

## *Digital Currencies, Decentralized Ledgers, And The Future Of Central Banking*

Central banking in an age of digital currencies is a fast-developing topic in monetary economics. Algorithmic digital currencies such as bitcoin appear to be viable competitors to central bank fiat currency, and their presence in the marketplace may pressure central banks to pursue tighter monetary policy. However, the technology behind digital currencies may be coopted by central banks themselves, giving them more power and greater control over monetary policy than ever before.

When an autonomous digital currency circulates in an economy, it competes with the official currency issued by the country's central bank. In most countries the local currency faces its greatest competition from foreign governments' currencies, especially the U.S. dollar. For a central bank, the challenges posed by a digital currency are basically the same as those posed by the presence of a competing foreign currency. For an economy, competition among currencies causes suppliers to drive price and quality to an appropriate equilibrium that reflects utility. One benefit from competition between different monies is the stability produced by the flexibility of contracting parties to choose settlement terms. From the point of view of consumers of money, having competitors in the provision of money is a check on the unilateral behavior of the supplier. Put into concrete terms, digital currencies could offer a country struggling with a mismanaged money supply a way of creating stability.

The costs of competing digital currencies primarily consist in undermining a central bank's ability to conduct monetary policy as a monopolist. In a

world where central banks are forced to compete with other central banks and private actors, supply and demand alone will drive which money is used as the generally accepted medium of exchange. However, central banks operate under regimes that have enacted legal tender laws whose function is to compel acceptance of their notes. Such laws do not require parties to contract in the currency of the central bank, but they deny legal recourse to a party who refuses to accept the legal tender of the country as payment for debts contracted in some other medium of exchange. This gives rise to Gresham's Law, namely that bad money drives out the good. Legal tender laws therefore confer a monopoly privilege on the government, allowing it to operate its printing press. Without such laws, central banks would simply be banks.

Countries have taken different attitudes towards digital currencies, ranging from equivocating or hostile to laissez-faire and encouraging. Often an overlap exists between these attitudes and how the country treats foreign currencies generally. For instance, although it is legal for individuals to own bitcoin in China, banks and financial institutions are prohibited from doing so. In April 2014, the People's Bank of China ordered commercial banks and trading companies to shut down accounts that dealt in bitcoin. The United Kingdom, on the other hand, allows the private use of bitcoin as well as the opening of businesses that transact in the currency. Many officials in the United States government have expressed a similar attitude of benign neglect toward digital currencies. Although anti-money laundering laws apply in both countries, neither has attempted to ban bitcoin or prevent its

*Max Raskin and David Yermack, NBER Working Paper*

proliferation.

Although bitcoin and other digital currencies were created to bypass the control of central banks, the possibility of a central bank withdrawing its bills and notes from circulation and replacing them with its own digital currency has become an appealing topic of debate among monetary economists. This would result in omnipotent uber-banks such as the U.S. Federal Reserve co-opting the very technology that was created to compete against them. Under the Fedcoin proposal, citizens and businesses would be permitted to open accounts at the central bank itself, rather than depositing their funds in commercial banks as is done today.

Central banks may never elect to narrow the banking system and issue digital currency along the lines of the Fedcoin model. However, like other financial institutions, central banks may see great appeal in the block chain technology that lies at the foundation of bitcoin and other algorithmic currencies, and central banks may choose to adapt block chains for use in their payments processing and transaction clearing functions. Even though the original goal of digital currency block chains was to facilitate peer-to-peer value transfers that could bypass the interbank clearing process, the technology may ironically find its widest use in allowing central banks to move money more reliably and more cheaply between their depositors. The central bank currency would be a settlement currency, akin to the function served by gold in the past. Banks perform these bookkeeping and settlement tasks not only for themselves, but also on behalf of commercial banks. Although block chain technology remains in its infancy, estimates

of its potential savings in processing and bookkeeping costs often fall in the range of 50% to 80%. For a central bank processing enormous volumes of transactions, the possible size of these savings is substantial.

