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A Tale of Two Countries: Cash Demand in Canada and Sweden *

Walter Engert, Ben Fung, Björn Segendorff[†]
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Abstract

Cash is being used less and less for making payments in many countries, including Canada and Sweden, which might suggest that cash will eventually disappear. However, cash in circulation in most countries, including Canada, has been stable for decades, and even rising in recent years. In contrast, aggregate cash demand in Sweden has been falling steadily. This paper explains these differences between Canada and Sweden by focusing separately on the transactions demand for cash and on the store-of-value demand. We find a long-term downward trend in small-denomination bank notes relative to gross domestic product in both Canada and Sweden. This reflects similar experiences in decreasing cash use for transactions over time due to the adoption of payment innovations. This means that payment innovations and diffusion are not sufficient to explain why aggregate cash demand has been declining rapidly in Sweden but not in Canada. Instead, the difference in the trends of cash demand between these two countries is due more to the behaviour of larger-denomination, store-of-value bank notes. Finally, we identify influences and frictions that help explain the persistent decline in the demand for larger bank notes in Sweden relative to Canada.

Keywords: Bank topics; Bank notes; Digital currencies and fintech; Financial services; Payment clearing and settlement systems.

JEL codes: E, E4, E41, E42, E5.

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1. Introduction

Cash is being used less and less for making payments in many countries, including Canada and Sweden.¹ Charts 1a and 1b show that the number and the value of cash transactions have been declining over the last two decades in both of these countries.² One of the main reasons for declining cash use has been the growing reliance on electronic payment methods, such as credit and debit cards.³ Charts 2a and 2b present the value of cash, debit card and credit card spending relative to gross domestic product (GDP) in Canada and Sweden. Canadians have long preferred to use credit cards, and their use of debit cards also overtook cash in the early 2000s (Chart 2a). In comparison, while Swedes were still using cash more than cards in 2001, they have increasingly preferred debit cards to make purchases since the early 2000s, and in the last few years credit card use has also overtaken cash (Chart 2b). Corresponding to these trends, increasing card acceptance by merchants has also contributed to greater card use in both Canada and Sweden.

Such persistent declines in cash use in numerous countries might suggest that cash will eventually disappear. Indeed, Chart 3a illustrates that cash demand more generally (the ratio of cash to GDP) steadily decreased in a number of countries following the end of Second World War.⁴ However, the cash-to-GDP ratio stabilized in most countries in the late 1970s and early 1980s. In Canada, for example, bank notes as a ratio of GDP declined steadily from 10 percent in 1946 but then stabilized in the 1980s and have remained between 3 and 4 percent. There has even been a slight upward trend after the 2008 financial crisis in Canada and in most other advanced economies (Bech et al. 2018). So, decreasing cash use for transactions has not resulted in a sustained decline in cash demand in Canada (to this point). And the story is similar in most other advanced economies (Chart 3a).

The evolution of cash demand in Sweden and Norway, however, has been markedly different from the experiences of other advanced countries (Chart 3b). In Sweden, for example, the value of bank notes relative to GDP declined continuously from a peak of 13.5 percent in 1945 to 1.2 percent in 2017. Unlike the experience in most other advanced economies, cash-to-GDP did not stabilize in the 1980s, nor did it increase after the financial crisis. Moreover, the absolute value of bank notes outstanding in Sweden started to decline in 2007, from a peak of SEK 108.5 billion in 2007 to just over SEK 55 billion in 2017. Thus, in Sweden, declining cash use for payments appears to be more closely associated with the decrease in cash demand more generally. Indeed, the popular press has been predicting that Sweden will become the world's first cashless society when the Swedes stop using cash completely.⁵

The divergent experiences of Canada (and other advanced countries) on the one hand and Sweden (and Norway) on the other raise several questions. Why has there been a persistent decline in overall cash demand in Sweden but not in Canada? Have Swedes been reducing

¹ The terms cash and bank notes are used interchangeably in this paper.

² The value and number of cash payments are estimated using cash withdrawal data from automated teller machines (ATMs). For a discussion of the methodology and limitation of the estimation, see Arango et al. (2012).

³ For a discussion of these developments in Canada, see, e.g., Fung, Huynh and Stuber (2015) and Henry, Huynh and Welte (2018). For Sweden, see Segendorf and Wretman (2015) and Sveriges Riksbank (2013).

⁴ The ratio of cash in circulation to GDP is widely used as a measure of the demand for cash and thus the importance of cash in an economy. The value of cash in circulation, like other goods, is determined by both supply-side factors (e.g. the number of bank branches and the size of the ATM network) and demand-side factors (e.g. the use of cash for payments and as a store of value). In most countries, including Canada and Sweden, the central bank typically provides enough cash to meet the demand for cash; thus, the value of cash in circulation reflects the underlying demand for cash.

⁵ See, e.g., N. Heller, ["Imagining a Cashless World," *The New Yorker*, October 3, 2016.](#)

cash use more quickly than Canadians? Are there meaningful differences in payment innovations in the two countries that can explain these experiences? Are there large differences in the availability and supply of cash? What factors could explain the different trends in cash demand more generally in the two countries? Does Sweden's experience of continuously falling cash demand indicate the future for other advanced economies, such as Canada?

This paper studies both the use of cash and the demand for cash in Canada and Sweden, and analyzes the main factors affecting cash use and demand in these two countries. More specifically, we discuss supply side factors such as the bank note distribution system and the access of cash through ATMs and bank branches, as well as demand side factors such as consumers' use of cash and merchants' acceptance of cash for transactions, and the holding of cash as store of value. We also discuss foreign demand and the demand for cash in the underground economy. In addition, we identify some unique developments in Sweden that help explain the persistent decline in the demand for bank notes. Such analysis can inform our understanding of potential turning points for cash demand in Canada, as well as policy measures that might affect such outcomes.

The Riksbank has been studying the implications of a persistent decline in cash use and demand in Sweden, highlighting some potential difficulties from a cashless society.⁶ Engert, Fung and Hendry (2018) also study the implications of a cashless society and note areas that could raise some concerns in that context—that is, operational reliability and contestability in retail payments, and the availability of a safe store of value in an extreme financial crisis. They also suggest options for policy-makers to deal with these potential problems, including taking steps to inhibit declining cash demand, regulating retail payment systems and issuing a central bank digital currency (CBDC) in a cashless society. To assess policy responses, it is important to understand the factors that could lead to the disappearance of cash in an economy. In particular, policy-makers might want to know how to avoid or inhibit declining cash demand. If this is not possible or desirable, then the central bank and other public authorities would need to consider other policy options to mitigate concerns if a cashless society were to evolve (as noted in Engert, Fung and Hendry 2018).

Canada and Sweden are similar in many ways. For instance, both of these northern countries are small, open economies that neighbour on much larger economies (the United States and those in the euro zone, respectively). Each has its own national currency, while citizens have easy access to an international reserve currency (the US dollar and the euro). The macroeconomic environments in Canada and Sweden also share similarities. For example, both Canada and Sweden have monetary policy frameworks that target inflation, and both have pursued the same inflation-control objective (2 percent) since the beginning of the 1990s. Their banking systems are broadly similar, each dominated by a handful of large, universal banks, but also including many smaller institutions. Canada and Sweden also both rank high in terms of digital infrastructure relevant to cashless payments; both are seen as among the most significant adopters of cashless payment methods and both are considered among the most cashless societies in the world.⁷ Finally, each has experienced a range of payment innovations over the past few decades (e.g., Swish in Sweden, and Interac e-Transfer in Canada) that have contributed to the reduced use of cash for payments.

⁶ See, e.g., Sveriges Riksbank (2017) and Sveriges Riksbank (2018a).

⁷ For rankings of digital infrastructure and network readiness, see the [Networked Readiness Index compiled by the World Economic Forum](#). For an example of rankings of cashless societies, see, S. Smith, "[The 10 Most Cashless Countries in the World: Where Does the UK Rank?](#)" *The Telegraph*, October 10, 2017,.

And yet, despite the similarities, the evolution of overall cash demand is very different in the two countries, as shown above. It follows then that studying the factors driving cash demand in Canada and Sweden could inform our understanding of the importance of various influences and provide some insight into the evolution of cash demand in Canada: Will cash demand in Canada follow Sweden's path?

The rest of the paper is organized as follows. The next section discusses access to cash in Canada and Sweden, focusing on how bank notes are distributed to the general public. The following two sections consider transactional and non-transactional demand for cash. More specifically, the third section discusses the main factors that determine transactional demand and assesses whether these can explain the differences between cash demand in Canada and Sweden. Section 4 considers non-transactional demand for cash and related influences. Section 5 discusses the use of cash in the underground economy. The final section provides conclusions.

2. Access to cash in Canada and Sweden

Typically, a central bank distributes bank notes to financial institutions; these, in turn, operate a network of branches and automated teller machines (ATMs) that allow the public to withdraw or deposit bank notes. This section begins with a brief overview of the banking systems in Canada and Sweden and then describes how the respective central banks distribute bank notes to financial institutions. Access to cash by the general public through financial institutions' branches and ATMs is also considered. We discuss differences between Canada and Sweden regarding providing and accessing cash, and whether this affects cash use and demand.

2.1 Overview of the Swedish and Canadian banking systems

In Canada, six major universal banks dominate financial services.⁸ These six banks account for over 90 percent of total banking assets and have a significant economic footprint, with assets around 2.5 times Canadian GDP. The major Canadian banks are also highly interconnected with each other and with the broader financial system. They also play important roles in most aspects of the Canadian financial system (OSFI 2019). These banks are well-diversified. Each provides a wide range of financial services across Canada, with commercial and personal (including mortgage lending) segments comprising the core businesses (IMF 2014). The largest four Canadian banks have an important presence outside of Canada as well, variously in the United States, the United Kingdom and South America. In addition, each of the major banks in Canada has been designated as a domestic systemically important bank, subject to enhanced regulatory provisions and a specific, open-bank (bail-in) resolution regime. One of these banks—Royal Bank of Canada—has also been designated a global systemically important bank by the Financial Stability Board (FSB). There is also a large number of smaller banks—about 80—along with many trust and loan companies, and co-operative deposit-taking institutions which are particularly important in certain regions of the country.

Similar to the Canadian case, four major, universal banks dominate financial services in Sweden.⁹ These four banks account for about 85 percent of total banking assets and two-thirds of broader financial system assets more generally (IMF 2017). The major banks' assets are large compared with the Swedish economy, amounting to around 5.5 times Swedish GDP.

⁸ These six banks are Bank of Montreal, Banque Nationale, Canadian Imperial Bank of Commerce, Royal Bank of Canada, Scotiabank and TD Bank.

⁹ These four banks are Handelsbanken, Nordea, SEB (Skandinaviska Enskilda Banken) and Swedbank. In October 2018, Nordea moved its head office (and legal incorporation) from Sweden to Finland.

These banks are also highly interconnected with each other and with other participants in the financial system. Further, they play important roles in most aspects of the Swedish financial system. Each of the four major banking groups provides a wide range of financial services, but they have somewhat different business mixes and geographic concentrations across the Nordic and Baltic regions and other countries (IMF 2017). Nevertheless, the commercial banks and their mortgage subsidiaries are the dominant entities for each major bank. Nine financial institutions have been designated by Swedish authorities as domestic systemically important (Riksgalden 2018a) and are therefore subject to enhanced regulatory provisions and a specific, open-bank bail-in resolution regime. One of the major banks operating in Sweden—Nordea—has also been designated as a global systemically important bank by the FSB. In addition to the four dominant Swedish banks, there are also many—over 100—smaller banks, including niche participants and some foreign bank subsidiaries and branches (Swedish Bankers’ Association 2018).

With low interest rates and interest-spread compression prevailing in the last 10 years, the major Canadian and Swedish banks have sustained profits with low credit losses, an expansion of real-estate-based lending (mortgages) and increased fee income, along with tight control of operating expenses (Finansinspektion 2018; IMF 2017).

In sum, the banking market structures in Canada and Sweden are broadly similar, characterized by the dominance of a handful of large, universal and systemically important banks, but with many smaller institutions competing as well. Further, the strategic, business responses of the major banks in each country to the prevailing economic influences in recent years have been broadly similar.

A key difference between Canadian and Swedish banks concerns their funding. The major Canadian banks rely on personal and other deposits, which provide for over half of their liabilities, almost equally split between demand/notice deposits and fixed-term deposits (IMF 2014). And Canadian-dollar personal deposit funding is about 35 percent of Canadian-dollar assets. In contrast, the major Swedish banks depend on wholesale, market funding, primarily through covered bonds. Correspondingly, deposits comprise only about one-third of the aggregate funding for Swedish deposit-taking institutions (IMF 2017). Similarly, SEK personal deposits amount to just 17 percent of SEK assets.

2.2 Bank note distribution systems

The Bank of Canada is the sole issuer of bank notes in Canada and is responsible for providing adequate bank notes in circulation to meet the public’s demand. In 1998, the Bank of Canada introduced a computerized inventory-management system, the Bank Note Distribution System (BNDS), to facilitate the exchange of bank notes between the Bank and participating financial institutions, and between financial institutions themselves.¹⁰ Through two agency operation centres (AOCs) in Toronto and Montreal, the Bank of Canada exchanges bank notes with 43 regional distribution centres (RDCs) located in 10 regional distribution points (RDPs) across the country.¹¹ Each RDC is owned by one of the nine financial institutions that are members of the BNDS (which include most of the major Canadian banks), and each member financial institution is allowed to have no more than one RDC in each RDP. A financial institution’s RDC manages the note flows of its regional network of branches and ATMs.

¹⁰ Bilkes (1997) provides background information and an overview of the system.

¹¹ These regional distribution points broadly correspond to the different provinces of Canada.

A member financial institution with surplus notes declares them to the BNDS, receives credit from the Bank of Canada, and then moves them to the vault of its RDC, segregated from its own note holdings. A financial institution that needs notes places orders on the BNDS and arranges for the transportation of notes from other RDCs in the same RDP that have surplus notes. The Bank then debits its accounts accordingly. Unfit notes are shipped by financial institution branches to their RDCs, where the notes are registered as deposits to the Bank. These notes are then shipped by the Bank to one of its AOCs for processing and removal from circulation. The Bank also supplies new notes (and processed fit notes) as needed by shipping these notes to the RDCs, where they are held in the vaults of the RDCs until required.

In Sweden, the Riksbank started issuing bank notes early in the eighteenth century. The number of Riksbank branches at which banks can obtain cash from the Riksbank has been declining gradually in recent decades. In the late 1980s, the Riksbank had 20 local branches that managed note distribution, and by 2006 this number had declined to two. Since 2014, only one Riksbank regional branch remains in operation. Consequently, the network of cash distribution depots is now mostly operated by the market.¹² Banks bear costs from cash in terms of foregone interest, which generates an incentive for the banks to deposit cash at the Riksbank each afternoon and withdraw cash the next morning to cover the day's needs. To avoid unnecessary transportation and related costs, banks are credited interest compensation if they store and report idle cash at the depots in accordance with a specific set of requirements.

In sum, both the Bank of Canada and the Riksbank have substantially decentralized note processing, storage and distribution to financial institutions. As a result, financial institutions bear a significant share of the costs of providing cash to the public. In Canada, for example, Kosse et al. (2017) estimate that 56 percent of the total resource costs of cash are borne by financial institutions. Similarly, Segendorf and Jansson (2012) estimate that banks and cash-in-transit companies bear about half of the total resource costs of cash (and nearly all of the cash distribution costs specifically). Therefore, financial institutions in both countries are constantly looking for ways to reduce the costs related to their cash operations.

