Thinking about the future of money and potential implications for central banks

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1. Introduction

The technological infrastructure of financial transactions is changing fast, due in part to innovations such as peer-to-peer lending, crowdfunding and cryptocurrencies. Peer-to-peer lending is the large-scale lending of money between people online, for which well-known sites include LendingClub and Prosper. Crowdfunding, instead, is the recent practise of soliciting financial contributions from the online community to fund a new business venture, for which leading examples are Kickstarter and IndieGoGo. Last, cryptocurrencies such as Bitcoin are virtual and digital currencies protected by cryptography. More specifically, cryptocurrencies use a technology that allows every single transaction that ever happened within each specific currency network to be recorded on a distributed ledger called the block chain[1]. The integrity and chronological order of the block chain are made secure with cryptography.

These innovations have potentially serious implications for the traditional business model of commercial banks and for the ability of central banks to shape monetary policy. This is so because if lending were to take place increasingly outside the traditional banking system, the role that traditional commercial banks play in the standard money multiplier process, by which changes in open market operations and the quantity of reserves directly affect the amount of lending in an economy, could be severely diminished. This may in turn hamper central banks' ability to control liquidity in the economy and the economic performance through standard monetary policy operations. Additional implications could come from cryptocurrencies like Bitcoin. Indeed, one must wonder what the consequences for regulation and supervision would be if banks were to adopt distributed ledgers such as the block-chain technology in order to settle payments.

In Sweden, such challenges overlap with a large decline in money demand in the last 10 years, when cash in the hands of the public (M0) has fallen from 3.5 per cent to 2 per cent as share of GDP. Indeed, even if the decrease in the cash/GDP ratio is quite common across OECD countries (see for example Sveriges Riksbank, 2013), in Sweden even the nominal

* The opinions expressed in this article are the sole responsibility of the author and should not be interpreted as reflecting the views of Sveriges Riksbank.

1 A key issue for any digital payment system is how to avoid double spending of money. Banks solve this problem by keeping records on individuals' balances, i.e. ledgers. The Bitcoin network, instead, relies on a shared public ledger known as the block chain. All confirmed transactions are included in the block chain, which is enforced with cryptography. See Segendorff (2014) for a detailed explanation of the block chain technology.

value of cash in circulation has been decreasing since 2008 (see Figure 1). This may affect seigniorage substantially if a decrease in cash implies a lower inflation tax and hence has important implications for the balance sheet of the Riksbank, especially in times of zero or even negative interest rates.

In what follows, I will explain these new challenges in detail and investigate their potential implications for central banks through the lenses of monetary theory.

2. Decrease in money demand

Recently, an interesting debate has emerged around the need for cash in modern societies. On the one hand, Rogoff (2014) has proposed the elimination of paper currency in favor of all-electronic transactions, primarily for two reasons. First, a no-cash economy would allegedly allow central banks to set negative interest rates, a possibility which, in the current situation, would provide an additional tool for central banks to stimulate the economy. The argument is that policy rate well below zero is not possible as long as paper currency is available, since cash pays a zero interest rate which means that households and firms can always use it to avoid negative interest rates.[2] Second, paper currency facilitates anonymous transactions, which makes it easier to avoid laws and taxes. Getting rid of cash should create obstacles for the underground economy and hence likely lead to an increase in governments' tax bases and revenues. Indeed, exactly in light of this second argument, several European governments (e.g. Belgium, Greece, Italy, Spain and Slovakia) have introduced ceilings on cash transactions, and the European Commission is considering stricter rules on the use of cash. On the other hand, Chapter IV of the ECB Payment Accounts Directive (PAD)[3] introduced measures aimed at ensuring that all consumers in the EU by law have access to payment accounts with basic features, among them the right to make cash withdrawals and placing funds in an account.

