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ORIGINAL ARTICLE

Global networks of money and information at the crossroads: Correspondent banking and SWIFT

Gary Robinson[1,2,3] | **Sabine Dörry**[1] | **Ben Derudder**[2,4]

[1]Department of Urban Development and Mobility, Luxembourg Institute of Socio-Economic Research (LISER), Esch-sur-Alzette, Luxembourg

[2]Department of Geography, Ghent University, Gent, Belgium

[3]University of Luxembourg, Esch-sur-Alzette, Luxembourg

[4]Public Governance Institute, KU Leuven, Leuven, Belgium

Correspondence
Sabine Dörry, Department of Urban Development and Mobility, Luxembourg Institute of Socio-Economic Research (LISER), 11 Porte des Sciences, L-4366 Esch-sur-Alzette, Luxembourg.
Email: sabine.doerry@liser.lu

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Abstract

This article explores how transaction information is a fundamental element enabling and fostering global flows of money. Financial systems, constructed around account-based money, require infrastructure, which is separated into two parts: messaging and settlement, performed via trusted agents. This separation has allowed the geographical expansion of banking, and to this day constitutes a key architecture of increasingly global networks of money. Focusing on the correspondent banking system and the Society for Worldwide Interbank Financial Telecommunication, this article demonstrates the workings of this infrastructure in cross-border payments and in enacting economic sanctions. This sociotechnical infrastructure is a crucial yet overlooked area of global banking, which makes global economic and financial activity possible in the first place. Importantly, by analysing the organizational architecture of the global payments system and including the actors and agencies within it, we elucidate the (changing) relationships between data/information, geographies and power, contributing to the formation of a literature that conceptualizes financial infrastructure.

KEYWORDS
correspondent banking and SWIFT, cross-border payments, financial geographies, financial infrastructure, geopolitics, information networks

INTRODUCTION

This paper elaborates on the generic observation that finance is 'essentially an information business where most processes may be IT-supported' (Alt & Puschmann, 2012, p. 204) by exploring how transaction information is a fundamental element enabling and fostering global flows of money. The importance and justification for this elaboration is reflected in the uniqueness of an infrastructure composed of the tightly intertwined interplay of the Society for Worldwide Interbank Financial Telecommunication (SWIFT) and correspondent banking (CB), whose geo-political and geo-economic significance requires forensic examination and a thorough understanding of their workings. Information is a critical building block of this global architecture. Information is interwoven through banking relationships that form specific geographies and link financial centres around the world (while excluding other places), thereby exerting financial power that is transformed into geopolitical power. The continued production of infrastructure by public and/or private actors is necessary for the reproduction of capitalism.

The social sciences have seen a turn toward new and more nuanced understandings of infrastructure, recognizing that both its material and immaterial forms set the rules and standards that shape the rhythms and flows of social life (Appel et al., 2018; Easterling, 2016). The importance of infrastructure as critical to modern life is often thought of in terms of national, physical and public infrastructure (Church et al., 2004). However, private global network infrastructure as a bridge between disparate jurisdictions in the world economy has a vital coordinating intermediary role. The specialized infrastructure of finance is crucial in enabling global economic activity but is often characterized as the 'plumbing' of the global financial system, and perceived as 'boring, low margin and not strategic' (Lord et al., 2015, p. 6). We prove otherwise in this paper.

The financial sector has clearly been a pioneer in the adoption of information and telecommunications technologies. For example, the wave of digitalization that started emerging in the 1960s (Arner et al., 2015) has led to now almost all financial markets being digital, while the industry is currently undergoing unprecedented change due to a variety of fintech actors, innovations and trends, including the ever-increasing digitalization of payments (Wójcik, 2021). Information in finance is referred to in terms of market data, such as indices and prices, crucial for trading and investment decisions (Petry, 2021). Additionally, knowledge creation and information flows are key variables in configuring global economic geographies, for example the information asymmetries providing the underlying logic for financial firms to cluster in specific places (Kindleberger, 1973) and allowing advantages in high-frequency trading (Zook & Grote, 2017). Recent research has also drawn attention to previously less explored forms of financial information, which has gained in importance in light of the rise of fintech and digital platforms: payment transaction data (O'Dwyer, 2019; Westermeier, 2020).