When central banks oversee payment and settlement functions on behalf of the entire financial system, they seek to provide a system that is both safe and efficient in order to create a high level of public confidence in the health of the banking system. Central banks process transactions on behalf of businesses, consumers, banks, and international counterparts, and even small gains in efficiency can save vast amounts of money. Despite the potential to achieve efficiencies through economies of scale, certain segments of the money transfer market such as international remittances remain extraordinarily costly for users. According to the World Bank, at the end of 2015 the average cost of an international money transfer was 7.37% worldwide, and it was only modestly lower, at 6.89%, for sending funds overseas from one of the G8 countries. Such transfers typically take several days to complete due to many layers of checking and verification in the clearing process. In addition, fraud and theft remain problems, even when the parties involved are government central banks. While the international money transfer market involves numerous intermediaries in addition to central banks, block chain technology could make many of them unnecessary. It would have the beneficial side effect of allowing central banks to monitor the behavior of their depositors more directly, helping to defeat problems such as money laundering and tax evasion.

Source: [www.nber.org](http://www.nber.org)

## *India's Potential Output Revisited*

The importance of potential output and output gap was ignored prior to the global financial crisis which led to overheating of economies and ultimately freezing of financial markets world over in the aftermath of the crisis. Countries have witnessed tepid growth since then and are still coming to terms with the new normal. EMEs have become victims of economic slack observed in developed countries. Major factors attributed to the current economic situation are dwindling total factor productivity growth and deceleration in growth of working age population. The IMF's World Economic Outlook has consistently revised global growth downwards since 2010 on the backdrop of subdued demand, sluggish recovery, slumping commodity prices and persistent disinflationary trend. In the midst of grim global outlook, this paper deciphers India's potential GDP and output gap on a quarterly basis by using production function approach in addition to conventional statistical methods for the period 1980 Q2-2015Q4.

India has recently revised its estimates of GDP to improve coverage, incorporate new methodology and align it with global best practices in addition to revising the base year. Potential output and output gap have acquired paramount importance in recent times as crucial parameters in determining structural reforms and in the conduct of monetary policy. Accuracy in quantifying these measures will help in fathoming whether the recent slowdown is due to change in the trend or due to cyclical factors. This study tries to estimate India's potential output employing various statistical filters along with

structural economic model.

Potential output generally refers to the level of output that is consistent with full capacity utilization along with low and stable inflation. The output gap on the other hand is typically estimated at levels rather than growth rates. The estimation of potential output involves a few steps: (i) estimation/determination of labour share based on historical data; (ii) estimation of total factor productivity as Solow residual (i.e. output less the weighted sum of labour and capital inputs); (iii) derivation of trend of total factor productivity and potential labour and capital; and (iv) potential output is estimated based on the values of coefficient and variables obtained in the previous step.

The results show that potential growth was low at around 5 per cent during 1981-1991, which increased to around 6 per cent during 1992-2002. But the growth rate accelerated during 2003-2008 and was close to 8 per cent. However, the potential growth has fallen significantly in the post global crisis period and the growth was around 7 per cent during 2009-2015. Most of the estimates suggest that the potential growth is close to 7 per cent at present.

According to the paper, potential growth estimated through Kalman filter, is around 6.8 per cent with a band of (+/-) 50 bps at 95 per cent confidence interval. This implies that the estimates could lie anywhere between 6.3 per cent and 7.3 per cent. The contribution of capital stock to growth culminated in 2010 with a steep fall thereafter, mainly due to

*Barendra Kumar Bhoi and Harendra Kumar Behera, RBI Working Paper Series No. 5*

depletion in fresh investments and deceleration in its growth. Additionally, the contribution of total factor productivity (i.e. measured from Solow residual) to overall growth has seen a secular decline during the recent period.

Majority of the estimates indicate that output gap has been negative since Q3 of 2012, though the gap is closing slowly. Further, the estimated gaps are found to be positively and strongly correlated with core inflation at higher lags, which further confirms the robustness of these estimates. Positive correlation of output gap with the average capacity utilisation further corroborates that output gap could be a good indicator of aggregate demand in India for the policy purpose. Key to accelerate

growth as well as potential output in India lies with higher level of capital formation as its contribution dominates vis-à-vis the contribution of labour and the total factor productivity.

