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The Fourth Industrial Revolution and Central Banking

Our [discussions](#) here in Jackson Hole have been wide-ranging, but a common theme throughout has been digital disruption. Just about everything is being disrupted—from production, to consumption, to financial intermediation. We are in the early stages of what many are calling the fourth industrial revolution. That is because the deployment of digital technologies will alter the economy as fundamentally as did the steam engine, the internal combustion engine and the computer chip. I will use my time today to offer some preliminary thoughts on what all this might mean for monetary policy.

Let us begin with the obvious. The deployment of digital technologies will be very positive for economic progress. Over time, these new technologies will find their way into everything—transforming existing firms and creating new ones. This will lead to new types of jobs in entirely new industries. Where firms are successful, productivity will rise, and economic growth will be more concentrated in those sectors. The positive spillovers will spread throughout the economy. Holistically, this is a predictable process, but the details are of course quite unpredictable.

It is worth reflecting on an insight on economic growth offered by Arnold Harberger some 20 years ago. He argued that economic growth has always been more like mushrooms than yeast. In other words, economic growth is uneven, popping up here and there. This metaphor aligns well with Joseph Schumpeter's notion of creative destruction.

This insight is important in today's context. As Peter Howitt has argued, it means that economic growth is naturally contentious, which introduces politics into the equation. If growth were evenly spread, in the way yeast causes dough to rise, everyone would be a winner. But because it is like mushrooms, the associated disruption means that some will lose out while others win. In certain conditions, the winners can even become superstars; hence, the term "winner takes most," as described in John Van Reenen's [paper](#) here.

I would like to thank Eric Santor for his help in preparing these remarks.

It is human nature to focus on the negative. In the process of creative destruction, destruction gets more headlines than creation does. This is because the threats to individuals are concrete and easily identifiable—whether manufacturing workers, call centre workers, truck drivers, investment advisors or radiologists. Modern social media enable grievances to be amplified many times over. By contrast, the opportunities being created by the application of new technologies—and the broad, positive spillover benefits to the rest of the economy—are much harder to identify and measure.

This brings me to my first policy implication: it falls to policy-makers to explain the process, and offer concrete evidence that it is unfolding as usual. We need to demonstrate that beyond the initial negatives are many positives, which are likely to dominate over time. We need to acknowledge that real people and businesses are being disrupted and require policy support. And we need to point to the new and different jobs that are being created and explain that the new incomes are being spent in a wide array of traditional economic sectors. In other words, when mushrooms grow, they have yeast-like second-round effects as the growers spend their incomes.

We can do this now because the narrative around technological disruption is not much different from the disruption associated with globalization, which has been with us for some 20 years. But beyond explaining and documenting these complex dynamics, we also need to be attentive to potential pitfalls, such as those connected with the rise of so-called superstar firms, as we discussed earlier here.

These and other legitimate public policy concerns make it imperative that policy-makers reallocate some of the benefits of growth to cushion the impact on those who are directly affected by disruption, and help them adjust.

All that being said, let us consider the possibility that we are living in a profound, global, positive expansion of aggregate supply—the product of digital disruption. As with all major supply shocks in the past, it could take a long time for us to truly understand that it is happening. Still, we must conduct monetary policy in the meantime.

We can start by measuring growth in the digital economy itself. One rough proxy for the digital economy—the computer system design and related services sector—accounts for close to 2 per cent of Canadian gross domestic product today and has been growing by about 7.5 per cent annually for the past five years.

But that growth is likely to be only the tip of the iceberg—what we need to know is how it is spreading through other sectors and affecting aggregate supply. For example, in the automobile industry, advances in computer technology are driving improvements in quality and represent significant value added from one model year to the next. Another example would be the financial services industry, where fintech is driving gains in productivity.

Statistical agencies are hard at work on this. As discussed in [the paper](#) by Crouzet and Eberly, digitalization has led statistical agencies to underestimate investment, particularly in intangibles. A consequence is that central banks are working with estimates of potential output today that may be revised up in the

future. The recent historical revisions to US GDP data, which improved the measurement of investment in intangibles such as software, indicate that this could be important. A similar exercise in Canada has delivered a large upward revision in investment, and, hence, potential output, beginning in 2014. This makes one wonder about what revisions may be forthcoming for 2015, 2016 and, of course, today.

The spread of digital technologies may also help explain the slow, measured growth of international trade. We know that cross-border supply chains have complicated the task of gathering accurate data on trade. Digital technologies are making it even easier to fragment production globally. And digital ordering, payments and service delivery are making it easier for transactions to occur that fall below customs reporting thresholds or are missed altogether.

The point is that our ability to measure the impact of digital technology is continually playing catch-up with the technology. At the same time, the diffusion of digital technologies to other sectors is itself a gradual process. We have seen a similar scenario before—it was several years before we could measure the rise in aggregate productivity that followed the increase in spending on information and communications technology in the 1990s.

Positive revisions to the history of potential output could help explain the underperformance of inflation over the past five years. This underperformance has occurred in a wide swath of economies, both advanced and emerging. These countries have, on average, a high level of Internet penetration—a possible proxy for the pace of adoption of digital technologies. Related to this, empirical evidence of the so-called Amazon effect on inflation, like the Walmart effect of 20 years ago, has so far been limited. But we need to bear in mind that this work relies on estimates of potential output that may be revised up in the future.

Of course, it would be considered risky to conduct monetary policy based on an assumption that we were enjoying a pickup in aggregate supply. Central bankers would generally require empirical evidence of the phenomenon before embracing it, because the consequences of being wrong could be significant. However, that does not prevent us from treating digital disruption as a risk to the inflation outlook like any other.

Arguably, this has already been happening in practice. Our economies have begun to return to normal after the trauma of the global financial crisis. But the process of interest rate normalization has been much more gradual than traditional models with embedded Taylor rules would advocate. Taking a gradual, data-dependent approach to policy is an obvious form of risk management in the face of augmented uncertainty.

Importantly, this approach does not mean keeping interest rates unchanged until inflation pressures emerge. That would virtually guarantee falling behind the inflation curve. Rather, it means following a more gradual approach to normalizing interest rates than traditional models would advocate, thereby balancing the risks around future inflation. The central risks that affect that balance are, on the one hand, the possibility that inflation could accelerate as we approach full capacity and, on the other hand, the possibility that digitalization of the economy is boosting aggregate supply and holding inflation pressures at bay.

The bottom line is that digital technologies are disrupting central banking along with everything else. Digital disruption is likely to be a major preoccupation of central bankers for the foreseeable future.