Taken together, transaction information is a crucial building block on which the backbone of global networks of money runs, yet the geographies of financial information remain relatively recondite in terms of their organizational structure, potential power and geographical impact (Zook, 2018).

A complex global architecture undergirds the mechanics of financial flows. For example, account-based flows in cross-border payments involve myriad chains of actors, intermediaries and specialized infrastructures collecting, transmitting, storing and ordering information—messages with transaction instructions—as they connect places. Accounts are siloed at trusted institutions, whose ledgers are subsequently reconciled, or settled, based on this information, realizing the movement of money. The informational and financial components have different business models and congruent but different geographies. Payments is one of the core banking areas targeted by fintech entities, and efforts to rewire this could have far-reaching implications for the geographical organization of global networks of money, for example in terms of who engages in which financial activities and where.

Against this backdrop, the overarching aim of this paper is to shed light on how informational (messaging) and financial (settlement) geographies structure global flows of money. Financial infrastructures have been somewhat of an analytical blind spot, but recent contributions have begun to (in-)form a more coherent conceptual embrace (Brandl & Dieterich, 2021; Campbell-Verduyn & Goguen, 2019; de Goede & Westermeier, 2022; Dörry et al., 2018). We build

on these contributions by (1) examining evolutions in account-based money to highlight the separation of information and settlement processes, and to show the contingency of the architecture of global banking on this money form, and (2) examining these dual intertwined processes and geographies in the CB infrastructure for cross-border payments, which helps to tease out the 'social fabric' and its organization that define the working of financial infrastructure.

We thus highlight the pivotal role of SWIFT as a global financial *information* infrastructure that does not itself touch money, and show the importance of the CB system as a historically central banking infrastructure with a continued crucial role. Probing the workings of this system in its use for cross-border payments and in enacting sanctions allows us to more precisely grasp how funds cross borders as transaction information that moves across space through unevenly networked places. In doing so, we illustrate how informational and financial geographies, while closely linked and sometimes matching, are distinct elements of global networks of money, and suggest that disentangling them is crucial. Therefore, this article employs a qualitative analysis of multidisciplinary secondary data, including literature from economic and financial geography, business studies, political economy, critical data studies and science and technology studies, as well as industry reports and insights from 30 expert interviews across the banking and payments industry (Robinson, 2021).

The remainder of this paper is organized as follows. Section 2 examines the historical evolution of deposit banking and financial flows from being predominantly token based to account based. This precondition facilitated the spatial expansion of finance by dividing financial transactions and flows into two separate processes: transmission of transaction information (messaging) and reconciliation of transactions across accounts (settlement). Section 3 conceptualizes both the terminologies and use of data and information in finance. Section 4 introduces financial infrastructure as a distinct category of actors built around the architecture of account-based money. It focuses on the CB system as a pivotal global banking infrastructure, highlighting its dependence on a crucial financial actor that handles information rather than money: SWIFT. Section 5 uses the examples of cross-border payments and of economic sanctions to demonstrate the workings of the system of account-based flows and its twin informational and financial geographies, shaped by the interactions of more than 11,000 banks worldwide. The paper concludes with reflections on the significance of transaction information flows in global banking, and on technological innovations that seek to rewire informational and financial geographies.

TWO SIDES OF THE SAME COIN: INFORMATION AND SETTLEMENT

As Maurer (2012, p. 20) points out, 'you can't have finance without the act of value transfer—the seemingly small, mundane little technicality that sets the world of finance, high and low, in motion'. Every day across every economy, a huge number of transactions takes place across a range of economic actors. Excluding barter, whether for the purchase of goods, services or financial assets, each transaction has two settlement components: (1) the delivery of goods or services and (2) the transfer of funds or payment. There are two basic types of payment mechanism or money form: objects, or *tokens* (e.g. cash), and claims, or *accounts* (e.g. deposits at commercial banks) (Abrazhevich, 2001; Green, 2008). Discussing banking and payments invites a brief reflection on the relationship between money and finance. Proponents of cultural economy, for example, argue that a purely utilitarian approach to money, that is 'market money', would disregard the 'extraeconomic, social basis of modern money' (Zelizer, 1989, p. 342). While we agree, here, we define money as a distinct function of finance, with money and finance being functionally and metaphorically close. The latter notion therefore guides the choice of our terminology and meaning of money throughout the article.