2.3 Access to cash through ATMs

To obtain cash for transactions, consumers usually rely on ATMs. This is facilitated by the high degree of access to banking services in both Canada and Sweden, as virtually all Canadians and Swedes have a bank account.¹³ In Canada, ATMs handle mainly \$20 and \$50 notes, and some bank ATMs recently began dispensing \$100 notes as well. Some also provide customers with choice across a range of note denominations. Canadian bank ATMs typically accept deposits of bank notes and cheques as well. In Sweden, ATMs generally handle 100-krona, 200-krona notes (since 2015), and 500-krona notes (which some ATMs started dispensing in the late 1980s), but not the smallest denominations, 20-krona and 50-krona notes.¹⁴ ATMs have withdrawal limits in both countries, set by each bank.

Chart 4a shows that the number of ATMs per million population in Canada is much higher than in Sweden; more specifically, there are about 10 times more ATMs per million

¹² Similar to the Canadian experience, the transition in Sweden to rely on market participants to distribute cash was motivated by the Riksbank's view that the market is better suited to providing efficient cash distribution than is the central bank itself. See Daltung and Ericson (2004) for more background on this decision.

¹³ More specifically, over 99 percent of Canadians and 97 percent of Swedes have a bank account according to the latest survey data; for Canada, see Henry, Huynh and Welte (2018), and for Sweden, Sveriges Riksbank (2018b).

¹⁴ The CAD/SEK exchange rate is about 1:7 (July 2019).

inhabitants in Canada than in Sweden. Further, the number of ATMs in Canada had been growing until recently, with much of this increase coming from white-label ATMs. The number of ATMs in Sweden has been fairly stable over the last 20 years. In Sweden, the distribution of ATMs has recently started to move away from bank branch locations toward “cash centres” that congregate several ATMs in high-traffic areas, such as shopping malls.¹⁵ Major Canadian institutions also place ATMs in high-traffic areas, as well as in bank branches.

While there are many more ATMs per capita in Canada than in Sweden, this does not necessarily mean that there is a friction inhibiting access to transactional cash in Sweden compared with Canada. The business models underlying the deployment of ATMs in the two countries appear to be quite different. In Canada, banks apparently see their ATM networks as part of their branding and a means to attract and retain customers. Major Canadian banks each have their own branded ATMs to compete for customers, joined in a common network linking all banks’ ATMs. As a result, customers can withdraw cash from their own-bank ATMs with no (or minimal) charges. They can also withdraw funds from their account via another bank’s ATMs or white-label ATMs, but subject to additional fees for most account holders. And bank customers can deposit cash (and cheques) only at ATMs of their own bank.

In comparison, Swedish banks appear to have viewed ATMs more as a cost centre than a means of competition, and thus have collaborated since the late 1960s to work toward shared and interoperable bank-ATM networks to reduce their costs. By the mid-1990s, bank and savings bank ATM networks were interoperable to provide for cash withdrawals (but not deposits) across all ATMs. In 2013, all bank ATMs in Sweden came under the management of one company, to improve interoperability and service more generally.¹⁶ As a result, customers of any Swedish bank can use any ATM to access their account to withdraw cash without being subject to any fees. This suggests that a smaller ATM network would be sufficient to provide for cash distribution (other things equal). In this context, Swedish banks have also been concerned about possible adverse impact of a common, generic ATM network on their branding. This has been addressed by having the ATM display the specific card-issuer’s starting page following recognition of the customer’s inserted access card.¹⁷ However, Swedish ATMs do not generally accept cash deposits, and specific cash-deposit machines have been hard to find. As a result, depositing cash was becoming increasingly difficult in Sweden (more on this below).¹⁸ Recently, however, cash-deposit machines are being located at cash centres (noted above) along with regular ATMs.

In sum, different competitive and business strategies seem to explain the much smaller number of ATMs per capita in Sweden than in Canada. But the nature of the interoperability of the bank ATM networks in Sweden suggests that this is unlikely a material friction in accessing transactional cash via ATMs. A recent official study (Statens offentliga utredningar

¹⁵ In 2017 there were about 100 such cash centres, and 30 more were expected to open in 2018. See [Bankomat press release, May 17, 2018](#).

¹⁶ The Swedish ATM network is currently managed by Bankomat AB, which is jointly owned by the five largest banks in Sweden: Danske Bank, Handelsbanken, Nordea, SEB, Swedbank (with the Savings Banks) For more information, see [Bankomat website](#). The tradition of co-operation among Swedish banks in this regard is described in Segendorf and Wretman (2015). See also Bätz-Lazo (2018), especially Table 6.2.

¹⁷ In addition to the dominant ATM network, one bank has kept its own ATM network, and there are some white-label ATMs as well. Further, ICA (the largest grocery store chain in Sweden) opened ICA Bank, which has an (in-store) ATM network that is interoperable with the main ATM network. One of the cash-in-transit companies also operates its own ATM network. These two networks each have nearly 20 percent of the market.

¹⁸ A search of Bankomat’s website reveals that few of its ATM locations provide cash deposit services.

2018) on access to cash in Sweden reached a similar conclusion, but raised questions about access to deposit services, especially given the development of cashless bank branches in Sweden (discussed below).

2.4 Access to cash through bank branches

Larger bank notes are usually not available in ATMs and, instead, are supplied via bank branches in both Canada and Sweden. Therefore, the ease of accessing cash services from banks influences the use and holding of larger notes in these two countries. Chart 4b shows that the number of bank branches per million population is much higher in Canada than in Sweden; that is, there are about 50 percent more branches per million inhabitants in Canada.¹⁹ This suggests that accessing cash through bank branches is more difficult in Sweden than in Canada. The number of bank branches per million population, however, has been declining in both countries, especially since the 2008 financial crisis.²⁰

Further, it has become increasingly difficult to access cash in a bank branch in Sweden since many bank branches no longer provide over-the-counter (teller) cash services. These cashless branches might provide cash withdrawal services via ATMs located in the branch, but given the strategy to build ATM cash centres, bank branches with ATMs are becoming increasingly unusual in Sweden. This development is considered further in Section 4, which focuses on various influences affecting the demand for larger-denomination notes.

2.5 Summing up

A number of key factors influencing access to cash in Canada and Sweden are similar, including banking market structures and the bank note distribution systems. While there are significantly fewer ATMs per capita in Sweden, the nature of the interoperability of the ATM networks in Sweden suggests that this is unlikely related to any material friction around accessing transactional cash via ATMs.²¹ However, a relative lack of access to deposit services at ATMs, fewer bank branches per capita and the development of cashless bank branches in Sweden could represent frictions that inhibit the demand for cash (particularly for larger value bank notes), compared with in Canada. These aspects are discussed further below.

3. Small-denomination bank notes and transactional demand for cash

As discussed above, cash-to-GDP in Canada and Sweden trended down for years after the end of the Second World War. But while the cash-to-GDP ratio stabilized in Canada in the early 1980s and has even increased somewhat in the last few years, this ratio has continued to fall steadily in Sweden. As a result, cash-to-GDP in Sweden fell below that of Canada in 2009 (although Sweden has had a higher ratio for most of the post-war period). Considering small- and large-denomination notes separately illuminates these contrasting trends.

Charts 5a and 5b plot the ratio of small-denomination notes-to-GDP and large-denomination notes-to-GDP separately. For Canada, notes of less than \$50 in value are considered small-denomination notes, and notes of \$50 or more are considered large-denomination bank notes. For Sweden, notes less than 500 krona are small-denomination notes, and the 500-, 1,000-

¹⁹ The data for Canada include branches of banks, credit unions and governmental savings institutions; for Sweden, branches of banks and savings banks are included. All data are from the BIS Redbook.

²⁰ A subsidiary of the Swedish Post—Svensk Kassaservice—had provided basic cash and payment services over the counter, but it was closed in 2008. For more on this, see Statens offentliga utredningar (2018).

²¹ Taken together, the number of cash-withdrawal points in Sweden (ATMs, bank branches and various shops) decreased by 38 percent between 2011 and 2018 (from 5,232 to 3,212; Länsstyrelserna 2018).

and 10,000-krona notes (which were removed from circulation in 1993) are considered large-denomination bank notes.²²

For small denominations, the patterns are similar in Canada and Sweden, with the ratio of small notes to GDP in both countries following a long-term declining trend.²³ This ratio was generally higher in Sweden than in Canada for most of the immediate post-war period (e.g., in 1946, 10.6 percent in Sweden versus 7.4 percent in Canada), suggesting that Sweden was more cash-intensive than Canada during these decades. However, the value of small notes to GDP has declined substantially in both countries since 1946, and since 1988 this ratio has been lower in Sweden than in Canada. In 2018, it reached 0.3 percent in Sweden and 1 percent in Canada.

For large denominations, however, the trends in the two countries have been strikingly different. In Canada, the value of large notes-to-GDP declined from the late 1940s, stabilized in the late 1960s, and has been rising since the early 1980s. Further, the rate of increase has accelerated since the 2008 financial crisis. In Sweden, large notes to GDP increased slightly from the late 1940s, and this increase accelerated in the 1970s. The ratio of large notes to GDP then stabilized in the early 1990s before going into a persistent downward trend starting in 2001.

Charts 5a and 5b show that the decline in small denominations was driving the downward trend in total cash demand in Canada until the 1980s, and in Sweden until the mid-1990s. After 1980 in Canada, rising demand for large denominations offset declining demand for small denominations, resulting in fairly steady total cash demand and a slight upward trend after the 2008 financial crisis. After 1995 in Sweden, total cash demand briefly stabilized (at around 4 percent) as demand for large denominations remained at a high level while demand for small denominations continued to decline slowly. In 2001, the demand for large denominations started to fall, driving the sharp downward trend in total cash demand for the last two decades in Sweden.

Small-denomination notes are typically used for transactions, especially for day-to-day purchases, as these notes are widely accepted by merchants and are readily available at ATMs. While large-denomination notes are also used for transactions, such notes are more likely held as a store of value.²⁴ The cash-to-GDP ratios in Charts 5a and 5b suggest that cash held for transactions (small notes) has been consistently declining since the 1940s in both Canada and Sweden. In contrast, cash held for non-transactional reasons (large notes) has been following different trends in Canada and Sweden over the last three decades—and so are the key to explaining the difference in total cash demand over time in Canada and Sweden.

Indeed, these divergent trends suggest that it is useful to consider separately the factors that have influenced holdings of small denomination notes and large denomination notes. Accordingly, the rest of this section focuses on influences affecting the demand for small-denomination notes in Canada and Sweden. Section 4 then considers the demand for large-

²² This classification is consistent with the literature, which typically considers the largest two or three denomination bank notes as “large-denomination” notes. See, e.g., Amromin and Chkravorti (2009) and Judson (2018). For a long-time series, however, there are some caveats. Persistent inflation, e.g., could suggest that some notes, especially \$50 and 500-krona notes, should not be considered to be “large denomination” (primarily store-of-value) notes throughout the entire period under consideration. That is, with a rising price level, such notes become more suitable for making payments over time. This perspective is reinforced by fact that these particular notes (\$50 and 500-krona) have become available in ATMs in Canada and in Sweden, respectively.

²³ It should be noted that small-denomination notes relative to GDP are also declining in many other advanced economies; see, e.g., Judson (2018).

²⁴ See Amromin and Chkravorti (2009).

denomination notes, where there appear to have been some notable differences between the two countries.

3.1 Cash for point-of-sale transactions

As discussed above, increased use of electronic payment methods such as debit cards and credit cards has led to reduced use of cash. Card ownership is very high in Canada, with 99 percent of Canadians owning debit cards and 89 percent owning credit cards (Henry, Huynh and Welte, 2018). In Sweden, 97 percent of the population has a debit card but only 49 percent owns a credit card (Sveriges Riksbank, 2016). Correspondingly, the use of cash for payments has been decreasing relative to cards in both Canada and Sweden (Charts 2a and 2b).

While cash is still the single most popular payment method for small-value transactions in Canada (i.e., less than CAD 15), retail payment innovations such as contactless cards are also reducing the use of cash for such transactions (Chart 6a). In Canada, the cash-value share of transactions less than CAD 15 has declined from 65 percent in 2009 to just 40 percent in 2017, while the value share of contactless credit cards has grown considerably. In Sweden, while 20 percent of the population in 2018 still prefer cash for transactions that are less than SEK 100 (which is around CAD 15), more than 70 percent consider debit cards to be their main payment method for all transaction sizes as shown in Chart 6b (Sveriges Riksbank, 2018).

Contactless credit cards and contactless debit cards were introduced in Canada in 2011, and their use has grown rapidly (Chart 6a). Survey data suggest that contactless cards are particularly popular for transactions less than CAD15.²⁵ Currently, all credit cards and most debit cards in Canada support the contactless function, and an increasing number of payment terminals are contactless-ready. As a result, contactless cards will likely continue to have a significant and growing impact, reducing cash use for transactions in Canada.²⁶ And this impact could be especially notable for small-value transactions, where cash has been a relatively popular payment method, given the speed and convenience of using contactless cards.

In Sweden, contactless cards began to roll out only in 2016 and have been gradually gaining popularity. All cards and 94 percent of payment terminals are expected to support the contactless function by the end of 2019 and, as in Canada, contactless cards are likely to lead to a continuing decrease in cash use for transactions in Sweden.²⁷

Another common gauge of cash use is the number of consumers who report using cash for transactions over some prior period. In this regard, survey data in both Canada and Sweden (somewhat differently configured) indicate that declining proportions of their populations are using cash. Surveys conducted in Canada show that the percentage of Canadians who have used cash in the past week is declining, from 88 percent in 2010 to 68 percent in 2017.²⁸ At the same time, however, preliminary results from a subsequent survey suggest that only a small proportion (7 percent) of consumers have stopped using cash entirely, and only 5

²⁵ See also Henry, Huynh and Welte (2018), Chart 3. Note that contactless credit cards and debit cards in Canada have a limit on the size of the transaction, set by the issuing bank, typically at CAD 100.

²⁶ Fung, Huynh and Sabetti (2014) and Chen, Felt and Huynh (2017) show that introducing retail payment innovations, such as stored-value cards and contactless credit cards, leads to a reduction in cash usage for transactions in terms of both value and volume. (Additional work is underway at the Bank of Canada on the impact of recent innovations such as contactless cards and person-to-person payment methods on cash use.)

²⁷ For more information on contactless payments in Sweden, see the [Contactless Forum website](#).

²⁸ Canadian Financial Monitor conducted by Ipsos Reid.

percent plan to abandon cash in the next five years (Bitcoin survey 2018). Similarly, according to the Riksbank, the percentage of Swedes using cash in the past month declined from 94 percent in 2010 to 61 percent in 2018. So, while cash use has been declining in both Canada and Sweden, it seems likely that some cash use for payments will continue for (at least) the medium term.

A payments market is a two-sided market, as consumers and merchants influence each other in the use and acceptance of various payment methods. Fung, Huynh and Kosse (2017) argue that it is consumers, however, who ultimately determine the prevalence of a payment method. Therefore, as long as a sufficient number of consumers use cash, merchants are likely to continue to accept it for transactions. However, if cash use continues to decrease such that eventually only a small number of consumers use cash, merchants might reconsider their acceptance of cash given the costs associated with it. Merchant acceptance of cash is discussed further below.

3.2 Cash for person-to-person transactions

Cash has long been the main payment method for person-to-person (P2P) transactions in a number of countries (see, e.g., Fung, Huynh and Stuber 2015). But innovations in P2P payments, such as Interac e-Transfer in Canada and Swish in Sweden, have the potential to reduce considerably the use of cash for P2P transactions in both countries.