One major finding of this paper has been the correlation between output gap and capacity utilization. Output gap is positive whenever capacity utilization is around or over 75 per cent. Thus, it is apt to deduce that India attains its potential level of output whenever capacity utilization reaches 75 per cent. It is fair to say that the central bank has been keeping close tabs on capacity utilization while formulating monetary policy.

Source: [www.rbi.org.in](http://www.rbi.org.in)

## *What Drives the Short-Run Cost of Fiscal Consolidation? Evidence from OECD Countries*

The effects of the fiscal stimulus enacted soon after the collapse of Lehman Brothers in September 2008 have been a source of significant disagreement among economists, with estimates varying greatly across studies. There is also debate over the process of fiscal consolidation and its effects in several countries. In some countries, fiscal consolidation has occurred against a backdrop of historically low and declining real yields largely due to central banks' unconventional policy measures. Two other factors heightened sovereign risk due to high public debt and diminished competitiveness have kept fiscal multipliers' effect low post-crisis. These developments work as a disincentive to current private spending. However, actual fiscal consolidation plans were criticized for being too front-loaded or insufficiently gradual when fiscal multipliers were thought to be larger than usual. The pre-crisis evidence showed support for the criticism that short-run government spending multipliers tends to be substantially larger when there is spare economic capacity or economic growth is weak. Fiscal multipliers have also been found to be much larger during financial crises, when credit constraints are mostly likely to be binding.

The short-term effects of fiscal consolidation on output and employment depend on various macroeconomic states like - business cycle, monetary policy, public debt level, current account balance etc. Examining dependency of fiscal multipliers across multiple states and then transmission mechanism of fiscal consolidation on various economic states, the paper found no evidence of the strong Keynesian effects that was priori presumed to have large fiscal multipliers' effect. The paper found lower multipliers' effects in cases of high public debt or current account deficit, consistent with the notion

of improvement in broad financial conditions and competitiveness due to fiscal consolidation. Fiscal consolidation is found to lead to a larger increase in net exports than most empirical studies not relying on narrative shocks. On the transmission channels of fiscal consolidation shocks, the paper found that an important factor contributing to dampening negative effects of fiscal consolidation on output is net trade. The nominal exchange rate depreciates temporarily, but wage moderation and lower price pressures help maintain the improvement in the competitive position and reabsorb the initial loss of employment.

Moreover, a decline in interest rate (especially long term interest rate) helps to dampen the responses of private demand. Fiscal multipliers do not seem to differ much with the output gap. In positive output gap states, external adjustment through nominal exchange rate depreciation seems to be a main offsetting factor, whereas a loosening of monetary policy is more relevant when the output gap is negative. Differences in employment outcomes are largely determined by the response of public employment. Fiscal consolidation leads to a larger-than-average drop in the long-term interest rate in case of high public debt due to a lower risk premium - which is associated with a crowding-in of private investment and a smaller negative impact on output. The consolidation tends to have large and more persistent effects on private demand in case of tighter monetary policy. But the paper did not find higher cost of fiscal consolidation in case of loose monetary policy.

Analyzing the costs of fiscal consolidation in terms of output and employment, the paper found that employment declines by about half a percent in first two or three years and then recovers quickly in case

*Ryan Banerjee and Fabrizio Zampolli*

of positive output gap (statistically insignificant response). But the decline in employment is evident in first three years before starting its recovery in case of negative output gap. The effect of monetary policy on employment shows a decline in employment in case of tight monetary policy, but inconsistent in case of loose monetary policy in subsequent years. The public debt appears to have an asymmetric impact on employment and GDP. In case of high public debt (as above 80% of GDP), fiscal consolidation may be less costly in terms of output growth than average against any clear directional observation in case of low public debt. The paper also suggests that fiscal consolidation may be somewhat more costly when the output gap is negative.

Analyzing the effect of current account balance on GDP and employment, the paper found smaller but significant effect of negative current account on GDP and employment. Conditional on a current account deficit, fiscal consolidation tends to produce a larger nominal exchange rate depreciation, which presumably explains the positive temporary response of inflation as well as a large and persistent drop in the real wage. Consolidation is also associated with an appreciation of the nominal exchange rate. In case of large current account deficits, a successful fiscal consolidation should help rebalance demand and improve competitiveness. By contrast, conditional on a positive current account, fiscal consolidation is found to have a larger deflationary impact on the economy than average.