Money is both information and infrastructure (Maurer, 2014). Banknotes must be designed and printed in ways to make it difficult to forge, and need to be securely transported, stored and accounted for. With token- or object-based payments, settlement is immediate; there is no other exchange of information needed. However, most payments today are account based. Although they simplify transactions, they need a complex supporting infrastructure (Adrian & Mancini-Griffoli, 2019). Digital payments rely on, amongst other things, chip and PIN cards, point of sales terminals, mobile phones and telecommunications networks. On top of this, there are centralized settlement systems,

agreements and rules governing the use of systems and networks, as well as a legal framework. With account-based payments, payment takes the form of transferring ownership of a claim on value held elsewhere. For example, payment with a debit card sends instructions to transfer ownership of one person's claim on bank assets to another person. The act of payment in account-based money therefore comprises two parts: transmission of transaction information (or: instructions) and subsequent settlement (or: reconciliation) of accounts. Thus, in funds transfer, what is actually transferred is information. This separation has its origins in the Middle Ages and is essential to understand when considering previous and current efforts to change how global networks of money are organized.

Deposit banks evolved from moneychangers' original function as custodians of physical specie in medieval Europe. The quality and quantity of coinage were ill-suited to commerce. Rather than constantly counting and transferring *physical* coin as payment, they instead allowed transfer of title to, and ownership of, coin deposited with them. This immobilized the coin and instead strengthened the recording of ownership transfer and the creation of a kind of *book-entry* or *account* money. Account-based money comprises debt/credit claims on a party, which are dematerialized as they are recorded in accounts or books. Payment thus evolved from physical transfer of an object (token) to book (account) transfer. Using bank deposits for payments allowed netting, that is, using one debt to extinguish another, resulting in the mediation of a large volume of transactions without the need for much final settlement in cash. Payment was executed by transferring debts between strangers, with the bank as trusted intermediary. Banks' distinctiveness lays in centralizing these operations across many parties in their books. While deposit banks were a local affair, trade and finance expanded further across geographical distance with the bill of exchange. Merchants sent goods and remittance instructions to agents to accept payment in one location's local coin and to repay in another location's coin, with a delay of up to several months between receipt and repayment (Kohn, 1999, 2001).

For most of history, information moved with people: tokens and information about them moved at the same speed. This changed, however, in the 19th century, when the telegraph brought the dematerialization of telecommunication, allowing information to travel faster than physical objects (Wenzlhuemer, 2007). Digitalization of accounts from the 1960s greatly enhanced accounting and settlement (Bátiz-Lazo et al., 2011) but technological improvements to information flows impacted hugely on the geographies of banking. The Euromarkets from the late 1950s and the end of the dollar gold standard in 1971 increased cross-border flows of money (Burn, 2006). The subsequent advent of electronic funds transfer from the 1970s further intensified the speed of flows and the globalization of the banking sector (Langdale, 1985). Importantly, this digital transition did not change financial intermediation patterns based on the account money form but rather optimized them. The separation of information and settlement in the account money form is one reason why communications advances have been so impactful in finance. Fintech innovations and actors target both processes in novel ways, making it important to understand the nature of these building blocks that shape global money's current and future architecture.

FINANCIAL DATA AND INFORMATION

As an information business, finance has long been data driven (Hussain & Prieto, 2016). Data, information and knowledge can be understood as different hierarchical layers (Kitchin, 2014), in which each layer is differentiated by distilling it through reduction, abstraction, processing, organizing, analysis and interpretation, to reveal relationships and truth, thus adding meaning and value. Finance is not only an information business in terms of price and market information and associated asymmetries, but also in terms of account and transaction details. The distinction between *types* of financial information is vital in the context of the heightened importance of data. Computing advances have greatly expanded the volume of data that can be processed and transmitted, thereby placing more emphasis on innovation (Thrift, 2005). Unlike physical commodities, the value of data does not lie in its materiality. It can exist simultaneously in multiple places, and is not lying around waiting to be dug up—it must be appropriated (Couldry & Mejias, 2019). Conceptualizations of data as a crucial element in modes of capitalist accumulation and monetization capture the moments and processes at and through which this happens (Sadowski, 2019).