Interac e-Transfer is a P2P payment system in Canada that has been operational since 2001.²⁹ (e-Transfer can also be used for person-to-business, business-to-business and business-to-person transactions.) To make an e-Transfer payment, payers must log into their online or mobile banking service to initiate the process. Interac e-Transfer payment messages are exchanged between financial institutions through a secure network. When payers authorize a transaction, funds are immediately debited from their accounts and an email or text message to a mobile phone is sent to the recipient. In principle, it can take up to 30 minutes for an e-Transfer to be received by its recipient, although in practice receipt occurs much more quickly for most transactions. For example, according to the website of a major Canadian bank, an Interac e-Transfer is typically received within one minute. Before 2017, recipients had to log into their bank's online or mobile banking service, select the account and answer a security question (posed by the payer) before the funds were credited to their account; but since 2017, customers can register to receive funds directly into a designated account without these above steps.³⁰ Financial institutions generally set daily, weekly and monthly sending and receiving limits for end-users as an important means of controlling fraud risk. Some banks also charge a fee for sending an e-Transfer, but receiving e-Transfers is always free of charge.

The left-hand panel of Figure 7 shows that the number and value of Interac transactions have been increasing rapidly since 2011, at an annual rate of almost 50 percent. There are 15 million unique active users of Interac e-Transfer every month, and 80 percent of online banking customers are registered to use the e-Transfer service.³¹ In 2018, consumers and businesses made more than 371 million transactions worth more than CAD 132 billion, with average transaction value of CAD 357. According to the 2017 MOP Survey, 57 percent of Canadians used Interac e-Transfer at least once in the preceding year.³² While e-Transfer was

²⁹ Interac is the Canadian company that operates a debit payment network linking Canadian financial service providers.

³⁰ And at least one of the major banks now offers Interac e-Transfers via voice commands and Touch ID on its banking app.

³¹ For more on this, see Interac press release, "[Use of Interac e-Transfer Service Surges in 2018](#)." February 19, 2019.

³² See Henry, Huynh and Welte (2018), Table 12.

designed initially as mainly an alternative to cash or cheque for P2P payments, in 2017, about one in six e-Transfer transactions are conducted by a business, and this segment is expected to grow in the coming years.

Swish is a P2P fast-payment system in Sweden that started operating in 2012. It was created by a consortium of Swedish financial institutions and is designed for use with smartphones. Every subscriber to Swish links a mobile phone number to a bank account.³³ A payer in Swish enters the payee's mobile number and authorizes the payment with the Swish app. Both the payer and payee receive notification through the Swish app in the course of the payment process, and only one or two seconds elapse between payment initiation and the availability of funds to the payee. Financial institutions typically impose a maximum transaction limit of around SEK 20,000.

According to a 2018 Riksbank payments survey, 62 percent of the Swedish population used Swish in the month preceding the survey. (This compares with 61 percent of survey respondents who reported using cash in the past month.) But only a small number of respondents reported using Swish to pay for their last purchase; this probably reflects the fact that the expansion of Swish to person-to-business payments and point-of-sale transactions is still at an early stage. (The point-of-sale service builds on QR-codes and has different levels of integration with the cashier system to target a broad range of businesses.)

The right-hand panel of Figure 7 shows that use of Swish grew slowly in the first three years following its introduction in 2012. Starting in 2015, however, the number and value of Swish transactions increased sharply each year. According to Swish, by December 2018, nearly 6.8 million private individuals were using this system, which is about two-thirds of the Swedish population.³⁴ Furthermore, during December 2018, individuals made 29 million P2P transactions worth SEK 17 billion, with an average transaction value of about SEK 572. Almost 3,500 stores accepted Swish for payments in December 2018, where consumers made 6.3 million Swish payments worth SEK 1.4 billion, with an average transaction value of SEK 227. In terms of total transacted value, Swish overtook cash in 2017.

3.3 Merchant acceptance of cash and cards

In Canada, cash is nearly universally accepted as a means of payment, according to a merchant survey conducted by the Bank of Canada (Fung, Huynh and Kosse 2017).³⁵ As for other means of payment, in 2014, almost all large businesses (i.e., those with more than 50 employees and more than one location) accepted payment cards, but only two-thirds of small and medium-sized businesses accepted cards. And about five percent of these businesses accepted only cash.

In Sweden, cash is also nearly universally accepted as a means of payment. More specifically, according to Arvidsson, Hedman and Segendorf (2018), whose work is based on a survey of Swedish retailers, 97 percent of merchants accepted cash at the end of 2016, about the same as the card acceptance rate. However, looking ahead, 25 percent of merchants reported that they expect to stop accepting cash by 2020, and over 50 percent expect to do so

³³ Businesses and charities generally obtain a proxy number to substitute for a mobile phone number.

³⁴ Statistics on Swish were retrieved from the [Swish website](#).

³⁵ Preliminary results from a recent Bank of Canada merchant acceptance survey of cash by Huynh, Nicholls, and Nicholson (forthcoming) suggest that, among small and medium size businesses (less than 50 employees and \$10 million in revenue), about 4 percent of merchants currently do not accept cash. Only about 8 percent of merchants plan to stop accepting cash in the next five years, while 79 percent of merchants do not plan to stop accepting cash and 8 percent are uncertain.

by 2025.³⁶ In this regard, the cost of handling cash, given decreasing cash turnover, is an important driver of potentially lower merchant acceptance of cash. Concern for the working conditions of employees, including security and allergic reactions to metal coins, is also an influence according to this survey. But retailers also expressed concern about the potential impact on customer satisfaction and sales of not accepting cash. (Swedish retailers indicated that a recommendation to discontinue cash acceptance from a relevant organization, such as the retailers' association, or from a government authority, would carry great weight in their eventual decisions.)

As noted, Swedish merchants report a greater interest than Canadian merchants in moving toward not accepting cash as a means of payment in the future. This difference might be partly explained by the different card payment schemes that consumers have been adopting in these two countries. As discussed above, in Sweden, consumers have been moving away from cash and toward debit cards for P2B payments, while in Canada, consumers have been moving toward mostly credit cards for P2B payments (Erlandsson and Guibourg, 2018; Henry, Huynh and Welte 2018). Given that debit cards tend to be less expensive for merchants than credit cards are (due to, e.g., lower interchange fees on debit cards), it is perhaps not surprising that merchants in Sweden report a greater willingness to move away from cash acceptance than merchants in Canada.³⁷

The development of payment card readers that can be attached to mobile devices, such as Square in Canada and iZettle in Sweden, are also likely to lead to increasing merchant card acceptance. In particular, these devices allow merchants without regular store fronts and associated payment infrastructure, (e.g., pop-up stores, kiosks at festivals, craft and farmers' markets) to accept payment cards through mobile phones. (There is no comprehensive payments data currently available on how these devices may have affected cash use.)

3.4 Online commerce and digital economy

A development that has the potential to further reduce cash use is online commerce and the growth of the digital economy. For online purchases, the most common payment methods are credit cards and debit cards, and cash is typically not accepted. In Canada, 69 percent of survey respondents in the 2017 MOP Survey made purchases online using a credit card or an online payment account (e.g., PayPal) in the month preceding the survey. And according to the Digital Economy Survey conducted by Statistics Canada, nearly 80 percent of Canadians aged 18 and above reported purchasing (or using free versions of) digital products such as music and video streaming services, e-books, online games, mobile applications and computer software between July 2017 and June 2018.³⁸

In Sweden, according to the Riksbank's 2018 payment survey, 56 percent of respondents purchased goods or services online in the preceding month and 60 percent have used mainly a debit card or credit card for the online purchase. Online commerce is expected to continue growing, which is likely to further reduce cash use for transactions in both countries.

3.5 Summing up

The value of small-denomination bank notes in circulation has been declining consistently relative to GDP for many years in both Canada and Sweden. This decline corresponds with

³⁶ The fact that many merchants indicated they were planning to stop accepting cash in coming years seems consistent with recent anecdotal evidence that it is becoming more difficult to find stores in Sweden that accept cash.

³⁷ For the costs of debit cards and credit cards to merchants in Canada and Sweden, see Kosse et al. (2017) and Segendorff and Jansson (2012), respectively.

³⁸ For more, see Statistics Canada [Digital Economy Survey](#).

the finding that the use of cash for point-of-sale payments has been steadily decreasing in both countries, in absolute terms and as a share of payments, as Canadians and Swedes have increasingly relied on debit cards and credit cards. In Canada, the use of contactless payment cards has also grown quickly in the past few years and is likely to reduce cash use further, particularly for small-value point-of-sale transactions. In Sweden, contactless cards are still in the introductory stage, but they are likely to gain popularity rapidly, as has been the case in Canada. Other recent payment innovations are similar in the two countries, notably Interac e-Transfer in Canada (since 2001) and Swish in Sweden (since 2012), which have also contributed to reduced cash use in both countries, especially for P2P payments.

The use of cash versus other payment methods depends on both the consumer and merchant sides of the market. In practice, merchants tend to offer a range of payment choices that reflect their perceptions of consumer preferences, in order to maximize sales, conditioned by the costs of accepting different methods of payment. As a result, consumers drive the observed utilization of various payment methods over time, with merchant acceptance of different methods largely reactive in a competitive market. At the same time, as consumer preferences evolve (e.g., use less cash), merchants are more likely to move away from accepting cash, further discouraging consumers' use of cash. (For more on such interplay in the two-sided payment market, see Fung, Huynh and Kosse 2017, and Arvidsson, Hedman and Segendorf 2018.)

In sum, the long-term downward trend of small-denomination bank notes relative to GDP in Canada and in Sweden reflects declining transactional demand for cash in both countries, driven by the adoption of a range of similar retail payment innovations. And this trend is expected to continue. At the same time, merchant acceptance of cash has been (to this point) nearly universal in both Canada and Sweden. Since the end of the Second World War, transactional demand for cash in Sweden has declined more than that in Canada and is now at a very low level. However, our analysis suggests that payment innovations and their diffusion as well as merchant acceptance of cash have been similar in both countries. Accordingly, considerations related to such factors cannot explain the differences in aggregate cash-to-GDP trends in these two countries, particularly over the last decade or so. Next, we focus on non-transactional demand for cash to better understand this cross-country difference.

4. Larger-denomination notes and non-transactional demand for cash

The preceding section is concerned with the demand for cash used for purchases—that is, transactional cash demand. But bank notes can also provide a way to store value: cash is essentially free of credit risk, maintains its (nominal) value over time, can be exchanged at a later date for other assets, or used to purchase goods and services, without penalty. And large-denomination bank notes are a better (more efficient) store of value than small denominations. Indeed, holdings of large-denomination notes are usually considered to be motivated mainly by store-of-value considerations, rather than by payment needs, since the larger value of the notes makes them generally unsuitable for day-to-day transactions and comparatively more useful as a store of value. This perspective has probably become increasingly relevant over time as various technological payment innovations displace cash used for transactions.

This section argues that understanding the influences driving non-transactional—or store-of-value—cash demand is important for explaining the different experiences of Canada and

Sweden when it comes to the evolution of aggregate cash-to-GDP over recent decades. These influences are discussed in the rest of this section.³⁹

4.1 Store of value and a hedge against crisis

One aspect of holding larger notes as a store of value is related to increased demand during periods of political turmoil, recession or financial crisis, when such notes provide a safe store of “outside money”—in contrast to the “inside-money” balances held in the banking system.⁴⁰ For example, the financial crisis that began in 2008 appears to have had an incremental impact on the demand for cash in the most-affected countries; this is also evident in Chart 3a. More specifically, Bech et al. (2018, 77) show that the ratio of cash to GDP increased in advanced economies following the financial crisis, and they find a structural break in cash demand in 2007–08 for advanced economies (but not for emerging-market economies). They conclude that “the continuing demand for cash has been especially noticeable in advanced economies since the start of the great financial crisis, and is likely driven by store-of-value motives rather than payment needs.”

Similarly, as discussed in Engert, Fung and Hendry (2018), the case of Iceland is especially striking and informative in this context. Between 2008 and 2010 Iceland experienced what could reasonably be considered a financial system collapse, when all of its major banks and savings banks failed (Kristinsson 2012). While significant government intervention aimed to mitigate the severe economic costs of the crisis, GDP nevertheless declined by over 11 percent in the two years after 2008 (Guðmundsson 2016). In that environment, the demand for bank notes—particularly large-denomination notes—briefly increased significantly, until government interventions stabilized the payment and banking system. And the ratio of cash to GDP in Iceland has remained elevated, as it has in almost all other countries affected by the 2008 financial crisis.

Similar influences on the demand for large-denomination bank notes in Sweden are apparent during the post-war period. For example, as shown in Figure 5b, demand for large-value notes relative to GDP increased with the erosion and collapse of the Swedish post-war economic policy framework in the 1970s. This culminated in economic crisis and repeated devaluations of the krona in the late 1970s and early 1980s, along with significant structural adjustments and political changes. Elevated holdings of large notes were generally sustained through the 1980s. There were also significant increases in total tax wedges in Sweden during the 1970s, which corresponded with significant income redistribution efforts (Du Reitz, Johansson and Stenkula 2015).⁴¹ Higher taxation, in turn, could also have encouraged activity in the underground economy and associated cash demand, which is discussed in Section 5 below.

As part of the associated policy adjustments following these events, financial liberalization in the 1980s led to a subsequent credit boom, especially in real estate-based lending. This, in turn, in the context of weak banking regulation and supervision, culminated in a severe

³⁹ The arguments in this section should be seen as suggestive and not conclusive. More definitive conclusions require more rigorous empirical examination, also drawing on other countries’ comparative experiences, which is left for future research.

⁴⁰ For a discussion of outside and inside money, and related motivations, see, e.g., Engert, Fung and Hendry (2018), especially Appendix 1 of that paper.

⁴¹ The marginal tax wedge on labour income includes marginal income taxes, marginal social security contributions and marginal payroll taxes. According to Du Reitz, Johansson and Stenkula (2015, 36), “tax wedges peaked around 1980 when the top marginal tax wedge and the marginal tax wedge for the high-income earner could reach 90 percent...The major tax reform in 1990–1991 decreased the marginal tax wedges to levels that prevailed before [the 1970s].”

financial crisis in the early 1990s.⁴² (For more on these developments, see Carlgren 2015; Hogan 2010; Honkaphoja 2012; Schon 2008; and Wikfalk 1998).

In response to the banking crisis in the early 1990s, Swedish authorities initially responded in a piecemeal, ad hoc fashion. As the threat grew, however, policy-makers responded more aggressively to prevent a financial collapse. This ultimately included various supports for Swedish banks and the introduction in September 1992 of a blanket guarantee protecting depositors and other bank counterparties from loss. This was backed by open-ended funding for the Bank Support Authority created by the Swedish Parliament (Honkaphoja 2009; Jonung 2010). These formal banking system guarantees lasted until 1996. Sweden's response was ultimately widely regarded as a successful model of financial crisis management (see, e.g., Anderson 2009; Ergungor 2007; and Ingves and Lund 2008). Corresponding to these events, larger notes-to-GDP held as a store of value stabilized but continued at an elevated level through this period (Figure 5b).⁴³

During the 2008 global financial crisis, in contrast to the experiences of other countries, the demand for larger notes in Sweden increased only marginally and briefly. In fact, the value of 1,000-krona notes in circulation continued to decline throughout 2008 and 2009. Notably, following the lessons of the early-1990s banking crisis, Swedish authorities intervened promptly and aggressively to protect the financial system and inside-money balances. In October 2008, Swedish authorities introduced a comprehensive set of measures that provided state support to financial institutions and their creditors. These included liquidity assistance at short and longer maturities in SEK and in foreign currencies, guarantees of medium-term market debt issuances (which reached 10 percent of GDP), a bank-recapitalization scheme, increased deposit guarantee coverage, and a general stability fund to support other government interventions in the financial sector (Becker, Bryant and Henderson 2012; IMF 2011; and Jochen 2010). A central part of that program was legislation that gave the Swedish government unlimited fiscal powers to finance measures needed to ensure financial system stability, through guarantees, capital injections or other means. Distinguishing features of the Swedish crisis response were its promptness and thoroughness, as well as public transparency regarding both objectives and actions.