Estimating fiscal multiplier effects depending on credit growth state (a key difference between weak and strong credit states is the behavior of private consumption), the paper found larger cumulative fiscal multiplier effect when credit growth is weak. In that state, the negative effect of fiscal consolidation on private consumption is larger and more persistent after three years. A bigger-than-average drop in private consumption seems to drive the

increase in fiscal multipliers when private credit growth is weak, suggesting that the smaller ability of consumers to smooth consumption increases the size of fiscal multipliers. At the same time, the nominal exchange rate does not depreciate and there is less offset from the weak state. The adverse effect on employment is also more pronounced in the weak state. The consumer's ability to smooth consumption falls in case of falling income and rising unemployment in the weak credit state. The paper also found a relatively weaker fiscal tightening following the initial consolidation shock reflects the larger negative impact on output in the weak credit state.

The paper's findings can be summarized that large fiscal multiplier effect was not necessarily caused by higher public debt. Sovereign risks may cause large and rising public debt, but with smaller costs of fiscal consolidation. Currently several economies are going through consolidation process and the simultaneity of the process raises the costs of fiscal consolidation, compared to past estimates, given the importance of net trade in offsetting the costs of consolidation. Empirical results also displayed contrarian view of past historical evidences showing larger multipliers effect in post-crisis. There is no evidence of large output costs from fiscal consolidation in case of negative output gap. In case of high public debt or current account deficit (CAD), the paper found lower than average multipliers effect, indicating fiscal consolidation may help improve broad financial conditions, competitiveness and private agents' confidence. However, it is important to note that the effects on output depend not only on the size of the initial fiscal shock, but also on the predicted evolution of fiscal policy afterwards. The fiscal tightening typically lasts for three years. Furthermore, the size and shape of the fiscal variable's time profile may also be significantly different across different states.

Source: [www.bis.org](http://www.bis.org)

## *A comparative analysis of developments in central bank balance sheet composition;* *Christiaan Pattipeilohy;*

Since the onset of the global financial crisis, central banks have deployed a wide array of unconventional balance sheet policy measures, in addition to conventional interest rate cuts. As a consequence, central banks have experienced substantial changes in both the size and composition of their balance sheets. This paper contributes to the literature on central bank balance sheet policies by analysing developments in balance sheet composition across a broad panel of central banks in a unified framework. The panel used by the authors contains harmonized annual data on central bank balance sheet composition for 14 advanced economies and 20 EMEs from end-2001 until mid-2015, in order to assess quantitatively to what extent recent balance sheet policies can be considered unconventional relative to both own pre-crisis balance sheet configuration and those of peer central banks.

Recent unconventional balance sheet measures by central banks in advanced economies have reopened the theoretical debate on the irrelevance hypothesis of open-market operations. While portfolio rebalancing could indeed be an important potential transmission channel of central bank balance sheet policies, the effects on the relative supply of government bonds are only one consequence of such policies. Balance sheet policies have often impacted central bank balance sheet configuration along more than this single dimension. Often, however, these other dimensions are not taken into account in theoretical models analysing unconventional monetary policy.

However, it is argued that there could still be

potential advantages from central bank credit policies. In normal times, when stochastic financial disturbances are small, it is argued a central bank should follow the 'treasury-only doctrine', meaning the central bank should not actively shift its asset composition. However, in times of severe financial distress, when stochastic financial disturbances are large and persistent, the real cost of private sector financial intermediation may jump, depressing private sector financial intermediation and, as a consequence, output and inflation. Thus, central bank private sector lending, i.e. actively changing the composition of central bank assets, could smooth the impact of adverse financial shocks.

In order to enhance understanding of balance sheet policies, this paper focuses explicitly on developments in the composition of central bank balance sheets, i.e. the overall relative distribution of assets and liabilities. Central bank assets can be subdivided in holdings of foreign exchange reserves (FX) and domestic assets. With respect to central bank liabilities, typically the distinction is made between base money, i.e. banknotes in circulation and reserve balances from commercial banks, and non-monetary liabilities. To sidestep the practical inconveniences associated with the conventional theoretical differentiation between monetary and non-monetary liabilities, the authors have taken a different approach and classify non-banknote central bank liabilities by counterparty; i.e. liabilities to banks and liabilities to the government. They have computed a set of four balance sheet indicators – two for the asset side and two for the liability side – that jointly summarize central bank balance sheet

configuration.