Some consider banks the accounting centres and system of the economy (Stiglitz & Weiss, 1988). Building on this, global finance has been posited as 'a system for keeping track (and profiting from the manipulation) of information on ownership claims, debts, revenue streams, exposure to or protection from risk' (Campbell-Verduyn et al., 2019, p. 914). However, transaction data and information have been thus far underutilized for reputational and regulatory reasons (Omarini, 2020), meaning that 'until now, banks have thrived on money, not data' (Westermeier, 2020, p. 2). Payment data and information, such as transaction history and payment instruction information, for both retail and corporate customers, nonetheless constitutes an increasingly important data source, becoming more valuable than payment fees (O'Dwyer, 2019; TechCrunch, 2012). As the former CEO of Citigroup, Walter Wriston, put it, 'information about money has become almost as important as money itself' (Bass, 1996).

Although information flows and knowledge creation are key variables in the production of a broad range of economic geographies, the geographies of financial information have often remained somewhat obscure (Zook, 2018). A key exception is the literature that considers how information asymmetries lead to spatial proximity, which in the case of finance translates into the coordination of capital flows at the global level being concentrated in just a few places: international financial centres (IFCs) (Dörry, 2015; Grote, 2009; Kindleberger, 1973; Meyer, 2009). However, this centralized global financial infrastructure links globally dispersed financial actors through collecting, storing and communicating information via a financial messaging network.

One fundamental function of finance is the transfer of (exchange) value, more simply known as payment. The payments industry in itself is an enormous economic sector, without which global production and exchange as we know it would be impossible. This is echoed in one of the financial system's core economic functions: to provide a payments system that facilitates the exchange of money necessary in the purchase of all goods and services (Dixon, 2011). As we saw in the previous discussion of the origins of account-based money in deposit banking, settlement is performed in the books of trusted intermediaries, that is banks, and payment settlement instructions are transmitted separately. The interdependent geographies of information (messaging) and finance (settlement) are therefore different but intersecting. Having examined the history of this separation, we now turn to an analysis of cross-border payment flows via the CB system to demonstrate the inseparability of their organizational interplay and resulting geographies.

A GLOBAL INFRASTRUCTURE: CORRESPONDENT BANKING FOR PAYMENTS

Correspondent arrangements

Except for currency unions like the euro, currencies are mostly national. National payment settlement systems have become crucial financial infrastructures with public utility. Essential to everyday life, they are a vital part of a country's basic infrastructure to the extent that 'if you wanted to cripple the U.S. economy, you'd take out the payment systems' (Greenspan, 2007, p. 2). Central banks usually operate payment settlement systems within a jurisdiction where payments in that currency are ultimately settled. Direct access to a national payment system is typically granted only to financial institutions regulated in that jurisdiction. Payments in that currency are relatively straightforward: they are settled across the banks' accounts at the payment system. However, payments made in different currencies, or cross-border payments, are more complex, conducted via a global network of decentralized contractual agreements between banks, known as correspondent arrangements, supplemented since the 1970s with a financial messaging network centralized in SWIFT (Dörry et al., 2018).

In its most basic guise, a correspondent arrangement, or correspondent banking relationship (CBR), involves an entity (usually a bank) in one location, the respondent, engaging an independent entity (usually a bank) in another location, the correspondent, to conduct services there for it and its customers. The parties usually agree on the ongoing purchase and sale of products and services by exchanging contracts to establish a CBR (Naughton & Chan, 1998). CB is intrinsically geographical: its key element and indeed *raison d'être* is overcoming distance, and the term dates from when banks sent instructions in letters by ship (Leibbrandt & De Terán, 2021).

There are two main ways that financial institutions operate overseas. One way is by establishing an overseas presence as part of the parent firm, such as a branch, subsidiary, agency or representative office (Derudder & Taylor, 2020). The other way is via a correspondent arrangement, akin to exporting activities of manufacturing firms, where the correspondent is independent of the respondent (Cho, 1986). Most banks do not have a physical overseas presence and instead use correspondent arrangements for international business. While such arrangements may also be between banks within a local market, for example historically underpinning the U.S. banking system (James & Weiman, 2010), they are far more common internationally and have been a bulwark of the internationalization of finance for centuries (Merrett, 1995).

