 2006), or the reforms were of limited scope and occurred in a sequence (Belgium in 2012 and 2015). For instance, in 1998, Denmark passed a bill that tightened the criteria for drawing early retirement pensions and set a phase-in period of one year. The same bill, however, also lowered the normal retirement age from 67 to 65, effectively offsetting the retrenchment reform. In addition, in 2006, Belgium raised the early-retirement age from 58 to 60 years. Although the reform was implemented quickly—by 2008—Belgium had reached an agreement on this policy change in 2001.

Finally, we find that the trend for implementation delays varies by policy tool. For age-related reforms, the trend has been stable. Chart 7 shows the length of implementation delays for age-related reforms, where each dot represents the delay associated with one reform. The delays have a lower bound of a couple of years and an upper bound of 30 years. On average, reforms that raise the retirement age are phased in over close to 12 years, and this trend has been stable since 1980. In contrast, Chart 8 shows that the implementation delays for coverage-related reforms have been trending up from five years in 1986 to 21 years in 2014. Finally, Chart 9 shows that the implementation delays for reforms that involve changing indexation and pension payments are generally about five years, and this trend has been stable over time.

These prolonged implementation delays associated with pension reforms are particularly concerning considering that they come after
Chart 7
Implementation Delays for Age-Related Pension Retrenchment Reforms, 1962–2017

Sources: OECD and authors’ calculations.

Chart 8
Implementation Delays for Coverage-Related Pension Retrenchment Reforms, 1962–2017

Sources: OECD and authors’ calculations.
Chart 9
Implementation Delays for Other Pension Retrenchment Reforms, 1962–2017

Sources: OECD and authors’ calculations.

governments have already debated and passed legislative changes.4 Far-reaching reforms on pension systems are often subject to prolonged policy debates, as they involve substantial redistributions of wealth and liabilities among different segments of populations.5 The overall delays, combining both legislative and implementation delays, can be significantly longer than those shown here.

Although delays may help retirees better weather the effects of reforms, they also significantly slow the pace of scaling back government spending on pensions. To assess the overall effects of implementation delays, we examine case studies on three countries: Japan, Italy, and Belgium. After expanding their pension systems in prior decades, all three countries have since adopted retrenchment pension reforms with significant phase-in periods to address their rising pension expenditures.

These case studies may provide insight to countries facing similar challenges. Japan and Italy, for example, have the largest share of elderly populations and have been aging more rapidly than other advanced economies. Countries facing aging populations in the coming decades may be able to draw lessons from the pension retrenchments in Japan and Italy. In addition, countries that expanded early retirement programs to combat economic recessions may be able to look to Belgium for insights as they work to scale back those programs.
Japan

Japan’s public pension was designed to be a funded system, as the government initially built up huge surpluses to finance future liabilities. The original funding principle, however, gradually eroded during the 1970s: an increase in retirement benefits, as well as an increase in the population entitled to those benefits, led government spending on public pensions to rise ninefold from 1973 to 1980, reaching 4.3 percent of national income by 1980.

To address the long-run viability of Japan’s pension system, the Japanese government adopted a series of pension reforms, many of which had prolonged phase-in periods. In 1986, the government adopted a major overhaul of pension provisions, reducing benefit levels and raising the benefit eligibility age for women from 55 to 60 years. To ease the effects on beneficiaries, the reform provided a 20-year phase-in period for benefit reductions and a 15-year phase-in period for changes to the eligibility age. In 1994, the government decided to progressively raise the age of retirement from 60 to 65 by 2013 for men and by 2018 for women. And in 2004, the government introduced a system of “macroeconomic indexation,” which adjusts pension benefits based on changes in the number of contributors and average life expectancy. However, this system has not yet been implemented. Instead of a date-based phase-in period, the government instituted a threshold-based period: the reforms will take effect only when the consumer price index rises to 1.7 percent above its 2005 level, a condition that has not yet been met.