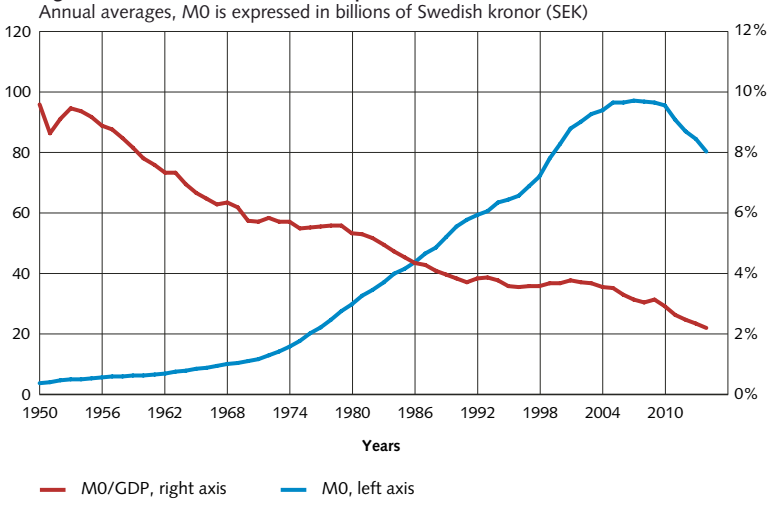
Sweden constitutes an interesting case study for the purpose of this debate, primarily for two reasons. First, as can be seen in Figure 1 and as documented in Segendorff and Wretman (2015), Sweden has been experiencing not only a decrease in the cash/GDP ratio for a prolonged period of time (-27 per cent since 2007 as per Sveriges Riksbank, 2013[4]). Second, it has experienced a decrease in the nominal value of cash in the hands of the public (M0) ever since 2008. While reasons behind the sharp decline remain unclear, it is not unreasonable to believe that the important changes in the Riksbank's role in cash handling in recent decades might have played a role.

2 The Riksbank repo rate is currently at -50 basis points. Switzerland maintains an even more negative policy rate at -75 basis points. However, policy rates cannot be persistently below the storage cost of paper money as this would give incentives for banks and firms to keep accumulating paper currency.

3 http://www.cliffordchance.com/content/dam/cliffordchance/PDFs/PaymentAccountsDirectiveMay2014.pdf

4 http://www.riksbank.se/Documents/Rapporter/Riksbanksstudie/2013/rap_riksbanksstudie_The_Swedish_retailpayment_market_130605_eng.pdf.

Figure 1. M0 (cash in the hands of the public) and M0/GDP
Annual averages, M0 is expressed in billions of Swedish kronor (SEK)



Sources: The Riksbank and Statistics Sweden

Nowadays, the Riksbank is in charge of promoting a safe and efficient payment system. In this capacity, it is responsible for supplying Sweden with cash and has the sole right to issue Swedish banknotes and coins. In the past, however, the Riksbank was involved in the daily flows of cash between banks, retail traders and other market participants. Moreover, commercial banks were offered compensation for interest expenses for cash stored in their own depots. Starting in 2005, however, the handling of cash in circulation was left in its entirety in the hands of private participants. The purpose of this change was to increase efficiency in cash handling, partly by reducing transports to and from the Riksbank. As a consequence of such changes, the Riksbank's role today is limited to issuing and receiving cash from depot owners, but the Riksbank does not decide on how much cash is put into circulation, which is instead determined by market participants.

Currently, commercial banks' cash handling in Sweden consists of over-the-counter deposits and withdrawals from accounts, withdrawals and deposits via ATMs, and cash deposits in service boxes, but it is presently undergoing some significant structural changes. As noted in Sveriges Riksbank (2011), Sweden's major banks (Danske Bank, Handelsbanken, Nordea, SEB, and Swedbank) are cutting back on the possibilities of conducting cash transactions over the counter.[5] Indeed, roughly fifty per cent of bank branches in Sweden are entirely closed to cash transactions, referring their customers to ATMs or other bank branches. The reason for this is that possibilities to charge fees on such transactions are limited while the costs for cash handling are relatively high, even more so after the Riksbank's change in cash handling since 2005.