CBRs are, first, an integral way that banks sell services to each other. Maintaining a network of global relationships is part of banks' back-office operations, supporting other activities within a bank and allowing the cross-selling of various departments' products to other banks (Chan, 2014). Purchasing products and services from correspondents is often cheaper than producing them in-house as large, vertically integrated correspondents can exploit economies of scale and network effects to lower prices (Osterberg & Thomson, 1999). CBRs are the cheapest way to do transaction banking across borders, including payments, trade finance, account and liquidity management and securities services (Naughton & Chan, 1998). It makes transaction banking services 'the bread and butter of international banking' (Merrett, 1995, p. 70), providing over 40% of global banking revenues (McKinsey & Company, 2019). Second, CBRs were also the means of settling foreign exchange (FX) transactions prior to the formation of the centralized Continuous Linked Settlement (CLS) infrastructure in 2002 (Lindley, 2008) (Figure 1), and are the means by which central bank swap lines operate (Aldasoro et al., 2020).

Banks often hold reciprocal accounts with each other, known as nostro/vostro accounts, and while this is not a necessary condition of a correspondent arrangement, doing so allows access to a wider range of correspondent services, such as cross-border payments. The ability to conduct such payments without legal domicile or physical presence in another jurisdiction supports myriad other global networks in trade and investment by providing 'a flexible and regulated channel with a potentially worldwide reach' (Coelho et al., 2020, p. 4). The geographies and business models of CB have not remained static. The telegraph was among the reasons for the development of CBRs into global interbank networks between the late 1800s and the early 1900s (Battilossi, 2006). Ease of communication aided banks in more easily expanding abroad without a direct presence via CBRs. The advent of electronic funds transfer, such as SWIFT, in the 1970s allowed the intensification of financial flows by greatly increasing the speed of information transfer. Reflecting SWIFT's foundation by Western banks, most payment flows then were between Europe and the United States. We examine SWIFT in more detail in the next section but for now it is important to note that its introduction brought about a marked increase in the scale and complexity of CBRs (Rice et al., 2020; SWIFT, 2011).

Since the financial crisis of 2008, despite a rise in the number of banks, the number of CBRs has declined by between 20% and 25%. The reasons for this include reduced profitability, partly because of high costs of due diligence and 'derisking' because of increased regulatory compliance responsibilities and the high costs and reputational damage from transgressions, mainly by U.S. and European banks (Accuity, 2017; Rice et al., 2020). Reciprocity is fading due to price and competition pressures and a decline in trust among banks post-global financial crisis with regard to credit and compliance risk (Langley, 2004; Lyddon, 2012). Trust is still essential, however, as participants' high interdependence through extending credit lines to each other, holding balances and exposure to operational failures, creates potential for systemic risk (Wandhöfer & Casu, 2018). The decline in CBRs has uneven regional impacts, for example affecting the Pacific Islands and Sub-Saharan Africa, where fewer direct and more nested CBRs have lengthened payment chains and increased costs (IMF, 2017; World Bank Group, 2018). New technologies bring more choice in payment channels, some of which support and others which substitute for CB (Rice et al., 2020). The demise of CB has been predicted many times (Hawser, 2015), but the system is geoeconomically, geopolitically and technologically key, because banks still need correspondents in places where they have no direct presence.

Other financial institutions also use correspondent arrangements, including central banks, financial infrastructures and non-bank financial institutions such as remittance operators (Buhl-Freiherr von und zu Guttenberg, 2018). Thus, correspondent arrangements are also a mode of international operation and expansion allowing the relational exercise

of power across space. Central banks, for example, used correspondents to intervene in FX markets in other jurisdictions (Eichengreen, 2019), also acting as correspondents for other central and commercial banks, both in the past (Cassis, 2010) and today (Deutsche Bundesbank, n.d.). With an estimated 1.3 million contractual relationships (Zschieschang, 2018), the CB system forms a decentralized and global infrastructure network for the flow of funds and the provision of other banking services. Although reaching all corners of the world, the uneven concentration of global networks captured by CBRs is influenced by currency hierarchies and trade volumes (Kaltenbrunner & Lysandrou, 2017). Large correspondent banks in IFCs are the key nodes and nexus. Particularly for payments, CBRs have facilitated the geographical expansion of banking via the updating of reciprocal accounts (settlement) held at partner banks in distant locations. Of crucial importance in determining the extent of expansion is the communication of transaction information, in which SWIFT's network is pivotal.