These prolonged implementation delays appear to have slowed progress on controlling government spending on public pensions. Japan’s pension spending increased from 6.4 percent of national income in 1992 to 12.1 percent in 2002. Pension spending is expected to reach 25 percent of GDP in 2050, as the rapidly aging population is imposing substantial stress on Japan’s PAYG public pension system.

Italy

The Italian PAYG pension system was expanded in the 1960s and 1970s through a series of changes geared toward guaranteeing a standard of living correlated with that of active workers. In 1994, pension
spending reached 14 percent of GDP, one of the highest ratios among the EU countries.

The high pension spending and debt in Italy, along with fiscal criteria to join the European Union, prompted the government to undertake pension reforms since the 1990s. Many of Italy’s retrenchment reforms have had long implementation delays. The pension reform of 1992, for example, raised the retirement age to 65 for men and 60 for women and linked the pension levels of younger workers to lifetime contributions. Both policies came with a phase-in period of 10 years. The Maroni-Tremonti law reform of 2004 increased the minimum retirement age for men with 35 years of contributions from 57 to 61 by 2010 and from 61 to 62 by 2014. And the Save Italy Law of 2012 extended the contribution-based system to all workers, raised the retirement age for women in the private sector from 60 to 62, and indexed pension requirements to changes in life expectancy that would be phased in by 2016.

Implementation delays are not the only threat to Italy’s pension solvency. Due to political compromises, major pension retrenchments have also included measures that exempted some workers from reforms or expanded the pension system at the same time. For example, the 1995 Dini Reform was aimed at replacing a defined-benefit system with a defined-contribution system. However, the new system didn’t apply to workers with more than 18 years of contributions. In addition, in 1997, the Prodi Agreement made the requirements for early retirement more stringent but also increased the social and minimum pensions, making benefits more generous for some pensioners.

Due to both long phase-in periods and policy compromises, the repeated attempts to reform the Italian pension system have yielded only modest success. As the population ages, Italy’s pension spending is projected to stay around 15 percent of GDP over the next 10 years.

Belgium

Belgium created three early retirement programs from 1975 to 1978 and expanded these programs in the early 1980s to combat economic recessions and high unemployment. Enrollment in the early retirement programs peaked at 3.5 percent of the labor force in the late 1980s, leading to significant increases in the government’s pension spending.
Since the late 1990s, the Belgian government has been shrinking early retirement programs gradually through a sequence of reforms, all of which have had long phase-in periods.

In 1996, the parliament decided to gradually increase the minimum working period for early retirement from 24 to 35 years by 2005 and to raise the age limit for early retirement from 55 to 58. In 2006, the government adopted a reform plan to raise the early retirement age from 58 to 60 by 2008 and increase the minimum working period from 25 to 30 years of service by 2012. In 2012, the minimum age for early retirement was raised again from 60 to 62 and the required working period from 35 to 42 years. And in 2015, the minimum age for early retirement was set to progressively increase from 62 to 63, while the required working period was set to increase from 40 to 42 years by 2019.

The long phase-in periods, as well as the gradual pace of those reforms, have led early retirement programs to decline slowly. The Belgian government spent 0.6 percent of its GDP on early retirement programs in 2014, compared with 1.4 percent of GDP in 1985.

IV. Social Security Reform in the United States

Compared with other OECD countries, large-scale changes to the Social Security system have been few and far between in the United States. Prior to 1975, Social Security benefits were not indexed to inflation, and legislation was frequently passed on an ad-hoc basis to raise pension benefit levels. Since July 1975, Social Security benefits have been automatically adjusted for inflation. As Romer and Romer (2016) have pointed out, Social Security benefits have varied only moderately since 1975.

However, the United States passed two notable pension reforms that changed pension eligibility ages. The Social Security Amendments of 1961 allowed men to retire with a reduction in benefits at age 62 instead of 65, opening the door for early retirements. Almost 20 years later, the Social Security Amendments of 1983 gradually raised the full benefit retirement age from 65 to 67 by 2000.