Senior Swedish officials have been clear that “a crucial lesson from the Nordic experience is the need for prominent state involvement in crisis resolution” (Ingves and Lund 2008, 21). Transparency is also seen as critical, including informing the public about official plans and actions. Finally, “there is also a role for a blanket guarantee to restore confidence and prevent bank runs and a potential financial meltdown” (Ingves and Lund 2008, 23).

It follows that Swedish authorities have demonstrated twice in the last 25 years comprehensive and transparent protection of the Swedish banking system and deposits under severe stress. And since the 2008 financial crisis, a new open-bank resolution framework has been established in Sweden for systemically important financial institutions (Riksgalden 2018b). Under this (bail-in) arrangement, Swedish authorities will take control of a systemically important institution that is deemed to be not viable. Furthermore, to avoid the broader adverse externalities from the closure of a systemically important bank, the

⁴² Along with Sweden, two other Nordic countries, Finland and Norway, also experienced a systemic financial crisis in the early 1990s (Honkaphoja 2009, 2012). All four of the Nordic countries also provided public support to their banking systems in this environment. In Finland, Norway and Sweden, public support was significant, while in Denmark this support was small (Honkaphoja 2009).

⁴³ The 500-krona note was introduced in 1985, and initially this note appears to have substituted for 1,000-krona notes as a store of value and the 100-krona notes for transactions. (Given persistent inflation in Sweden from the 1970s into the 1990s, the 500-krona note became more suitable for transactions during that period.)

institution will be kept open and functioning as usual so that depositors will have uninterrupted access to their accounts and other financial services.

These experiences and associated policy statements may have provided a disincentive for Swedes to hold cash as a store of value, and, in particular, larger bank notes (500-krona and 1,000-krona notes), as a hedge against crisis. In sum, there may be an expectation that, in periods of severe crisis, most deposits (inside money) will be secured by the actions of public authorities, thereby reducing the need for cash (outside money) as a hedge against crisis.⁴⁴

Canada has had comparatively little experience with banking crises, although Canadian authorities deployed several measures supporting bank liquidity in response to the 2008 global financial crisis (Zorn, Wilkins and Engert 2009). As well, Canadian authorities have established a broad range of powers and policies to manage such events, also including an open-bank (bail-in) resolution framework for the major Canadian banks (Engert, Fung and Hendry 2018, Appendix 2). But there have not been repeated demonstrations of such intervention powers as in the Swedish experience.

4.2 Cashless bank branches

As noted above, larger bank notes in both Canada and Sweden are handled mainly in bank branches. Therefore, the ease of accessing cash services from branches influences the holding of larger notes as a store of value. As shown in Figure 4b, there are significantly more bank branches per capita in Canada compared with Sweden (roughly 50 percent more).⁴⁵ The number of branches in Sweden began to decline following the 2008 financial crisis, as branch network rationalization has been part of broader cost-reduction efforts by Swedish banks. Further, many bank branches in Sweden have become cashless in recent years. That is, no cash services on demand are available at such branches, and at the minority where cash services are available, advance notice is required. Moreover, Bankomat has been installing ATMs in cash centres that are located in shopping malls instead of at bank branches to facilitate cash withdrawals for shopping. As a result, bank branches in Sweden are increasingly without any cash access at all, including without on-site ATMs.

Cashless bank branches in Sweden started in 2010 as a cost-reduction measure of the banks and have spread rapidly. In 2010, about 10 percent of Swedish branches became cashless, around 40 percent were cashless in 2012, and by 2016, 60 percent of Swedish bank branches were cashless.⁴⁶ And it is likely that this proportion has increased further since then. For instance, the exchange at bank branches of new Swedish banknotes for older, invalid series starting in 2015 was finished in 2017 (see below), which reduced ongoing demand for cash services and the banks' incentives to supply them after that point. The increasing share of cashless bank branches is also reflected in Swedish banks' cash holdings, which declined from SEK 9 billion at the end of 2010 to less than SEK 2 billion at the end of 2018. This trend to cashless branches probably has inhibited access to the largest bank notes in particular—that is, 1,000-krona notes.⁴⁷ In this regard, the value of 1,000-krona notes in circulation dropped from over SEK 21 billion in 2012 to SEK 10 billion in 2013, and to just

⁴⁴ A similar proposition arguably might apply for some other advanced economies, but perhaps has been less clearly demonstrated in practice than has been the case in Sweden.

⁴⁵ And there is some evidence that bank branches in Canada are becoming (even) more central to major Canadian banks' retail business strategies. See, e.g., T. Kiladze, "[TD Bank's Radical New Strategy](#)," *The Globe and Mail*, December 2, 2018.

⁴⁶ See Swedish Bankers Association [Bank and Finance Statistics](#) and Statens Offentliga Utredningar (2018).

⁴⁷ According to Bankomat, note denominations up to 500 krona are usually available in Swedish ATMs, subject to withdrawal limits set by each bank.

over SEK 3 billion in 2018. Further, this friction has been exacerbated by increasingly stringent anti-money laundering (AML) provisions.

As noted, the Swedish Bankomat ATM network (discussed above) provides for access to most smaller-denomination notes, so cashless branches are not a significant constraint on access to transactions cash. Instead, they appear to generate a friction inhibiting access to large-denomination, store-of-value notes in Sweden, particularly since 2010. In addition, as noted above, ATMs in Sweden are mainly for cash withdrawals, and only specific deposit machines accept cash deposits. Thus, together with the increasing number of cashless branches, it has becoming increasingly difficult to deposit cash, which could discourage the acceptance of cash in general.

Cashless branches could also inhibit merchants' willingness to accept cash at point-of-sale, given the increased cost to merchants of cash management arising from the proliferation of cashless branches. (This might especially affect small and medium-sized merchants.) For example, merchants that accept cash need to keep a sufficient amount of small denominations (e.g., 20-krona and 50-krona notes) on hand for change. Since Swedish ATMs do not dispense such small denominations, merchants must find a branch that provides cash services or they risk not having sufficient change. And to deposit cash received during the day, in the absence of a suitable bank branch that accepts cash or has a drop-off box, merchants increasingly depend on the services of cash-in-transit companies to deliver deposits and to obtain change—which increases merchants' cost of accepting cash. Indeed, Swedish authorities have identified the limited access to deposit services as a problem for businesses (Statens offentliga utredningar 2018).

As noted above, there are significantly more bank branches per capita in Canada than in Sweden, and almost all Canadian bank branches provide cash services on demand. In the last few years, some of the major Canadian banks have introduced branches that focus exclusively on the provision of financial advice and sales to consumers. This includes providing mortgages and other lending, investment and wealth management, as well as business services for small and medium-sized firms. These “financial-advice centres” do not provide any cash services over the counter (teller) but could provide access to cash through on-site ATMs. To date, such bank branches without over-the-counter cash services are relatively unusual in Canada, but they could be under consideration more generally by the major banks.

For example, it appears that 18 percent of the branches of one of the major Canadian banks are now cashless or tellerless (i.e., no cash services are provided at the counter), based on information collected online. ATMs are present at these branches and can dispense a range of bank notes, including \$100 notes, and accept deposits including stacked cash and cheques. As well, daily ATM withdrawal limits can be increased when needed, including to satisfy individual customer requests arranged on the spot with branch staff or in advance via telephone banking. More generally, ATMs in Canada increasingly provide consumers with a range of choice about the denomination of notes dispensed in ATMs, up to and including \$50 notes. Some banks are also considering stocking their ATMs with \$100 notes. As a result, , in contrast to the Swedish case, there do not seem to have been meaningful frictions inhibiting access to large-denomination notes in Canada due to cashless bank branches. However, some variant of cashless branches could proliferate in Canada in the future.

The evolution of cashless bank branches seems to reflect interactions characteristic of a two-sided market, similar to that discussed above concerning payment methods. More specifically, customer preferences regarding access to cash (e.g., over-the-counter versus ATMs, choice over denominations, etc.) are the fundamental drivers in a competitive banking

market, with banks responding strategically to these evolving customer preferences. At the same time, banks' decisions about access to cash, which are also influenced by cost considerations, can consolidate or reinforce the underlying trends in access to cash driven by customer preferences. (If, however, the banking market is not competitive or banks collude in this respect, then consumer preferences would be less dominant.)

4.3 Legal tender provisions

In Sweden, when a new series of bank notes is issued, the old series becomes invalid and loses its legal tender status after a certain terminal date. Loss of legal tender status appears to be a relatively frequent event in Sweden, occurring a few times since 1987 (Table 1). For example, many older series of bank notes, including most denominations of notes that were issued between 1890 and 1962, became invalid after December 31, 1987. Moreover, legal tender status of almost all note series that were issued between 1963 and 2000 became invalid either on December 31, 1998, or on December 31, 2005. Prior to 2015, the terminal date for old notes tended to vary over time and was usually several years after the issuance of a new series. However, when the latest series of bank notes were issued in 2015 and 2016, old series of bank notes became invalid in less than one year. For example, new 1,000-krona notes were issued on October 1, 2015 and all of the old 1,000-krona notes (first introduced in 2006) became invalid after June 30, 2016. Since the new notes differ from the old notes, both in design and size, the short exchange period was intended to help reduce costs to banks and the public that could arise from having different sets of notes in circulation.

To redeem old bank notes *before* they become invalid, note holders must exchange them at a bank branch offering cash services, which, as noted above, are becoming increasingly difficult to find. In practice, to facilitate the introduction of new notes, banks in some cases continued to accept invalid notes for a period after the official terminal date (consistent with an understanding between the Riksbank and the banks).⁴⁸ To redeem old bank notes *after* the exchange period, note holders must mail their notes to the Riksbank to obtain a corresponding deposit into their bank accounts. There is a fee of SEK 100 for each such exchange transaction, and applicants must provide certain attestations to the Riksbank. That is, note holders must explain how they acquired the notes, and why the notes were not used for transactions nor exchanged while they were legal tender.⁴⁹ The Riksbank may also ask for additional documentation when considering the application, particularly the amount. This process applies to all holders of Swedish bank notes, including foreign note holders.⁵⁰ As a result, in addition to generating cost and inconvenience for note holders, these exchange provisions undermine the maintenance of privacy of cash holdings—a particular (and legitimate) motivation for holding bank notes as a store of value. Further, these frictions appear to have been growing more severe over time in Sweden. For example, as noted above, generally shorter (and variable) exchange periods have applied over time to more recent new note issuances.

⁴⁸ The 20-, 50- and 1,000-krona notes became invalid after June 30, 2016 but were accepted for exchange by banks for two additional months. Similarly, 100- and 500-krona notes became invalid after June 30, 2017 but were accepted for exchange by banks for an additional year.

⁴⁹ Additional information and requirements concerning redemption of invalid notes are available at the Sveriges Riksbank website ("[Redeeming invalid banknotes](#)"). These requirements reflect the increasingly stringent AML /CTF regulations in Sweden (e.g., people who deposit more than SEK 10,000 are required to account for the sources of the cash).

⁵⁰ From 2015 to 2018, the Riksbank received 220,662 note-exchange applications, worth over SEK 1 billion. The number of such applications has been increasing recently. In 2017, there were 63,723 such applications, and in 2018 there were 67,411. (These applications can also cover very old bank notes, e.g., notes issued in the early 1900s that were declared invalid in the 1980s.)

In sum, the frequency with which bank notes have been deemed invalid in Sweden over the last 20 years, and the burdensome exchange provisions in some cases, especially coupled with the decreasing availability of cash services at bank branches, has probably undermined the demand for cash, particularly larger notes, as a store of value. A notable example is the decline in 1,000-krona notes in circulation over the last two decades. After peaking in December 2001 at SEK 48.4 billion, the value of 1,000-krona notes declined gradually to SEK 21.4 billion in December 2012. Beginning in 2013, this decline accelerated, and the outstanding value decreased to SEK 9.7 billion by December 2013. Subsequently, this decline levelled off (see Box 1 for a detailed discussion of the experience regarding legal tender provisions affecting the 1,000-krona note).

In contrast to these Swedish legal tender frictions, all bank notes issued by the Bank of Canada remain legal tender. Recently, legislation has been passed to allow the Bank of Canada to change the legal tender status of a denomination of a series of bank notes. The current plan is to remove the legal tender status of certain denominations of notes that have long been discontinued and are no longer issued: \$1, \$2, \$25, \$500 and \$1,000 notes.⁵¹ There are no plans to remove the legal tender status of any other bank notes. Therefore, there are no legal tender frictions suppressing demand for larger bank notes in Canada.

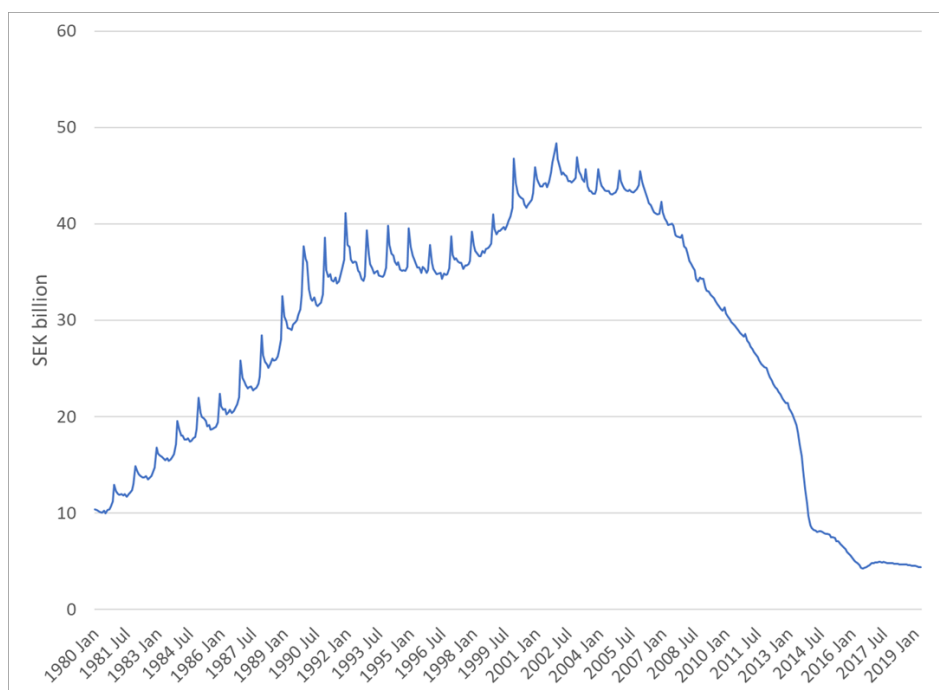
⁵¹ See upcoming changes to legal tender status for older bank notes at the [Bank of Canada](#).