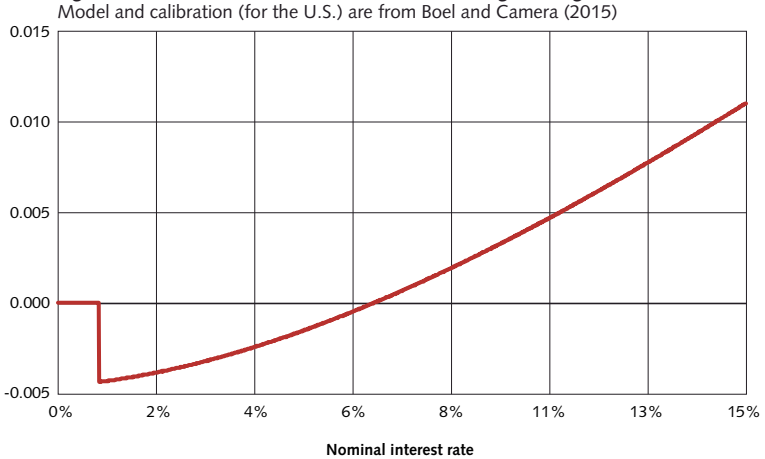
Such a pushback against cash does not come without consequences. Indeed, there is an important question of how forcing a shift to electronic payments affects transaction

5 http://www.riksbank.se/Documents/Sedlar_mynt/2012/Kontanthantering_2011_ENG.pdf.

costs since retailers generally pay a pro-rata fee for credit card services to companies such as MasterCard and Visa. Moreover, as Rogoff (2014) noted, since cash is anonymous, replacing it with non-anonymous electronic money would likely lead to a large shrinkage in demand and therefore seigniorage. Only if paper currency were replaced with electronic currency one to one would there be no long-run shrinkage in demand and the government would continue to garner seigniorage revenues as before.[6]

Boel and Camera (2015) also examine the issue of cash versus cashless societies, albeit from a different perspective. Specifically, they use a microfounded model of money and banking to investigate the welfare implications of costly banking in an economy where cash is used compared to a hypothetical economy without cash. Their model builds on Lagos and Wright (2005) and Berentsen, Camera and Waller (2007), who provide microfoundations for the existence of money and banking within a tractable framework. Compared to Berentsen, Camera and Waller (2007), Boel and Camera (2015) consider an economy where financial intermediation is costly because banks need to pay wages to employees. When this is taken into consideration, the model shows that the interest rate spread between loans and deposits depends on both monetary policy and the efficiency of the intermediation technology. Moreover, labor market wage distortions generate general equilibrium effects that affect financial activity and in turn welfare. Figures 2 and 3 describe the welfare implications of the model, which is calibrated to the US economy for the period 1965-2010.

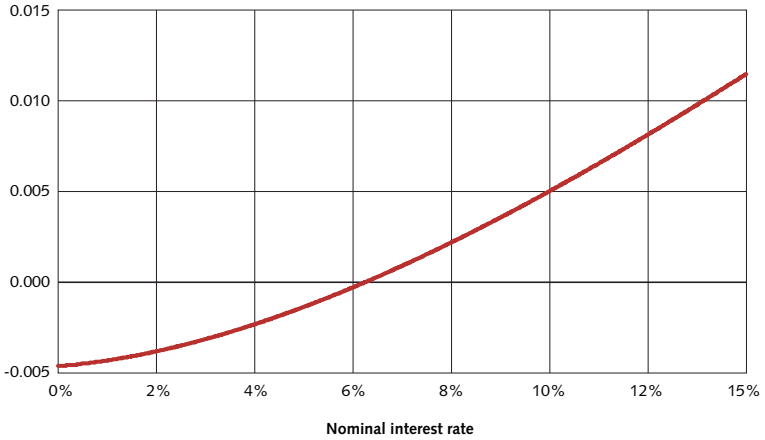
Figure 2. Welfare differences with and without banking when agents can use cash
Model and calibration (for the U.S.) are from Boel and Camera (2015)



Note. The graph shows the difference in the expected lifetime utilities with and without financial intermediation as a function of the interest rate. The welfare difference is quantified in an economy where agents can use cash.