SWIFT: Messaging infrastructure within and for infrastructures

SWIFT was established in 1973 by banks to create a standardized, secure and reliable digital messaging system. This is still a mainstay of its operations today. Holding no actual funds, SWIFT instead transmits instructions for the transfer of funds, which members act upon by updating their accounts. Payment instructions is one example. The SWIFT network encompasses both hard (e.g. network cables and equipment) and soft (e.g. standards and rulebooks) infrastructure, thus determining how users act for the system to function efficiently. During the 1960s, U.S. and European banks' needs for reliable computer and telecommunications systems increased with the expansion of global operations. They began to innovate by developing their own private networks (Scott & Zachariadis, 2014). Although domestic payments had become standardized, international payments were not yet automated because of different languages and procedures, relying on telex to communicate transactions.

European banks had begun to co-operate around the 1960s to prepare for the possibility of a monetary union, to react to competition from U.S. banks, and to take advantage of opportunities presented by the Euromarkets. Europeans spearheaded the initiative to examine the feasibility, costs and specifications of a communications network for international payments and related messages. Some U.S. banks came on board by 1971 and SWIFT was founded as a non-profit co-operative in 1973 with 239 banks from 15 countries. The choice of Brussels for SWIFT's headquarters—a jurisdiction of high political relevance today—was a political compromise in the rivalry between London and New York (Scott & Zachariadis, 2014; cf. Taylor & Derudder, 2022). The eventual decision to adopt SWIFT was taken partly in reaction to attempts by First National City Bank (now Citi) to have its proprietary messaging system imposed in 1975: fear of being locked into a competitor's system was a crucial factor in driving the adoption of a collective solution. More banks signed up for the cooperative and collaborative SWIFT option instead. This gave it critical mass, with the first SWIFT message sent in 1977 (Scott & Zachariadis, 2014). SWIFT's cooperative form is a key element engendering institutional trust among rivals, mediating between the world's banks and financial infrastructures within and across borders.

Incorporating features of both a public good and a private cooperative organization run on a not-for-profit-maximization basis, SWIFT's profits are recycled as rebates to its (today) over 11,000 member-owners. However, it is not ownership by equals. Board membership is determined according to network usage: the six countries with the largest messaging volume appoint two directors each and the next 10 countries appoint one each. This favours large global Western banks, who send most SWIFT messages, granting them more control over SWIFT (Bergin, 2016). Hailed as a model of co-opetition, SWIFT is classified as a critical financial service provider (National Bank of Belgium, 2017).

Figure 1 depicts the multiple interlinkages of national and international financial infrastructure for the example of Belgium, where SWIFT is headquartered. These core components of the financial system provide interconnection and manage risk. They comprise functions and systems for payments and securities trading, clearing and settlement, and have typically evolved into centralized infrastructures, many privately operated. Because the consequences of infrastructure failure are far-reaching, many have been designated systemically important by financial authorities (CPMI