Box 1: Additional information on legal tender provisions affecting the 1,000-krona note

The legal tender frictions associated with the issuance of new 1,000-krona notes in 2006 and again in 2015 appear to have contributed to the rapid decline of 1,000-krona notes, particularly in 2013 (Chart 1-A). With the introduction of the new 1,000-krona notes in 2006 (an improved note with a security foil strip), the 1,000-krona notes issued from 1989 to 1991 (without a foil strip) were scheduled to become invalid on December 31, 2013. (Similarly, the 50-krona note without foil strip was also deemed invalid after December 2013 and replaced.) Thus, holders of the old 1,000-krona notes had to exchange them for new notes at a bank branch before the end of 2013. In 2012, however, the Riksbank announced its intention to issue another new series of bank notes in 2015 and 2016, including another new 1,000-krona note, which would make all pre-existing series of bank notes invalid sometime after 2016. This could have had an impact on note holders' decisions to exchange their old 1,000-krona notes (no foil strip) for those issued after 2006 (with foil strip) before the end of 2013, which would become invalid sometime after 2016—or to simply exchange their old 1,000-krona notes (no foil strip) for bank deposits before the end of 2013.

Further, as discussed above, cashless bank branches started emerging in Sweden in 2010, and many bank branches (more than 40 percent of them) were cashless by 2012. The number of cashless branches has continued to grow, making it increasingly difficult to exchange old bank notes for new notes. As a result, the frequent replacement of 1,000-krona notes, combined with an increasing number of cashless branches, exacerbated the inconvenience and cost of exchanging outstanding 1,000-krona notes, likely contributing to the sharp decline in the circulation of these notes in 2013.

Chart 1-A: Value of 1000-krona notes in circulation (January 1980 – April 2019)



Source: Riksbank

4.4 Other considerations

(i) *Domestic demand for large-value foreign notes*

Canada and Sweden both have strong ties with much larger, influential neighbours: i.e., the United States and euro area economies, respectively. Have residents of the former increased their holdings of large-value foreign notes as a store of value? If so, this could reduce demand for larger domestic notes in favour of foreign notes. There appears to be little evidence that Canadians have been swapping large-value Canadian notes for US notes as a store of value.

Have Swedes dropped larger-value SEK notes in favour of euro note holdings as a store of value? If interpersonal trust or trust in Swedish institutions was very low in Sweden compared with major countries of the euro area, for example, Swedes might switch their holdings from large-denomination SEK notes to large euro notes or to deposits of major non-Swedish banks. The evidence, however, indicates that interpersonal and institutional trust in Sweden is consistently (and substantially) among the highest in Europe (Ortiz-Ospina and Roser 2018). And, as discussed above, Swedish authorities have gone to considerable lengths to provide for the robustness of their banking system under stress. More generally, there seems to be little evidence that Swedes have been swapping their large-value SEK notes for large euro notes as a store of value.

(ii) *Foreign demand for large-value domestic notes*

Some anecdotal evidence suggests an increase in foreign demand for large-denomination Canadian bank notes in recent years, but this is not well understood (Flannigan and Parsons 2018). The strong increase in demand for Canadian notes after the 2008 global financial crisis, especially for larger denominations, could reflect diversification of foreign demand toward a relatively stable financial system. As the global financial system continues to stabilize over time, this demand might dissipate.

In addition, the steady growth of immigrants, international students and tourists coming to Canada might have also contributed to increased foreign demand for Canadian bank notes. For example, the number of immigrants to Canada increased from 248,748 in 2011 to 286,479 in 2017.⁵² The top three source countries for immigrants were India, the Philippines and China, accounting for 43 percent of all immigration in 2017, for example. Also, the number of international students studying in Canada has been increasing at a steady rate over the last two decades, and the increase has accelerated since 2008—09.⁵³ In 2016–17, international students totalled 245,895, accounting for 12 percent of total enrolments in Canadian post-secondary institutions. Over 50 percent of the international students in Canada are from Asia, with China and India the most important source countries. Finally, the number of international tourists visiting Canada has been increasing steadily since 2009, with over 6.5 million tourists from countries other than the United States in 2017. Historically, these travellers have come predominantly from Europe. However, Europe's share of overseas travellers has declined while the number of Asian tourists has doubled (2.3 million in 2017) since 2009.⁵⁴

Notably, China and India, two of the main source countries for immigrants, international students and tourists coming to Canada, have imposed capital controls, including restrictions

⁵² See [Annual Report to Parliament on Immigration by Immigration, Refugees, and Citizenship Canada](#), various years.

⁵³ For details, see Statistics Canada, "International Students in Canadian Universities" and "Canadian Postsecondary Enrolments and Graduates, 2016/2017."

⁵⁴ See Statistics Canada, "The Evolution of Canadian Tourism, 1946 to 2015" and "Travel Between Canada and Other Countries, December 2017."

on the purchase of foreign currencies by their nationals. For example, Chinese citizens are allowed to purchase foreign currencies in amounts equivalent to up to US\$50,000 per person, per year. (While this annual allowance would seem adequate for most peoples' overseas travel needs, it might not be sufficient for major investments overseas, such as purchasing a property.) Also, Chinese visitors to Canada are likely to hold some Canadian bank notes when entering Canada for convenience and wide acceptance, particularly since Chinese citizens have had limited access to major global card companies' products. (However, "China UnionPay" cards, the main debit and credit cards accessible by Chinese nationals, are increasingly accepted in Canada.) Also, international students and immigrants from China might acquire Canadian bank notes before arriving in Canada so that they can make purchases until they have set up a domestic bank account.

Sweden also has experienced substantial immigration in recent decades, as indicated by the 2.4 million residence permits granted between 1980 and 2018, of which nearly half were granted after 2008.⁵⁵ Roughly one-quarter of the latter were granted for asylum reasons, one-quarter for labour market reasons (i.e., pursuing work opportunities) and one-third were family unifications.⁵⁶ Ten percent of the residence permits were issued to students, foremost from China and India. (European Union citizens moving to Sweden are not included in these data.) As well, there has been labour immigration from some Eastern European countries following their accession to the European Union in 2004.⁵⁷ In sum, most immigration to Sweden in recent decades has been from cash-intensive countries, and this might have increased the demand for cash, at least for a period before the immigrants adapt to local Swedish practices. There is, however, no concrete evidence supporting this perspective. Indeed, the rapid decline of cash demand in Sweden in recent years seems to suggest that this influence has been negligible.

Likewise, there are no data on the holdings of Swedish bank notes abroad, for example, in immigrant countries of origin. Some insight might be gained from the invalid bank note exchange applications sent to the Riksbank in 2015 and subsequent years: Around 15 percent of all such applications are made by foreign citizens, often from Eastern Europe. If these numbers are representative of the distribution of SEK notes generally, then there could be almost SEK 1 billion held abroad.⁵⁸ Even if foreign SEK holdings were somewhat higher than this estimate, they would still be a relatively low amount compared with the total demand for cash and would not likely have had a significant effect on the demand for high- or low-denomination notes.

In sum, an increase in foreign demand for Canadian bank notes might have contributed to the strong demand for large-denomination notes in recent years. While there are some possible explanations for this increase in foreign demand, as noted above, this is not well understood. A better understanding of the foreign demand for cash requires better data (including, e.g., data on the shipment of Canadian bank notes overseas), along with more rigorous analysis of foreign sources of demand.⁵⁹

⁵⁵ Statistics on granted permits can be found at [Swedish Migration Agency](#). (More detailed statistics are available in Swedish.)

⁵⁶ The most common countries of origin for refugees were Syria, Afghanistan, Eritrea, Somalia and Iran. For family unification, main source countries were Syria, Iraq, Afghanistan, Eritrea and Somalia. And major source countries for labour market reasons were India, Thailand, China, Albania and Turkey.

⁵⁷ Most of this labour came from the Baltic states and Poland.

⁵⁸ At the end of 2018, SEK 5.5 billion in invalid notes were in circulation. Fifteen percent of this is close to one billion.

⁵⁹ For example, it would be useful to understand whether people from a cash-oriented country are more likely to accumulate and carry foreign bank notes when travelling overseas or when immigrating to another country. Kosse and Jansen (2013) find that first-generation migrants from a number of countries that can be seen as cash-oriented are more likely to use cash in the Netherlands.

4.5 Summing up

The divergent trends of cash demand in Canada and Sweden since 2000 have been driven largely by developments affecting larger notes—that is, \$50 and \$100 notes in Canada, and 500-krona and 1,000-krona notes in Sweden. Several influences together appear to have led to reduced demand for larger, non-transactional notes in Sweden.

Sweden’s crisis-management experience may have created incentives that discourage reliance on large notes as a hedge against uncertainty. In addition, the proliferation of cashless bank branches and the operation of Swedish legal tender rules appear to have created frictions that inhibit holdings, especially of larger Swedish notes. At the same time, foreign sources could have generated increased demand for large-denomination Canadian bank notes in recent years (which could diminish over time). Taken together, these various influences and frictions help to explain relatively low demand for store-of-value cash in Sweden compared with Canada. (Recently, there has been a modest uptick in holdings of 500-krona notes; see Box 2 for more on this.) More definitive conclusions require further empirical examination, drawing also on other countries’ experiences, which is left for future research.

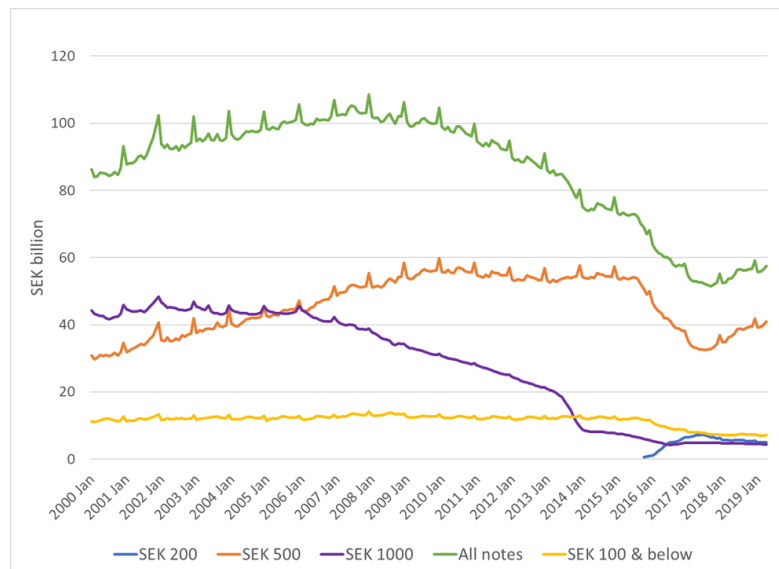
Box 2: Recent developments affecting the 500-krona note

Since late 2017, there has been an increase in the (absolute) value of bank notes in circulation in Sweden, driven by an increase in 500-krona notes (see Chart 2-A below). (This has had little discernable impact on the value of 500-krona notes relative to GDP.) The reasons for this modest reversal are not entirely clear, but it likely reflects a buildup of cash buffers of households. One possible reason for this is a recent Swedish government initiative to *increase* reliance on cash as a hedge against crisis. To this end, an agency of the Swedish government (the Swedish Civil Contingencies Agency) provided every Swedish household a booklet entitled *If War of Crisis Comes* to help Swedish citizens be better prepared for a range of calamities, including serious accidents, extreme weather, information technology dysfunction and military conflict. The booklet also points specifically to disruptions in payment card and ATM networks. (See the [Swedish Civil Contingencies Agency website](#) for more information.) Accordingly, the agency recommends, among other things, that citizens hold a buffer of cash in small denominations at home, and it appears that Swedes have decided that 500-krona notes (which are available from ATMs) can address this need.

The crisis preparedness booklet was sent to households in May 2018, but news about its circulation and its key recommendation were publicly available since at least January 2018. (See, for example, “[What If War Comes](#),” in *The Irish Times*, January 18, 2018.) The authorities also previously posted the key recommendation on its webpage. A version of this booklet was issued regularly in Sweden during the Cold War, from 1943 to 1991. And Swedish authorities have been gradually increasing their focus on security policy over the last 10 years or so.

The recent build-up of this cash buffer could also reflect an element of involuntary cash hoarding by households and businesses, given the difficulty of depositing bank notes in Sweden (as discussed in the text). It is also possible that households did not fully restore their cash buffers to their desired level during the last bank-note exchange and have been gradually doing so recently in 500-krona notes.

Chart 2–A: Value of Swedish bank notes in circulation (January 1980 – April 2019)



5. Demand for cash and the underground economy

A connection is often made between the underground (or shadow) economy and cash. This section considers that connection and whether it plays a significant role in explaining the differences in the evolution of cash-to-GDP in Canada and Sweden.

5.1 Background

The focus here is the underground economy, in which the underlying activities and transactions are legal but are concealed from public authorities for a variety of reasons. Following Schneider (2016), we consider the underground economy as including market-based, legal production of goods and services that are concealed from public authorities largely to avoid one or more of the following:

- payment of taxes, such as income taxes or value-added taxes
- payment of social security contributions
- compliance with administrative procedures, such as completing statistical questionnaires
- certain labour market standards, such as minimum wage or safety requirements

Given the intent to conceal the benefits of the underlying activity, it seems reasonable to conjecture that cash, which provides for anonymity, is a preferred means of payment in the underground economy. As a result, one could expect that changes in the size of the underground economy might help explain cash demand over time.

While the preceding provides a straightforward conceptual definition, reliably measuring the size of the underground economy is, of course, challenging. Further, there are typically large discrepancies in estimates depending on the empirical methodology used, and there does not appear to be a preferred or dominant approach to measuring the underground economy (Dunbar and Fu 2015; Medina and Schneider 2018).

In Canada, for example, Dunbar and Fu (2015) note that studies using discrepancies in national accounts to measure the amount of unreported income estimate the underground economy at about 3 percent of GDP, while studies using microeconomic consumption data result in estimates of around 5 percent. And studies based on macroeconomic data find that the size of the underground economy in Canada could be as much as 15 percent of GDP. Similarly, Dunbar and Fu (2015) use household-level income data and consumption data to estimate under-reported income, and they conclude that an upper bound of 14 to 19 percent of GDP is unreported in Canada.

With respect to Sweden, Guiborg and Segendorf (2007), using an unexplained-demand-for-cash approach, measure the size of the underground economy in Sweden to be 6.5 percent of GDP in 2006. In comparison, Medina and Schneider (2018), using macroeconomic and other data, estimate it at 11.1 percent in 2006.

Similarly large discrepancies across quantitative methods are evident for many other countries (e.g., Medina and Schneider 2018; Seitz, Reimers and Schneider 2018). In their review, Medina and Schneider (2018, 28) conclude, “There is no superior method [to measure the underground economy]. All methodologies, without exception, have their own advantages as well as weaknesses. If possible, one should use multiple methods [to draw

conclusions] ... Much more research is needed with respect to the estimation methodology and the results for different countries and periods.”⁶⁰

These authors also observe, however, that one stable conclusion from the evidence is that the size of the underground economy (relative to GDP) appears to have been generally declining across a wide range of economies (advanced and emerging) from 1991 to 2015 (interrupted only in 2008, likely due to the global economic crisis).⁶¹ Table 2 illustrates this aspect for Canada and Sweden.

Further, while it is reasonable to expect that the underground economy is relevant for explaining cash demand, in practice it is difficult to establish a meaningful empirical relationship between cash and measures of the underground economy. This appears to be the case across a number of countries and a variety of studies (Seitz, Reimers and Schneider 2018).⁶²

5.2 Swedish policy measures to reduce the size of the underground economy

Given concerns in Sweden about undeclared work and revenues, the Swedish Tax Agency has established several measures to reduce tax evasion in sectors with high cash turnover. A focus has been domestic services, such as home repairs, cleaning and home maintenance, where it is believed that such work traditionally has been undeclared to a significant extent (Swedish Tax Agency 2012). Accordingly, to reduce the prominence of the underground economy in Sweden and bring activity into the taxable, formal economy, tax deductions for 50 percent of the labour cost of certain domestic work were introduced in 2007 (for household services, so-called “RUT” provisions) and in 2008 (for home renovations, the “ROT” provisions). These measures provide tax incentives to pay for such services in the declared, formal economy, and therefore to discourage transactions in the underground economy.