6 Because currency demand would be replaced by demand for electronic central bank reserves.

Figure 3. Welfare differences with and without banking when agents cannot use cash
Model and calibration (for the U.S.) are from Boel and Camera (2015)



Note. The graph shows the difference in the expected lifetime utilities with and without financial intermediation as a function of the interest rate. The welfare difference is quantified in an economy where agents cannot use cash.

Figures 2 and 3 plot the difference in welfare between the economy with costly banking in Boel and Camera (2005), and in the hypothetical economy with no banking at all as in Lagos and Wright (2005). The takeaway from both figures is that for sufficiently small inflation rates, banks end up compensating depositors too little and charge too high a premium on borrowers. This is so because in this economy, intermediation absorbs labor resources, and there is a threshold inflation level below which active intermediation lowers macroeconomic efficiency. This threshold level depends on the productivity of the banking sector.

Figures 2 and 3 also emphasize that the welfare consequences at low inflation rates are different whether we are considering an economy where agents can trade with each other and hold cash outside of banks (Figure 2) or not (Figure 3). Specifically, agents are better off using cash when interest rates are very low. Why is that the case? Intuitively, when interest rates are sufficiently low, banks cannot fully compensate depositors since banks still need to pay for costly resources to operate. At the same time, the workers hired by the banks affect wages in the economy. Through general equilibrium effects, Boel and Camera (2015) find that abandoning paper currency increases wages, in turn lowering the production of goods due to higher labor costs.

This suggests that in thinking of cashless societies, we should remind ourselves that while cash is costly, so are banks' operations. Indeed, they absorb real resources such as labor, and this might have welfare-decreasing general equilibrium effects at low interest rates. Whether this is the case or not depends on the efficiency of alternative intermediation technologies.

3. Cryptocurrencies

Much has already been written describing the most salient features of cryptocurrencies,[7] but some aspects of the phenomenon are still worth emphasizing. First, there are some important differences between digital, virtual and cryptocurrencies. Digital currency is any currency stored and transferred electronically (e.g. Paypal); a virtual currency, as defined in ECB (2015),[8] is a digital representation of value, not issued by a central bank, credit institution or e-money institution, which in some circumstances can be used as an alternative to money.; a cryptocurrency, instead, is a digital and virtual currency protected by cryptography. Bitcoin, Feathercoin, and Namecoin, among others, are all examples of cryptocurrencies, of which Bitcoin is so far the best known and used among the hundreds currently existing.

Second, cryptocurrencies serve a dual purpose as a medium of exchange to facilitate the trade of goods and services between parties and a payment system to settle financial transactions. That is, cryptocurrencies are both money and a technology at the same time. Indeed, the genuinely innovative aspect of cryptocurrencies is not that they are a new form of money, thus leading to the coexistence of different currencies in the same country. Different currencies have coexisted within the same country in the past – think for example of the Free Banking Era (1837-1863) in the United States, when entry into banking was virtually unrestrained and banks could issue their own currency (see Rolnick and Weber, 2008) or Sweden between 1534 and 1803 (see Edvinsson, 2010). Instead, the truly novel aspect of cryptocurrencies relies on the fact that they are also a decentralized digital payment system, in that they use distributed ledgers to allow remote peer-to-peer exchanges of electronic value in the absence of trust between the parties and without the need for intermediaries.

One obvious question is whether cryptocurrencies can coexist with traditional forms of money in the long run, given the anonymous nature of both. As cryptocurrencies are a new phenomenon and the empirical evidence is still scarce, we need a theoretical model to answer this question. Boel (2015) develops a microfounded model of money based on Trejos and Wright (1997), which in turn builds on Trejos and Wright (1995), in an attempt to answer this question.