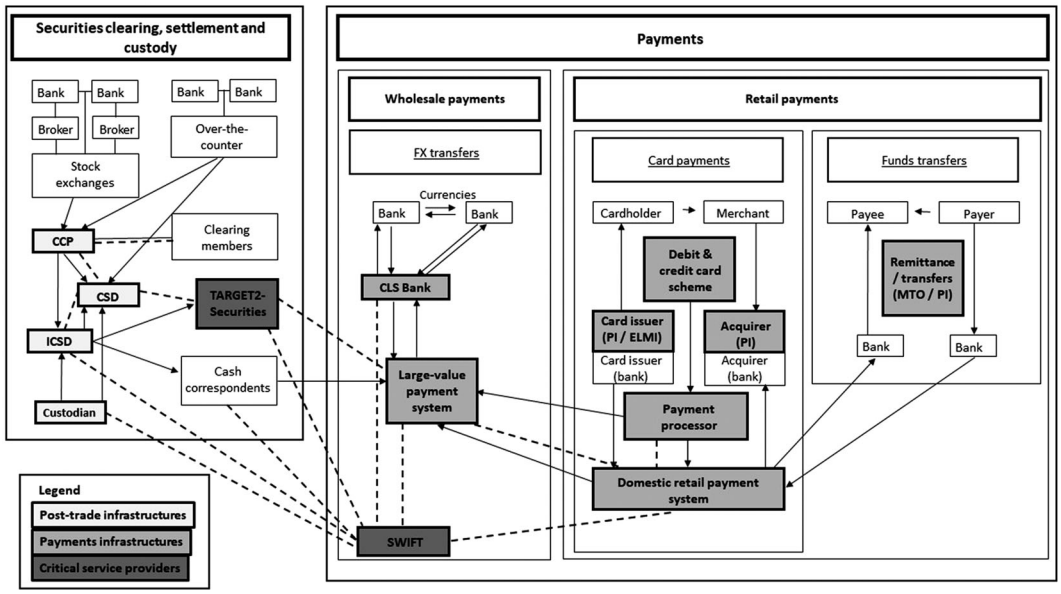

FIGURE 1 Interlinkages between financial market infrastructures and SWIFT. *Source*: National Bank of Belgium (2017), amended by the authors

& IOSCO, 2012). The architecture of this infrastructure is structured by the account money form. Each payment and securities infrastructure is a trusted curator of accounts, which must be reconciled with other infrastructures and actors for each transaction, with transaction information transmitted separately. SWIFT's financial messaging system links not only member banks but also these infrastructures, making it literally an *infrastructure for infrastructures*, but also 'a monopoly used by an oligopoly of participants' (Rambure & Nacamuli, 2008, p. 73).

Figure 1 shows the existence of multiple centralized infrastructures based on the account money form, as well as the importance of SWIFT in interconnecting these infrastructures. CB is not represented in Figure 1 because it shows centralized financial infrastructure in a single country (although some infrastructures are global, e.g. SWIFT, Internal central securities depository (ICSD)), but CB is decentralized cross-border (social) arrangements between banks in different jurisdictions and depicted in Figure 2.

Cross-border payments: A sociotechnical infrastructure

The correspondent arrangements for settlement do not constitute one centralized infrastructure, but rather a fragmented, decentralized global network of over a million bilateral contracts. While supposedly invisible, *technical* data infrastructure in reality has a very material geography (Furlong, 2021): its distributed and ubiquitous *social* dimension of over a million distributed bilateral relations is 'hidden in plain sight' (Panza & Merrett, 2019), but requires efficient coordination and control. For example, network participants need to know counterparty names and account numbers for different kinds of transactions and currencies. Known as standard settlement instructions (SSI), this information used to be available in printed directories like *Banker's Almanac*, first published in 1851 (Sylla, 1976) and still providing SSI today, albeit now online, while SWIFT also has such a directory.

Additionally, the efficient communication of financial information requires interoperability, standardization and security. This is the role of SWIFT, one of the advanced telecommunications services underpinning organizational networks and interconnecting powerful economic actors concentrated in cities (Langdale, 1989). CB predates SWIFT by

centuries, but together, the two constitute an infrastructure as an assemblage of artefacts, or sociotechnical configuration. SWIFT's genesis is inseparable from CB; it has become synonymous with it, the more visible technological counterpart to the distributed invisible social network of contractual arrangements it supports. If correspondent arrangements are the lifeblood of global payments, SWIFT's messaging network is the blood vessels and its financial messages the blood cells. Other messaging networks exist, but the basic architecture is the same, with the separation of information and settlement inherent in account-based money.

Especially in the area of payments, the financial messaging information and infrastructure has gained in importance, alongside a shift from perceiving payments as a technical back-office matter to a sector of new strategic interest (Villeroy de Galhau, 2018). 'Long chains' of financial information (Campbell-Verduyn et al., 2019), however, can be slow and inefficient, but incumbents profit from inefficiencies, while at the same time spending enormously on mitigating their negative impacts. This presents opportunities for 'disruption', which we discuss in the final section. We now turn to demonstrating the intertwined geographies of messaging and settlement by unpacking the mechanism of a cross-border payment.