These measures appear to have been effective in bringing some activity into the formal economy and reducing tax evasion (Swedish Tax Agency 2012). For example, surveys have indicated that, between 2006 and 2012, the proportion of citizens who know people who have evaded tax or participated in the underground economy during the preceding 12 months decreased significantly. More specifically, the proportion of respondents who know people who evaded tax decreased from 22 to 13 percent, and the proportion of respondents who know people working in the underground economy decreased from 38 to 22 percent. Swedish authorities consider these changes likely to be the result of the tax deductions described above for house repair and maintenance and for domestic work (Swedish Tax Agency 2012, 16)

The commercial sector has also been a focus for Swedish authorities, where there have been concerns about the manipulation of cash registers and associated under-reporting of revenues, particularly in businesses with high cash turnover (Eurofound 2013). Accordingly, starting in January 2010, businesses in Sweden selling goods and services for cash payments must use a certified cash register that includes a control unit (“black box”), which records transactions made by the cash register. Only the Swedish Tax Agency can access the sales and payment

⁶⁰ See also Schneider and Buehne (2017) for a related discussion.

⁶¹ This conclusion is based on a “Multiple Indicators Multiple Causes” (MIMIC) method to measure the underground economy. In MIMIC approaches, the shadow economy is formalized as the outcome of a multitude of measurable causes such as tax rates, the degree of regulation and the level of unemployment (Seitz, Reimers and Schneider 2018; Medina and Schneider 2018).

⁶² This is perhaps not surprising given the characteristics of cash (in particular, anonymity) and the nature of the underground economy (which is intended to be obscure).

records in the black box.⁶³ Analyses by the Agency (2013) indicate that this measure also appears to have reduced the extent of commercial tax evasion in Sweden.

5.3 Summing up

Given the outcomes reported by the Swedish Tax Agency (noted above), it follows that there would have been corresponding decreases in the size of the underground economy (other things equal) and cash demand in Sweden. Such outcomes would have contributed to the overall decline of Swedish cash-to-GDP during the last decade (discussed in earlier sections). On the other hand, given the considerable uncertainty in the measurement of the underground economy and its (empirical) relationship to cash demand, it is difficult to draw (strong) conclusions about the significance of these tax-policy measures in reducing cash demand in Sweden.

Moreover, as noted, numerous countries in the last 10 to 20 years have experienced a general trend of declining underground economies, including Canada. If this is correct, other (perhaps common) underlying factors might also be relevant. From this perspective, it seems unlikely that a declining underground economy in Sweden driven by tax changes explains the different experiences of cash-to-GDP in Canada and in Sweden.

6. Conclusions

Cash use for payments has been decreasing in many countries, including Canada and Sweden. However, notes in circulation relative to GDP in most countries, including Canada, have been stable for decades and even rising in recent years. In contrast, overall cash-to-GDP in Sweden has been falling steadily. To understand these outcomes, we focus separately on transaction (small-denomination) bank notes and store-of-value (large-denomination) bank notes.

Both Canada and Sweden have seen a long-term downward trend in small-denomination bank notes relative to GDP, reflecting declining transactional demand for cash in both countries. These outcomes have been driven by the adoption of a range of similar retail payment innovations. At the same time, merchant acceptance of cash has been (to this point) nearly universal in both Canada and Sweden. Therefore, neither payment innovations and their diffusion nor differences in merchant acceptance of cash are adequate to explain why aggregate cash demand has been declining rapidly in Sweden but not in Canada.

Instead, divergent trends in the demand for larger bank notes, typically used more as a store of value, seem to be the key to understanding the different overall cash-to-GDP trends in Canada and Sweden. More specifically, Sweden's crisis-management experience may have created incentives that discourage reliance on large notes as a hedge against uncertainty. In addition, the recent proliferation of cashless bank branches and the operation of Swedish legal tender rules appear to have created frictions that inhibit holdings of larger Swedish notes. These three influences work in the same direction to reduce demand for larger bank notes, and to some extent have probably reinforced each other to generate larger cumulative effects on cash demand over time. In Canada, some evidence suggests that foreign sources could have generated increased demand for large-denomination Canadian bank notes in recent years (which could diminish over time).

The analysis in this paper points to three broad lessons:

⁶³ Businesses bear the costs of installing and maintaining these monitored cash registers, and non-compliance is subject to fines levied by the Swedish Tax Authority.

(i) Policy interventions and bank resolution frameworks (e.g., bail-in) that credibly protect depositors (“inside money”) in financial crises reduce incentives to hold larger bank notes as a hedge against crises. Such interventions very likely are unavoidable in extreme (tail-event) financial crises and indeed are justifiable, particularly if the resolution framework is well-structured ex ante (as are some bail-in regimes). These considerations also suggest a reduced need for a central bank digital currency as a safe store of value in crises (as discussed in Engert, Fung and Hendry 2018).

(ii) Cashless bank branches create a friction inhibiting access to cash, depending on the ability of ATM networks to satisfy consumer demand for bank notes across a range of denominations and to provide adequate cash-deposit services, particularly for merchants. Given the need for merchants to manage relatively large volumes (and values) of bank notes, cashless bank branches can create disincentives for merchants to accept cash at the point of sale, which would inhibit the use of, and demand for, bank notes.

(iii) Legal tender rules, where old bank note series are declared invalid, create frictions that inhibit the demand for cash. The impact of such measures is stronger the more frequently these declarations occur and the more burdensome and variable the provisions are governing the exchange of old (invalid) notes for new notes. In that case, legal tender frictions can be expected to reduce the demand for bank notes, particularly as a store of value.

Finally, more work is required to better understand the demand for larger Canadian bank notes, including the role of foreign demand, which is left for future research.

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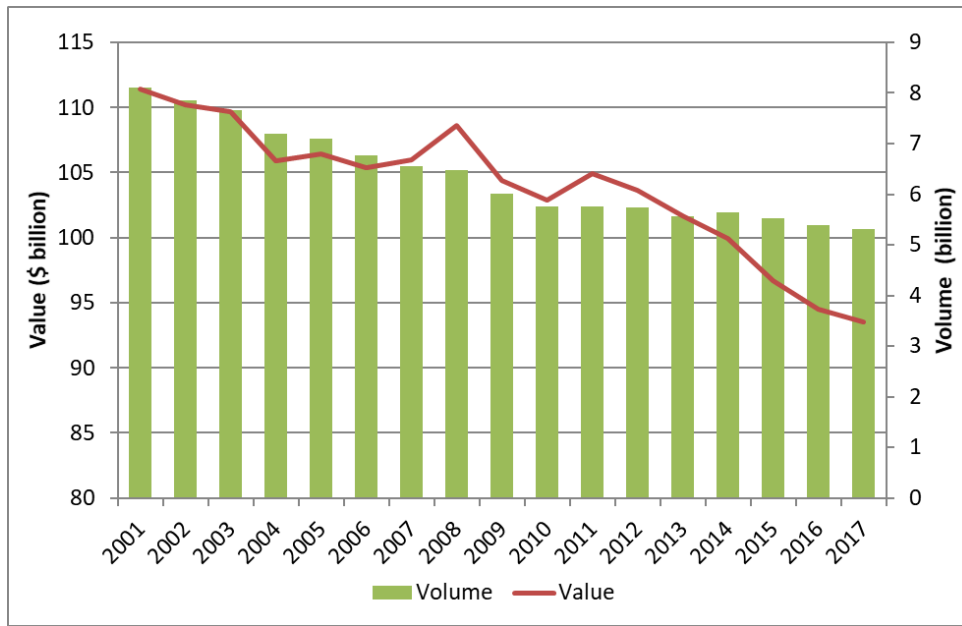
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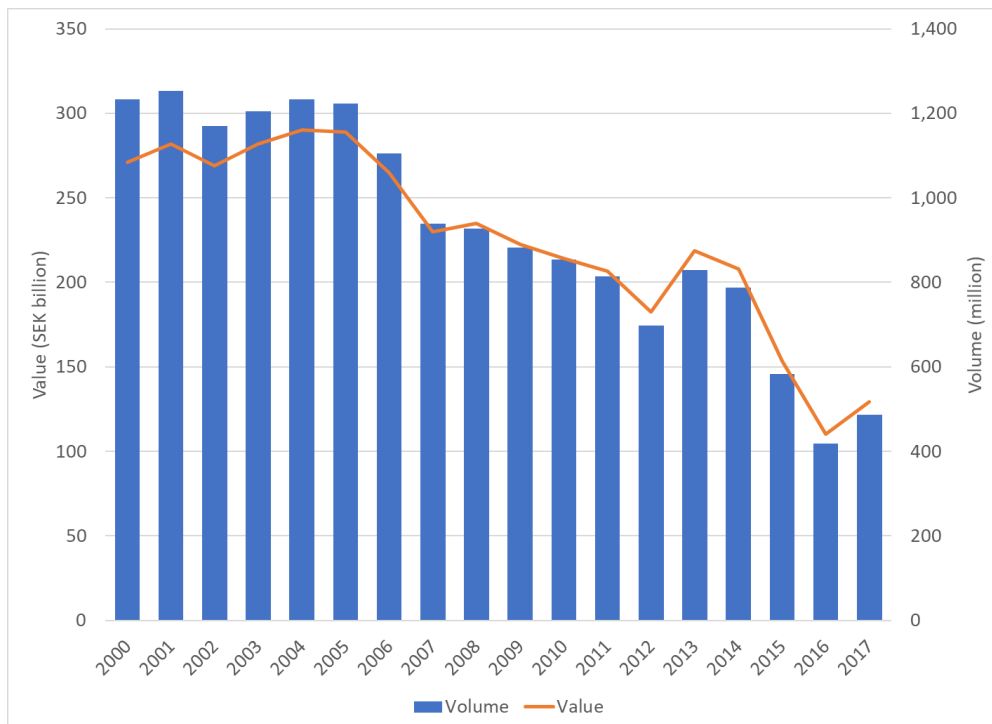
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Chart 1a: Number and value of cash transactions in Canada



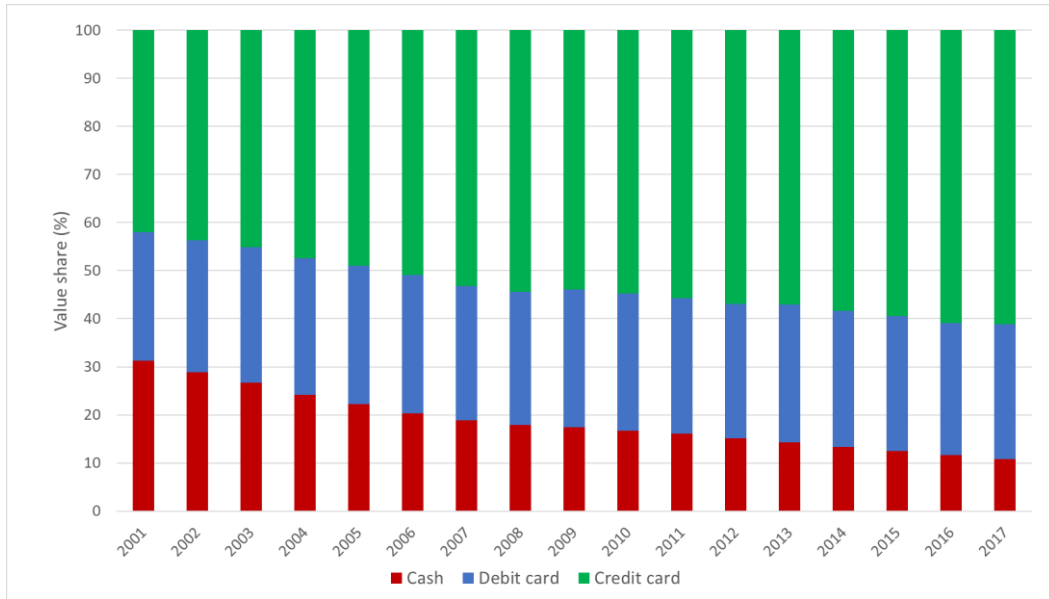
Sources: TSI International and authors' calculations.

Chart 1b: Number and value of cash transactions in Sweden



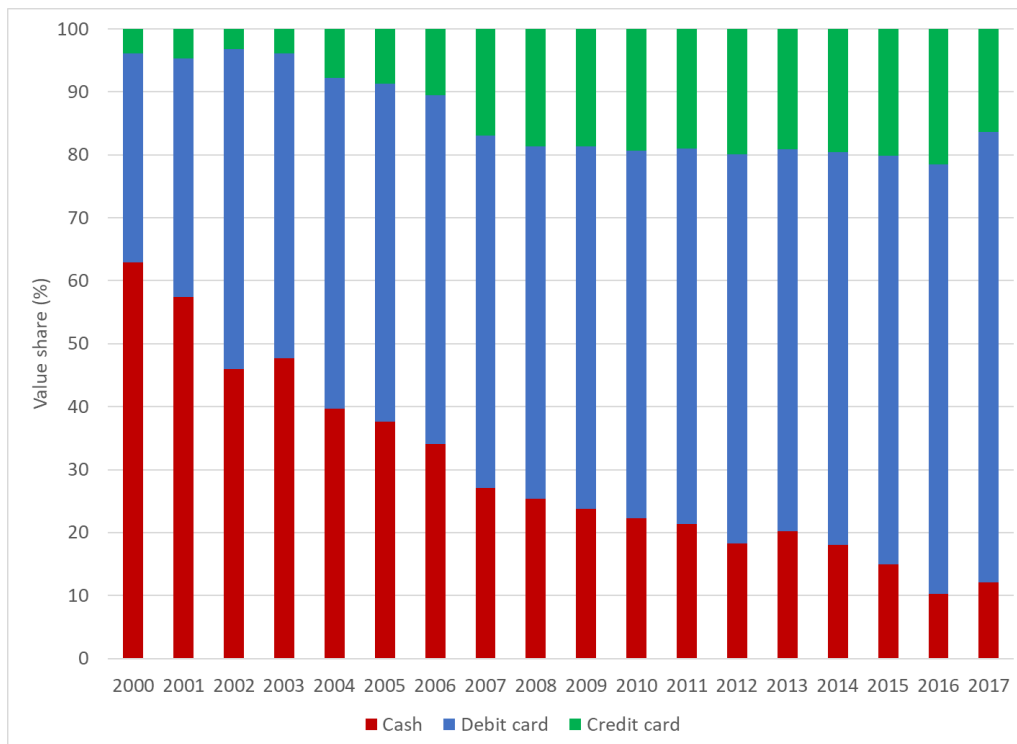
Sources: Bank for International Settlements and authors' calculations