Trejos and Wright (1997) consider an environment with two different countries, A and B. Agents are anonymous and specialized, so that there is no double coincidence of wants and money is needed to trade. Each of the two countries issues its own fiat currency, i.e. currency with no intrinsic value, M^A and M^B. Population and money supply are constant, so that there is no inflation in either country. Two possible equilibria exist in this environment: (i) if the two countries are relatively isolated in terms of trade, currency A circulates only in country A, and currency B circulates only in country B, thus leading to two national monies; (ii) currency A and B circulate in both countries so that two international monies exist.

7 See, among others, Segendorff (2014), Velde (2013),Brito and Castillo (2013) and CPMI (2015) for interesting overviews of cryptocurrencies.

8 https://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf.

Boel (2015) builds on this result and considers the case where countries A and B are not too isolated and therefore agents would prefer to use both currencies. The environment is analogous to the one in Trejos and Wright (1997), but now money supply grows according to $M_t^A = \pi_{t-1}^A M_{t-1}^A$ and $M_t^B = \pi_{t-1}^B M_{t-1}^B$. A cash-in-advance constraint is introduced, so that agents need to pay taxes using domestic currency. This is reminiscent of the legal restriction theory of the demand for money in Wallace (1983) and captures the idea that currencies A and B are backed by the governments of the respective countries. A fiat currency C, with no intrinsic value and unbacked by either government, is also introduced, with $M_t^C = \pi_{t-1}^A M_{t-1}^C$. Currencies A, B and C are assumed to have the same volatility, but may be associated with different expected inflation rates.

Without transaction costs, currency C circulates in equilibrium if, and only if, its expected inflation rate is lower than for the other currencies. This suggests that cryptocurrencies, which are intrinsically worthless and unbacked by any government and thus reminiscent of currency C, could circulate in countries with high inflation rates.[9] Of course, if currencies had different volatilities, this would also affect the acceptance rate of currency C.

Another reason why currency C may exist in equilibrium is transaction fees. Assume a positive transaction cost is incurred for exchanging currencies A and B, much like a fee for international money transfers. In this case, currency C will be used in equilibrium as long as the transaction cost is low enough. Why? Agents will use it to acquire the money with the lowest expected inflation rate. Intuitively, this suggests that cryptocurrencies should survive as a technology as long as they offer low transaction costs. That is, they should have value as a payment instrument regardless of their currency function.

This feature of cryptocurrencies can have important consequences. The use of distributed ledgers in payment systems may induce changes in clearing and settling transactions. Indeed, this would become even more revolutionary if banks were to adopt distributed ledgers such as the block chain, as that could have implications for supervision and regulation, and thus for the safety and soundness of payments systems.

4. Peer-to-peer lending

Peer-to-peer, or person-to-person, lending (henceforth "P2P lending"), which emerged in 2004 with the UK's Zopa platform, is essentially a virtual marketplace that matches supply and demand of funds. The virtual marketplace term is used because P2P lending uses platforms connecting investors/lenders and borrowers in one direct online market that removes layers of intermediation for investors wanting a diversified portfolio of a fixed-income asset class of consumer loans. With P2P lending, such investors do not need to access asset-backed security (ABS) markets.

9 See http://cointelegraph.com/news/114547/hyperrinflationleads-the-number-of-venezuelan-bitcoin-users-to-double, for a brief discussion of Bitcoin use in Venezuela in 2014-2015.