The four indicators are constructed in such a way that *ex ante* they are independent and uncorrelated. In other words, in principle, an unconstrained central bank can decide on the size of any of the four indicators irrespective of the impact on the other three. However, in practice a central bank will not be fully unconstrained. Therefore, it may not be able (or willing) to decide on the size of every single balance sheet indicator autonomously. Instead, it will consider many developments as exogenous shocks and adjust its balance sheet endogenously.

In their analysis, the authors aim to analyse changes in balance sheet composition through time, which can be interpreted as a measure of 'activeness' in terms of balance sheet policies undertaken by a central bank. However, they also point out that this measure does not tell anything about the direction of the change in balance sheet composition, or whether this should be interpreted as an easing or tightening of monetary policy. Secondly, they have also analysed aggregate cross-country dissimilarity, i.e. to what extent does a set of central banks in the dataset display a degree of similarity or dissimilarity in terms of balance sheet composition.

The authors do mention some of the caveats in their analysis and assumptions. For the purpose of increasing comparability, the framework depends on a highly simplified central bank balance sheet, whereas actual changes in balance sheet composition could be more pronounced. Second, not all countries in their sample report all relevant data in the IMF International Financial Statistics (IFS) database, therefore for such countries the authors had to complement the IFS data with

information from national sources. Furthermore, according to the authors, the counterparty perspective as utilized in this paper may not necessarily represent the most appropriate way to study the central bank balance sheet from a macroeconomic perspective.

Moving on to the data, the authors mention that they have constructed a unique dataset including annual data on balance sheet composition from 2001 until 2015 for 34 central banks. Most countries report standardized data on the central bank's balance sheet in the central bank survey of the IMF's International Financial Statistics.

The authors observe that as the financial crisis unfolded from 2007 onwards, some significant changes in balance sheet composition occurred. When they compare developments in balance sheet composition across the three central banks, the first noticeable difference refers to the very different starting positions in terms of balance sheets of the banks. This reflects to a large extent differences in operational frameworks, in spite of the short term money market rate being the operational target for all three central banks. Second, the amplitude and direction of the change in balance sheet composition differed remarkably across central banks from 2009 onwards. Whereas the Federal Reserve and the Bank of England experienced very significant changes in balance sheet composition, they moved in the exact opposite direction. By contrast, the relative shift in asset composition by the Eurosystem was much less pronounced, even though this will change in following years as the Expanded Asset Purchase Programme (EAPP) will be implemented.

A cross sectional analysis of central bank asset composition for 14 central banks in advanced

economies and 20 central banks in EMEs between end-2006 and mid-2015 shows that dissimilarity in asset composition appears much larger between advanced economies than between EMEs. All emerging market central banks are classified as foreign exchange holders. By contrast, almost half of the advanced economy central banks have domestic asset holdings equal to or larger than foreign asset holdings and are thus either private sector lender or treasuries holder. Many central banks have no or negligible holdings of domestic government debt. Additionally, most EME central banks have increased foreign asset holdings and/or domestic private sector debt relative to domestic government debt holdings. This may have been a consequence of foreign exchange interventions to counter currency appreciation and capital inflows as a consequence highly accommodative monetary policy in many advanced economies. However, the observation does not hold for the central banks in Argentina, India and Indonesia that have either maintained, or increased their relative holdings of domestic government bonds versus other asset categories.

In terms of liability structure the authors have observed a higher degree of clustering between central banks than in terms of asset composition. Before the crisis, EME central banks generally had higher levels of bank and government deposits relative to banknotes than advanced economy central banks. However, since the crisis differences in liability structure between advanced economy and EME central banks have narrowed.

Finally, the authors summarise that 14 central banks switched type in the period under review, i.e. around 40% of the total sample. Five central banks switched type only in terms of asset composition, while nine central banks did so in terms of the

composition of their liabilities. With respect to the latter group most type-switching central banks saw a relative increase in government deposits, leading to a reclassification to a government's banker. The remainder experienced an increase in bank reserves, switching to a bankers' banker. There were no central banks in the sample that switched type both in terms of asset and liability composition in the period under review.