Chart 2a: Value share of cash, debit card and credit card payments in Canada



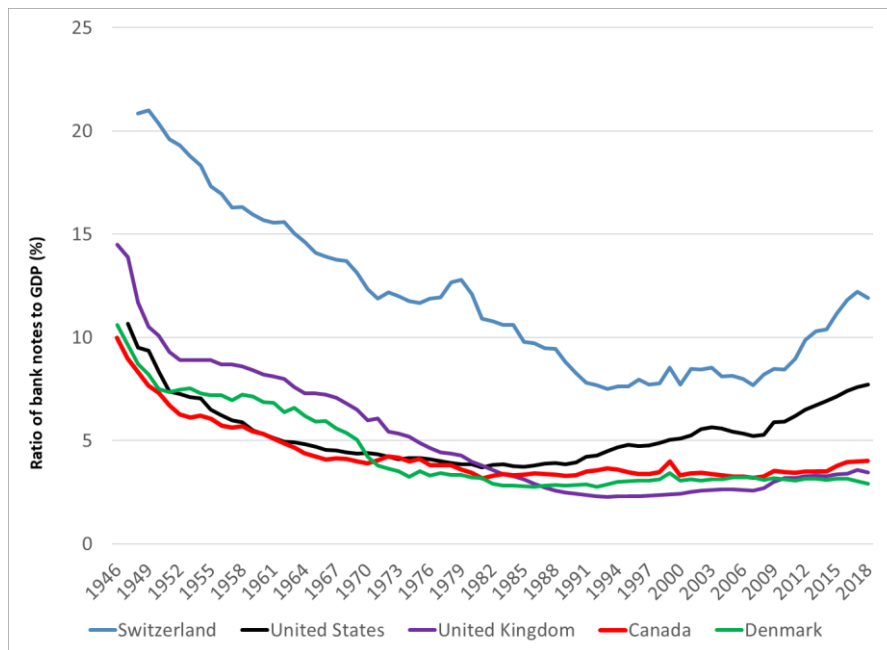
Sources: TSI International and authors' calculations

Chart 2b: Value share of cash, debit card and credit card payments in Sweden



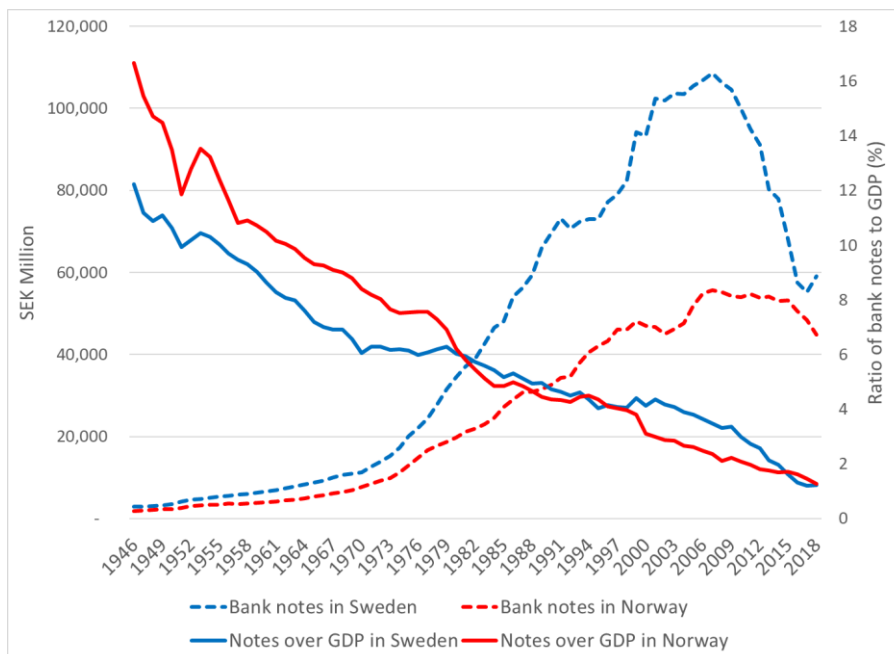
Sources: Bank for International Settlements; authors' calculations

Chart 3a: Bank notes as a ratio of GDP for selected countries (1945–2018)



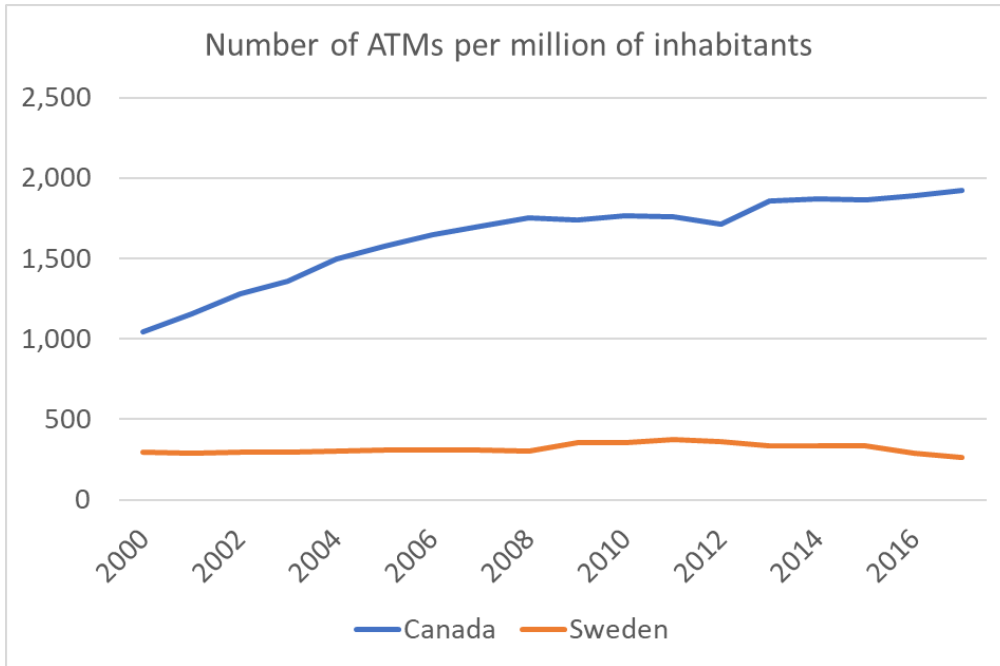
Sources: Bank notes data from central banks and GDP data from national account statistics in respective countries

Chart 3b: Bank notes as a ratio of GDP in Norway and Sweden (1945–2018)



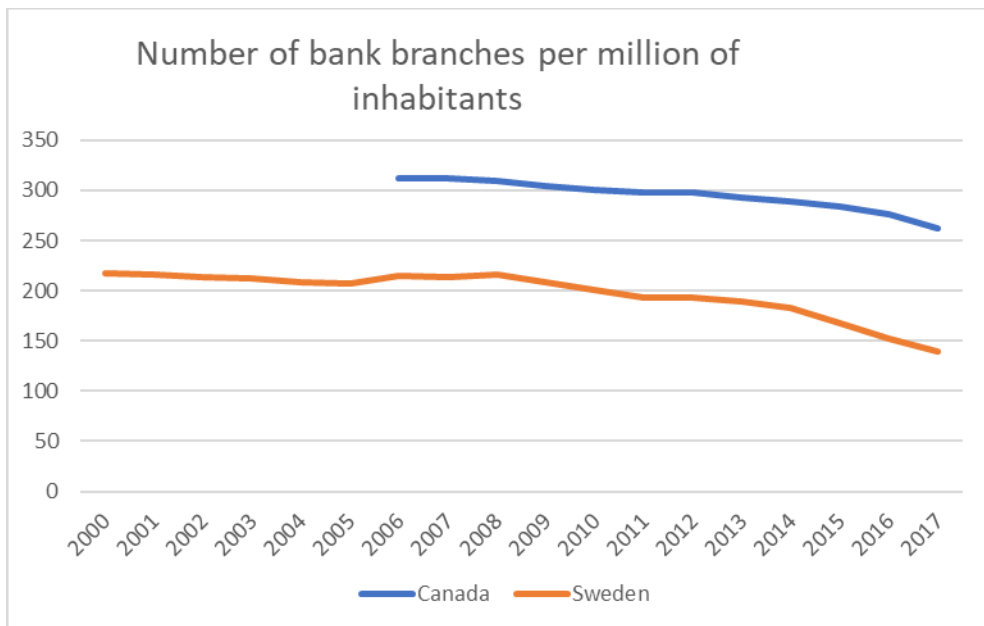
Sources: Sveriges Riksbank and Norges Bank

Chart 4a: Number of ATMs in Sweden and Canada



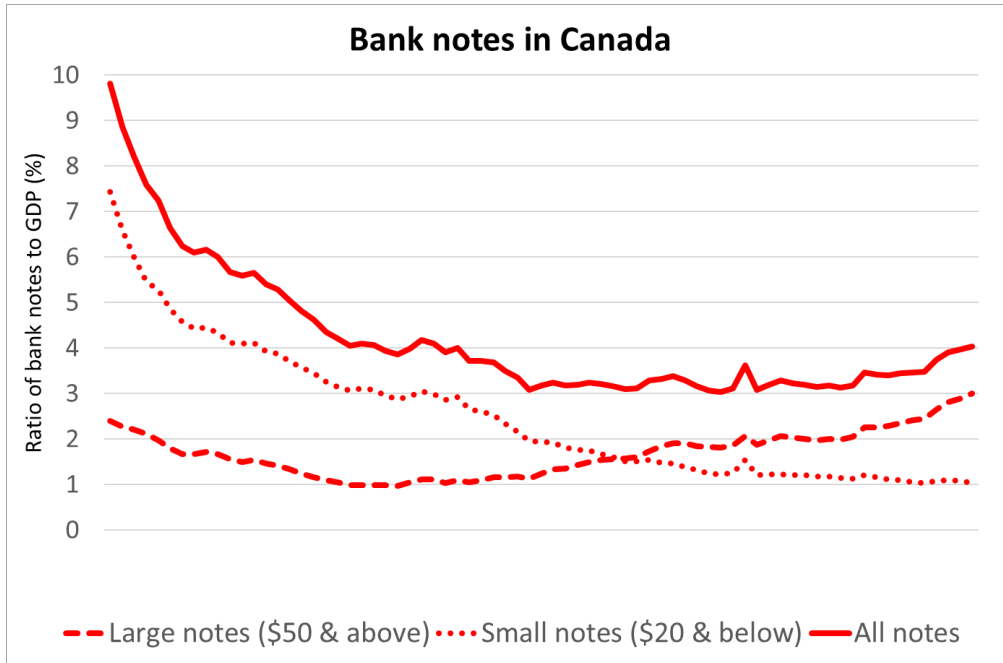
Sources: Bank for International Settlements and authors' calculations

Chart 4b: Number of bank branches in Sweden and Canada



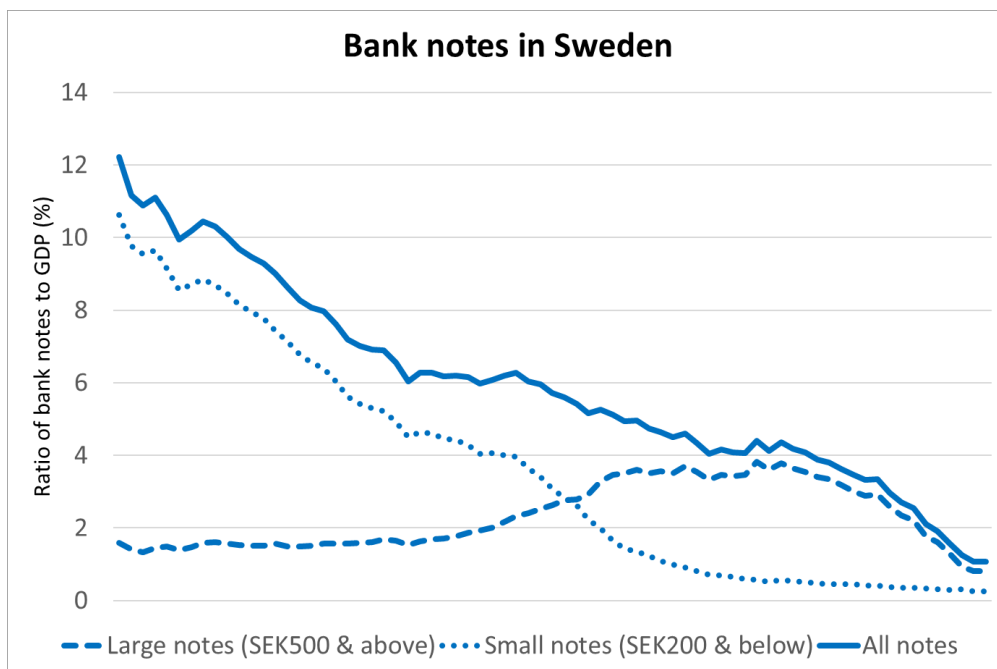
Sources: Bank for International Settlements and authors' calculations

Chart 5a: Large and small denominations as a ratio of GDP in Canada (1946–2018)



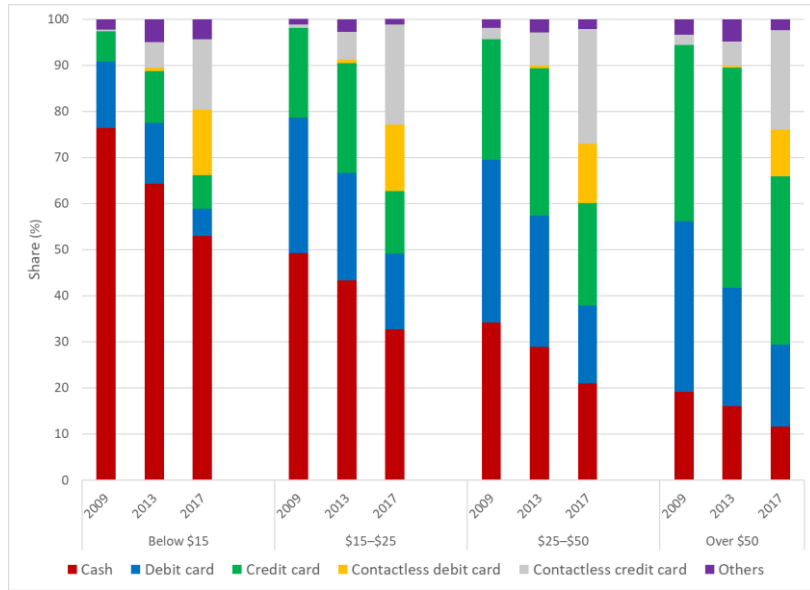
Sources: Bank of Canada and Statistics Canada

Chart 5b: Large and small denominations as a ratio of GDP in Sweden (1946–2018)



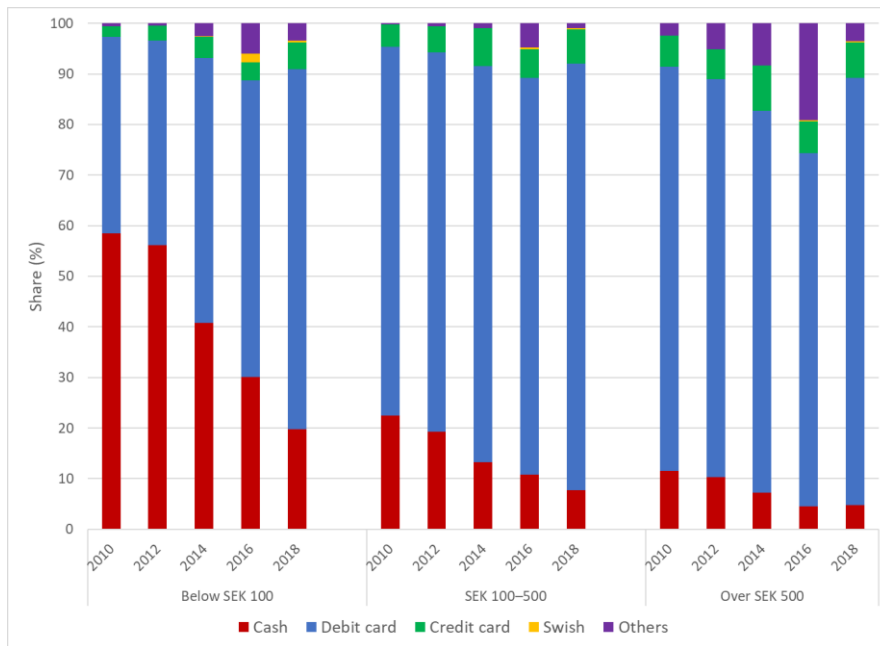
Source: Sveriges Riksbank

Chart 6a: Value share of cash, debit cards, credit cards and other payment methods, by transaction value in Canada