The Social Security Amendments of 1983 were passed against the backdrop of a deteriorating Social Security trust fund. The program had been in an annual deficit since 1975, and the U.S. government redeemed the trust fund’s assets to make up the shortfalls. To improve the
financial standing of the Social Security program, Congress passed legislation in 1977 involving phased-in benefit reductions and tax increases. At the time, the reforms were projected to keep the program solvent until 2027. However, the projections proved to be overly optimistic, as the deteriorating economic conditions of the 1970s continued into the early 1980s, and Social Security continued to run annual deficits.

In 1981, President Reagan appointed a bipartisan commission—the National Commission on Social Security Reform, also known as the “Greenspan Commission”—to address the program’s financing issues. The commission submitted a report with 16 proposals for policy changes, which became the basis for the Social Security Amendments of 1983. In addition to delaying the cost of living adjustment and implementing several tax increases, this reform raised the full retirement age from 65 to 67, which came with a long phase-in period of 17 years. The law also explicitly exempted people near retirement.

This 17-year implementation delay, together with the prolonged phase-in periods of pension reforms in other OECD countries, highlights the need for policymakers and the public to consider these delays when planning for the future. Age-related spending, including Social Security and Medicare, accounted for 41 percent of federal spending in fiscal year 2017 and is projected to consume 47 percent of the federal government budget by 2028 (Congressional Budget Office 2018). The federal government debt held by the public is projected to reach 150 percent of GDP by 2048. The prolonged phase-in periods associated with pension reforms underscore that 2048 is not such a distant future.

V. Conclusion

As the global population ages, public spending on pensions has increased and is expected to continue to increase in the coming decades unless governments adopt pension retrenchment reforms. However, simply passing a reform does not guarantee fiscal relief. Most pension retrenchment reforms take several years to implement, and the implementation delays for some types of reforms can last a decade or longer. In this article, we document changes in pension policy for 12 OECD countries and find that on average, pension reforms are phased in over about 10 years. The phase-in period can be significantly longer for age-related pension reforms, which account for the lion’s share of pension
retrenchments since 2000. Even though phase-in periods help to ease the effects of reforms on retirees, they significantly slow down the progress of pension retrenchments, raising unfunded liabilities and long-run fiscal risks for governments. Understanding and planning for these prolonged implementation delays is crucial for both policymakers and the public when discussing and debating pension reforms.
Endnotes

1 For Australia, New Zealand, and the United States, we also rely on country-specific legislative sources.

2 The 2000 pension reform in Finland that raised the early retirement age from 58 to 60 by 2003 was an exception in its short implementation delay. After the government reached an agreement in 1999, the policy change was enacted in 2000 and implemented in 2003.

3 The only exception is Japan. In 1986, the Japanese government decided to scale back benefits in the public pension system; however, this change was not fully phased in until 2006. This change was accompanied by other age-related pension retrenchment measures.

4 Data on implementation lags associated with other fiscal policy changes, such as discretionary spending and tax policy changes, are lacking in the existing literature. Therefore, we can not compare the implementation delays associated with pension reforms with the delays associated with other fiscal policy changes.

5 Yang (2007) documents legislative delays—the time elapsed between when a fiscal policy proposal was first announced and when it was enacted—for major federal tax changes in the United States from 1948 to 2006. Among the 26 tax acts documented, an average of seven months elapsed between the first signaling of the policy change and the final enactment of the tax bill.

6 In 1975, the Conventional Early Retirement Pension was introduced, allowing laid-off workers over age 60 to receive an allowance in addition to unemployment benefits. In 1976, the Statutory Early Retirement Pension was enacted and applied to male workers age 60 and female workers age 55 if they were replaced by persons under age 30. Finally, the Special Early Retirement Pension was introduced in 1978 to enable elderly persons out of work for more than a year to take early retirement.
References

The Phillips Curve and the Missing Disinflation from the Great Recession

Capital Reallocation and Capital Investment

Implementation Delays in Pension Retrenchment Reforms