The authors have plotted the change in balance sheet composition from end-2006 (pre-crisis) to mid-2015 (post-crisis) for the central banks in our dataset. As per their analysis, they observe that Bank of England has seen the most pronounced change in balance sheet composition from end-2006 until mid-2015, while at the same time experiencing one of the strongest increases in the size of its balance sheet, as a consequence of the large increase in government bond holdings. Also, for most central banks that experienced a relatively large change in balance sheet composition did so by altering the composition of their domestic asset allocation. For many central banks, including those in Algeria, Russia, Hungary, Canada and the US this was caused not by a relative increase in government debt holdings, but rather by a relative increase in lending to the private sector. Among the central banks that experienced the most pronounced change in balance sheet composition the Reserve Bank of India stands out, in that it saw a big shift in the composition of its non-banknote liabilities. This reflects a significant drop in government deposits held at the central bank in the period under review.

Interestingly, large changes in balance sheet composition did not always coincide with dramatic increases in the size of the balance sheet. For some central banks this is caused by base

effects. At a glance, the association between large changes in balance sheet size and composition seems somewhat stronger for advanced economy central banks than for those in EMEs. Many other central banks that accumulated large amounts of foreign exchange reserves in the period under review already started out with relatively high holdings of foreign exchange in 2006. Thus, the impact of further acquisitions of foreign assets on balance sheet composition has been relatively muted.

Elaborating on the dissimilarities between advanced economy and EME central bank balance sheets, the authors observe that in advanced economies, in the years leading up to the crisis, dissimilarity in balance sheet composition increased. However, during the global financial crisis in 2007-2009 this trend reversed and central banks in advanced economies became more homogeneous in terms of balance sheet composition. This response was generally characterized by an increase in the supply of reserves to the banking sector by increasing central bank lending to commercial banks. However, from 2009 onwards, there was a rebound in heterogeneity in balance sheet composition as many advanced economy central banks pursued again differing policies after the initial crisis response. Some, in particular major advanced economies, central banks engaged in large-scale purchases of domestic assets to add further monetary policy accommodation. By contrast, other advanced economy central banks, mostly in smaller open economies, experienced an increase in foreign exchange asset holdings. In contrast to advanced economies, heterogeneity in balance sheet composition between EME central banks has slightly trended upward in the period under

review, but remains below the levels observed for advanced economies.

Dissimilarity between advanced economy and emerging economy central banks increased in particular in the first phase of the crisis. In 2007 many advanced economy central banks increased their holdings of domestic (private sector) asset holdings, whereas EME central banks continued to increase their foreign exchange holdings. From 2008 onwards, between-group dissimilarity decreased again, as some (small and open) advanced economy central banks started accumulating foreign exchange reserves. Still, as the average advanced economy central bank continues to hold a larger proportion of domestic assets relative to foreign assets, heterogeneity in asset composition between advanced and emerging economy central banks continues to be high.

By contrast, dissimilarity in central bank liabilities has fallen substantially between advanced economies and EMEs. By undertaking recent balance sheet policies, advanced economy central banks have increased the level of reserves supplied to the banking sector. As a consequence, advanced economy central banks have become more similar in terms of liability composition to their EME counterparts that were already characterised by large reserve balance before the crisis. In this respect, EME central banks may already have valuable experiences in managing central bank liabilities that can also be helpful for advanced economy central banks.

Concluding their analysis, the authors state that the results in this paper can be informative in the discussion on exit strategies from current unconventional monetary policies. Currently there is no consensus on post-crisis central bank

balance sheets, nor whether this would coincide with pre-crisis practices. The results in this paper confirm that for some central banks the pre-crisis balance sheet configuration is more distant than for others. Moreover, as the pre-crisis configuration of central bank balance sheets was very heterogeneous across central banks it would

seem unlikely that central banks would converge to a similar design of their balance sheet in the new normal. However, such differences across central banks are typically not associated with differences in the efficacy of monetary policy implementation.

Source: [www.bis.org](http://www.bis.org)