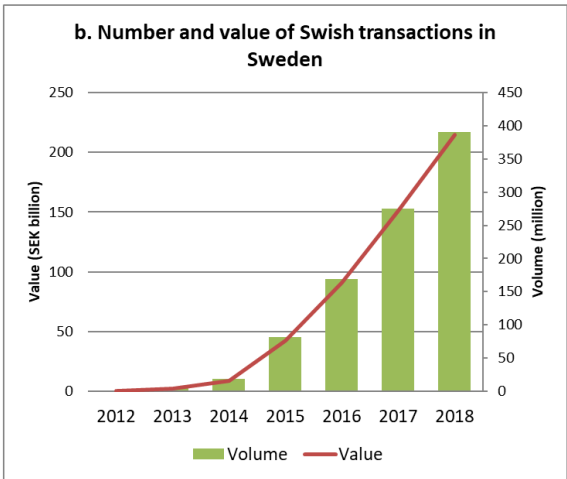
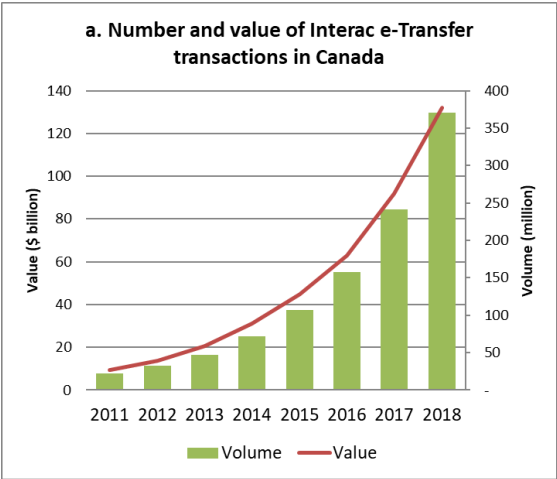
Source: Bank of Canada Methods-of-Payment surveys, 2009–2017

Chart 6b: The main payment methods for various transaction values in Sweden



Source: Sveriges Riksbank *Payment Patterns in Sweden*, based on the questions, “What was your main payment method for payments below SEK 100 (SEK 100–500 and over SEK 500) in a shop over the past month?”

Chart 7: Person-to-person payments: Swish and Interac e-Transfer



Note: The average transaction value of Swish in 2017 was about SEK550 (~CAD50) and the average transaction value of e-Transfer in 2017 was about CAD408

Sources: Swish, Interac Corp. and Bank for International Settlements

Table 1. Bank note series (SEK 20 to SEK 10,000) issued in Sweden from 1894 to 2017

	Printed	Invalid after		Printed	Invalid after
SEK 10,000	1939	December 31, 1987	SEK 1,000	1989–1991	December 31, 2013
SEK 1,000	1894–1950	December 31, 1987	SEK 50	1996–2003	December 31, 2013
	1952–1973	December 31, 1987			
SEK 100	1898–1963	December 31, 1987	SEK 1,000	2006	June 30, 2016
SEK 50	1896–1962	December 31, 1987	SEK 50	2006–2011	June 30, 2016
			SEK 20	1997–2008	June 30, 2016
SEK 10,000	1958	December 31, 1991			
			SEK 500	2001	June 30, 2017
SEK 1,000	1976–1988	December 31, 1998	SEK 100	2001	June 30, 2017
SEK 500	1985–1986	December 31, 1998			
SEK 100	1965–1985	December 31, 1998	SEK 1,000	October 1, 2015	
SEK 50	1965–1990	December 31, 1998	SEK 200	October 1, 2015	
			SEK 50	October 1, 2015	
SEK 500	1989–2000	December 31, 2005	SEK 20	October 1, 2015	
SEK 100	1986–2000	December 31, 2005			
SEK 20	1991–1995	December 31, 2005	SEK 500	October 2, 2016	
			SEK 100	October 3, 2016	

Source: Sveriges Riksbank

Table 2: Underground economy as a percentage of nominal GDP
(Selected estimates based on the “Multiple Indicators, Multiple Causes” method)

	1991	1995	2000	2005	2010	2015
Canada	19.31	16.59	13.40	13.57	10.71	9.42
Sweden	15.54	15.40	12.60	12.32	11.45	11.74

Source: Medina and Schneider (2018), Table A-1.

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What Broke First? Characterizing Sources of Structural Change Prior to the Great Recession <i>by Isaiah Hull</i>	2015:301
Price Level Targeting and Risk Management <i>by Roberto Billi</i>	2015:302
Central bank policy paths and market forward rates: A simple model <i>by Ferre De Graeve and Jens Iversen</i>	2015:303
Jump-Starting the Euro Area Recovery: Would a Rise in Core Fiscal Spending Help the Periphery? <i>by Olivier Blanchard, Christopher J. Erceg and Jesper Lindé</i>	2015:304
Bringing Financial Stability into Monetary Policy* <i>by Eric M. Leeper and James M. Nason</i>	2015:305
SCALABLE MCMC FOR LARGE DATA PROBLEMS USING DATA SUBSAMPLING AND THE DIFFERENCE ESTIMATOR <i>by MATIAS QUIROZ, MATTIAS VILLANI AND ROBERT KOHN</i>	2015:306

SPEEDING UP MCMC BY DELAYED ACCEPTANCE AND DATA SUBSAMPLING <i>by MATIAS QUIROZ</i>	2015:307
Modeling financial sector joint tail risk in the euro area <i>by André Lucas, Bernd Schwaab and Xin Zhang</i>	2015:308
Score Driven Exponentially Weighted Moving Averages and Value-at-Risk Forecasting <i>by André Lucas and Xin Zhang</i>	2015:309
On the Theoretical Efficacy of Quantitative Easing at the Zero Lower Bound <i>by Paola Boel and Christopher J. Waller</i>	2015:310
Optimal Inflation with Corporate Taxation and Financial Constraints <i>by Daria Finocchiaro, Giovanni Lombardo, Caterina Mendicino and Philippe Weil</i>	2015:311
Fire Sale Bank Recapitalizations <i>by Christoph Bertsch and Mike Mariathasan</i>	2015:312
Since you're so rich, you must be really smart: Talent and the Finance Wage Premium <i>by Michael Böhm, Daniel Metzger and Per Strömberg</i>	2015:313
Debt, equity and the equity price puzzle <i>by Daria Finocchiaro and Caterina Mendicino</i>	2015:314
Trade Credit: Contract-Level Evidence Contradicts Current Theories <i>by Tore Ellingsen, Tor Jacobson and Erik von Schedvin</i>	2016:315
Double Liability in a Branch Banking System: Historical Evidence from Canada <i>by Anna Grodecka and Antonis Kotidis</i>	2016:316
Subprime Borrowers, Securitization and the Transmission of Business Cycles <i>by Anna Grodecka</i>	2016:317
Real-Time Forecasting for Monetary Policy Analysis: The Case of Sveriges Riksbank <i>by Jens Iversen, Stefan Laséen, Henrik Lundvall and Ulf Söderström</i>	2016:318
Fed Liftoff and Subprime Loan Interest Rates: Evidence from the Peer-to-Peer Lending <i>by Christoph Bertsch, Isaiah Hull and Xin Zhang</i>	2016:319
Curbing Shocks to Corporate Liquidity: The Role of Trade Credit <i>by Niklas Amberg, Tor Jacobson, Erik von Schedvin and Robert Townsend</i>	2016:320
Firms' Strategic Choice of Loan Delinquencies <i>by Paola Morales-Acevedo</i>	2016:321
Fiscal Consolidation Under Imperfect Credibility <i>by Matthieu Lemoine and Jesper Lindé</i>	2016:322
Challenges for Central Banks' Macro Models <i>by Jesper Lindé, Frank Smets and Rafael Wouters</i>	2016:323
The interest rate effects of government bond purchases away from the lower bound <i>by Rafael B. De Rezende</i>	2016:324
COVENANT-LIGHT CONTRACTS AND CREDITOR COORDINATION <i>by Bo Becker and Victoria Ivashina</i>	2016:325
Endogenous Separations, Wage Rigidities and Employment Volatility <i>by Mikael Carlsson and Andreas Westermark</i>	2016:326
Renovatio Monetae: Gesell Taxes in Practice <i>by Roger Svensson and Andreas Westermark</i>	2016:327
Adjusting for Information Content when Comparing Forecast Performance <i>by Michael K. Andersson, Ted Aranki and André Reslow</i>	2016:328
Economic Scarcity and Consumers' Credit Choice <i>by Marieke Bos, Chloé Le Coq and Peter van Santen</i>	2016:329
Uncertain pension income and household saving <i>by Peter van Santen</i>	2016:330
Money, Credit and Banking and the Cost of Financial Activity <i>by Paola Boel and Gabriele Camera</i>	2016:331
Oil prices in a real-business-cycle model with precautionary demand for oil <i>by Conny Olovsson</i>	2016:332
Financial Literacy Externalities <i>by Michael Haliasso, Thomas Jansson and Yigitcan Karabulut</i>	2016:333

The timing of uncertainty shocks in a small open economy <i>by Hanna Armelius, Isaiah Hull and Hanna Stenbacka Köhler</i>	2016:334
Quantitative easing and the price-liquidity trade-off <i>by Marien Ferdinandusse, Maximilian Freier and Annukka Ristiniemi</i>	2017:335
What Broker Charges Reveal about Mortgage Credit Risk <i>by Antje Berndt, Burton Hollifield and Patrik Sandås</i>	2017:336
Asymmetric Macro-Financial Spillovers <i>by Kristina Bluwstein</i>	2017:337
Latency Arbitrage When Markets Become Faster <i>by Burton Hollifield, Patrik Sandås and Andrew Todd</i>	2017:338
How big is the toolbox of a central banker? Managing expectations with policy-rate forecasts: Evidence from Sweden <i>by Magnus Åhl</i>	2017:339
International business cycles: quantifying the effects of a world market for oil <i>by Johan Gars and Conny Olovsson I</i>	2017:340
Systemic Risk: A New Trade-Off for Monetary Policy? <i>by Stefan Laséen, Andrea Pescatori and Jarkko Turunen</i>	2017:341
Household Debt and Monetary Policy: Revealing the Cash-Flow Channel <i>by Martin Flodén, Matilda Kilström, Jósef Sigurdsson and Roine Vestman</i>	2017:342
House Prices, Home Equity, and Personal Debt Composition <i>by Jieying Li and Xin Zhang</i>	2017:343
Identification and Estimation issues in Exponential Smooth Transition Autoregressive Models <i>by Daniel Buncic</i>	2017:344
Domestic and External Sovereign Debt <i>by Paola Di Casola and Spyridon Sichliris</i>	2017:345
The Role of Trust in Online Lending <i>by Christoph Bertsch, Isaiah Hull, Yingjie Qi and Xin Zhang</i>	2017:346
On the effectiveness of loan-to-value regulation in a multiconstraint framework <i>by Anna Grodecka</i>	2017:347
Shock Propagation and Banking Structure <i>by Mariassunta Giannetti and Farzad Saidi</i>	2017:348
The Granular Origins of House Price Volatility <i>by Isaiah Hull, Conny Olovsson, Karl Walentin and Andreas Westermark</i>	2017:349
Should We Use Linearized Models To Calculate Fiscal Multipliers? <i>by Jesper Lindé and Mathias Trabandt</i>	2017:350
The impact of monetary policy on household borrowing – a high-frequency IV identification <i>by Maria Sandström</i>	2018:351
Conditional exchange rate pass-through: evidence from Sweden <i>by Vesna Corbo and Paola Di Casola</i>	2018:352
Learning on the Job and the Cost of Business Cycles <i>by Karl Walentin and Andreas Westermark</i>	2018:353
Trade Credit and Pricing: An Empirical Evaluation <i>by Niklas Amberg, Tor Jacobson and Erik von Schedvin</i>	2018:354
A shadow rate without a lower bound constraint <i>by Rafael B. De Rezende and Annukka Ristiniemi</i>	2018:355
Reduced "Border Effects", FTAs and International Trade <i>by Sebastian Franco and Erik Frohm</i>	2018:356
Spread the Word: International Spillovers from Central Bank Communication <i>by Hanna Armelius, Christoph Bertsch, Isaiah Hull and Xin Zhang</i>	2018:357
Predictors of Bank Distress: The 1907 Crisis in Sweden <i>by Anna Grodecka, Seán Kenny and Anders Ögren</i>	2018:358

Diversification Advantages During the Global Financial Crisis <i>by Mats Levander</i>	2018:359
Towards Technology-News-Driven Business Cycles <i>by Paola Di Casola and Spyridon Sichlirmiris</i>	2018:360
The Housing Wealth Effect: Quasi-Experimental Evidence <i>by Dany Kessel, Björn Tyrefors and Roine</i>	2018:361
Identification Versus Misspecification in New Keynesian Monetary Policy Models <i>by Malin Adolfson, Stefan Laseén, Jesper Lindé and Marco Ratto</i>	2018:362
The Macroeconomic Effects of Trade Tariffs: Revisiting the Lerner Symmetry Result <i>by Jesper Lindé and Andrea Pescatori</i>	2019:363
Biased Forecasts to Affect Voting Decisions? The Brexit Case <i>by Davide Cipullo and André Reslow</i>	2019:364
The Interaction Between Fiscal and Monetary Policies: Evidence from Sweden <i>by Sebastian Ankargren and Hovick Shahnazarian</i>	2019:365
Designing a Simple Loss Function for Central Banks: Does a Dual Mandate Make Sense? <i>by Davide Debortoli, Jinill Kim and Jesper Lindé</i>	2019:366
Gains from Wage Flexibility and the Zero Lower Bound <i>by Roberto M. Billi and Jordi Galí</i>	2019:367
Fixed Wage Contracts and Monetary Non-Neutrality <i>by Maria Björklund, Mikael Carlsson and Oskar Nordström Skans</i>	2019:368
The Consequences of Uncertainty: Climate Sensitivity and Economic Sensitivity to the Climate <i>by John Hassler, Per Krusell and Conny Olovsson</i>	2019:369
Does Inflation Targeting Reduce the Dispersion of Price Setters' Inflation Expectations? <i>by Charlotte Paulie</i>	2019:370
Subsampling Sequential Monte Carlo for Static Bayesian Models <i>by David Gunawan, Khue-Dung Dang, Matias Quiroz, Robert Kohn and Minh-Ngoc Tran</i>	2019:371
Hamiltonian Monte Carlo with Energy Conserving Subsampling <i>by Khue-Dung Dang, Matias Quiroz, Robert Kohn, Minh-Ngoc Tran and Mattias Villani</i>	2019:372
Institutional Investors and Corporate Investment <i>by Cristina Cella</i>	2019:373
The Impact of Local Taxes and Public Services on Property Values <i>by Anna Grodecka and Isaiah Hull</i>	2019:374
Directed technical change as a response to natural-resource scarcity <i>by John Hassler, Per Krusell and Conny Olovsson</i>	2019:375



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