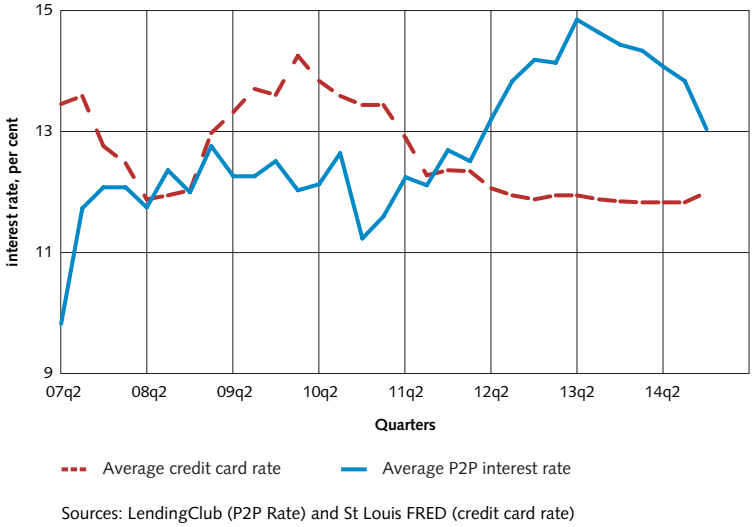
The attractiveness of P2P for borrowers lies in the promise of reduced rates. This is possible because P2P lending's use of internet platforms reduces costs by eliminating many operational expenses associated with traditional consumer bank loans, such as the cost of maintaining and staffing physical branches. Some cost savings are passed on to borrowers through lower interest rates than those offered by traditional banks. The loans are however unsecured, meaning there is no collateral for lenders to keep if the borrowers do not repay their loans. Thus, P2P investors face losing all their capital if the platform goes bankrupt.[10]

The P2P lending process varies by platform, but it generally involves some standard steps. First, a prospective borrower submits an application to the platform for consideration. Borrower applicants enter mandatory information including the loan amount request, maturity choice, purpose for loan, income, employment, and other debt, as well as voluntary information that is posted on the website. Borrowers may also upload documentation verifying income and employment. The platform can then obtain a credit report on the applicant (platforms typically set minimum FICO credit scores) and use this information, along with other data (e.g., loan characteristics), to assign a risk grade to the proposed loan. Depending on the pricing mechanism used, the loan interest rate is usually determined either by the platform itself or via an auction among bidding lenders.[11] If accepted, a loan request is posted on the platform's website, where investors can review all loans. They need not fund entire loans for any prospective borrower, but can instead diversify across borrowers. They can also choose to invest independently or within investment groups. Typically, platforms issue loans in amounts ranging from USD 1,000 to USD 35,000 with maturities of three to five years.

10 For example, the Swedish P2P firm TrustBuddy filed for bankruptcy and froze lenders' cash in October 2015. For more details, see http://www.telegraph.co.uk/finance/personalfinance/investing/11947261/Peer-to-peer-firm-delisted-from-stock-exchange-after-3m-of-savers-cash-goes-missing.html.

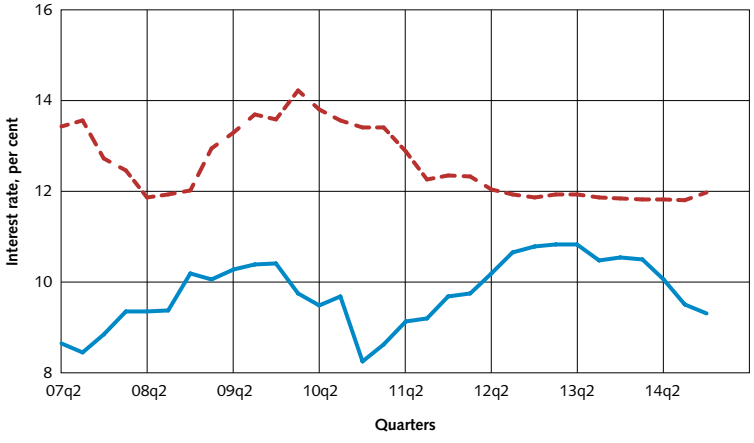
11 See Wei and Lin (2015) for an analysis of Prosper's switching from an auction to a posted-price mechanism in 2010.

Figure 4. Average credit card and P2P interest rates
Annualized



Sources: LendingClub (P2P Rate) and St Louis FRED (credit card rate)

Figure 5. Average credit card and P2P interest rates for borrowers A and B (low default risk)
Annualized



Sources: LendingClub (P2P Rate) and St Louis FRED (credit card rate)

The vast majority of P2P borrowing is for credit card and mortgage refinancing, but some P2P platforms focus on other segments of the consumer lending market as well, such as student loans (SoFi, Kiva), and younger borrowers (Upstart). As shown in Figure 4, not every borrower is able to obtain a better interest rate than a credit card one. However, LendingClub[12] ranks borrowers from A to G, with A reflecting the lowest probability of

12 LendingClub and Prosper are the two largest P2P lending platforms in the United States.

default. As shown in Figure 5, borrowers with grades A and B, i.e. the least risky borrowers, have consistently been getting better rates through P2P.

Platforms generate profits by closing and servicing loans. Using data from Morse (2015) based on all LendingClub loans issued in the first quarter of 2013, the mean and median origination fees were 2.7 per cent and 3 per cent, respectively. This fee is taken out of the funds provided to the borrower. The platform informs the borrower of the interest rate and the implied APR with the fee added into the calculation, so that the APR reflects the true borrower cost. When fees are paid to LendingClub to service the loan, the platform takes out a 1 per cent service charge before submitting the payments to the investor. LendingClub also collects delinquency fees from borrowers and collection fees from investors.

P2P lending has received great interest and experienced tremendous growth worldwide in the past few years. By one estimate, in the year 2014 alone in the United States, P2P generated more than USD 8.9 billion in loans, and received more than USD 1.32 billion in venture capital investments.[13] Yet, little research has so far emerged on the topic. Indeed, such research is very much needed to understand the welfare implications of P2P across borrower and investor types. As P2P continues to grow, it is also worth investigating the optimality of the lending structure of P2P. Are these middle-to-high income individuals with a probably higher than average tax burden well served by a 3 to 5 year installment loan? Is this the optimal maturity? A few studies have recently emerged on the optimal pricing mechanism in P2P. Wei and Lin (2013) study the event of the P2P platform Prosper unexpectedly moving from price setting via auction (the interest rate is priced at the margin when supply of credit reaches demand) to a coarser system in which Prosper pre-assigns an interest rate based on credit scoring assignment of prospective borrowers into buckets or grades of risk. The authors find that under the pre-set prices, loans are funded with a higher probability at a higher price, but with a higher default rate.

Most importantly, there is the big-picture question of where P2P is headed in terms of consumer finance and whether it could seriously erode the position of traditional commercial banks. So far, most US and UK banks have watched the growth of P2P from the sidelines. This attitude may be a reflection of P2P's relatively small size. While online lending is growing, its size still remains negligible given that the US consumer credit market is worth more than USD 3,000 bn. Moreover, as the business expands, P2P operators will need to find riskier borrowers to lend to. Indeed, they are already doing so, moving into areas such as small business lending where there is an appreciable need. What bankers seem ultimately to be counting on is that P2P will struggle to make this transition. If banks were proven wrong and P2P were to seriously drive activity out of the traditional banking sector, it could have disruptive effects for the standard channels of impact monetary policy has on the economy. At this stage, it is of course too early to quantify how big P2P should be for this to happen.

13 http://cdn.crowdfundinsider.com/wp-content/uploads/2015/04/P2P-Lending-Infographic-RealtyShares-2014.jpg.

5. Concluding remarks

Technological innovation could potentially lead to a diminished lending role from the traditional banking sector if phenomena such as peer-to-peer lending and cryptocurrencies become mainstream and grow. At the same time, the role of central banks could change in a world without cash. Regulators and central banks therefore need to understand how these innovations could potentially transform the banking sector as we know it today and fundamentally change the traditional channels through which monetary policy affects the economy. Monetary theory can offer valuable insights in this important analysis.

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