CURRENCY CORRIDORS: UNPACKING THE GEOGRAPHIES OF CROSS-BORDER PAYMENTS

Banks typically negotiate an arrangement with a correspondent for each currency they wish to transact in, creating 'currency corridors' (Figure 2). Contracts between correspondents specify how they want to handle various aspects of payments (e.g. different currencies, types of payments from private individuals or businesses); when to settle transactions; pre-funding accounts and extending credit; and fees, balances and who performs FX transactions. Approximately two thirds of international payments are conducted this way, with 13% conducted 'on-us', that is within a bank's own branches, and the remaining 20 percent using cross-border retail (e.g. credit card) and high-value payment systems (IMF, 2017, p. 44). The payments industry in general is growing and provided 34% of banking revenues in 2016

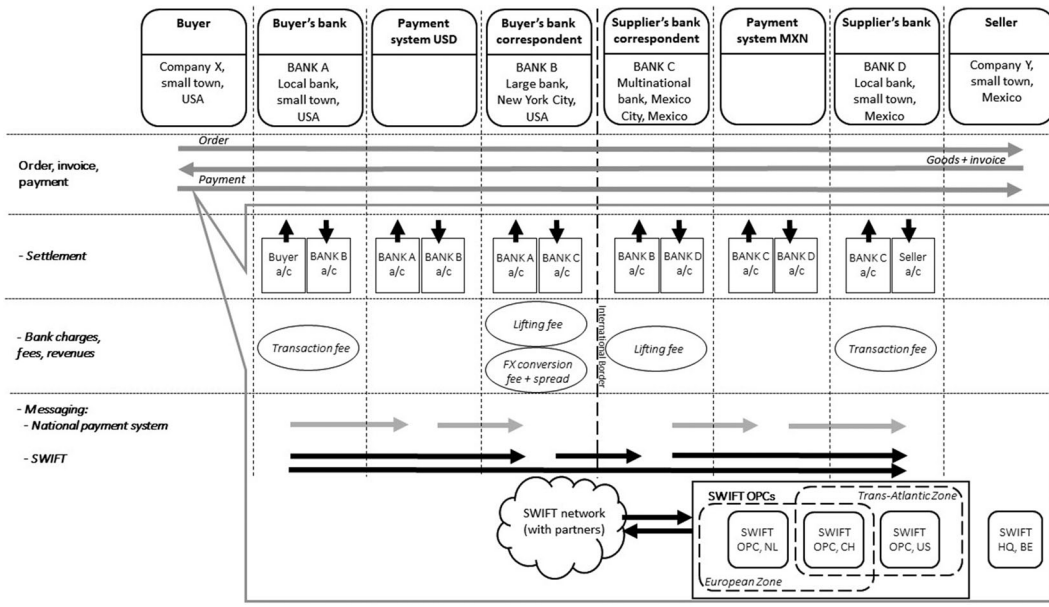

FIGURE 2 The anatomy of an international payment via correspondent banking. *Source*: Own illustration, based on ECB (2017), Gifford and Cheng (2016), McCune (2014)s, and SWIFT (2016, n.d.-b)

(McKinsey & Company, 2017). Revenue from cross-border payments, FX transactions and trade services amounted to USD 145 billion (Boston Consulting Group & SWIFT, 2017). Cross-border payments made up 2.5% of payments volume but 10% of revenue in 2010 (SWIFT, 2011). Payment revenues come from fees charged to the originator and the beneficiary, interest on 'float' (value difference between debiting the originator and crediting the beneficiary) and FX fees and spreads (Rambure & Nacamuli, 2008), which is the most profitable part (Collinson, 2017). Although CB is a crucially important infrastructure, it has been mostly overlooked outside of business and industry literature.

Figure 2 shows how CBR transfers funds in a particular currency corridor, here for a payment from U.S. dollar to Mexican Peso. This currency corridor is composed of the CB relationships between the banks in the boxes along the top of the figure: payer and payee, their banks, correspondent banks and national payment systems. There is a series of domestic transactions with the two banks ending up with more and less money in their respective correspondent accounts, shown in the settlement layer (McCune, 2014).

The flow of funds is concentrated in large banks in IFCs. Large banks settle the payments between each other across borders by debiting and crediting their correspondent accounts. These accounts are prefunded in anticipation of making payments. This is done in response to financial messages, as shown in the messaging layer at the bottom of the figure. Messages are stored with SWIFT but relayed serially between banks in a payment chain, with no overall central transaction visibility. At each stage, banks charge a transaction or lifting fee, effectively a toll for passing funds through their books by changing account entries and for passing financial messages to the next participant in the payment chain. Thus, there are two key pillars at the heart of this process, that is messaging and settlement, which define global flows of money. Via double-entry bookkeeping, the acts of changing account and ledger entries and balances involved in settlement make money move across borders. Mediating between all banks as the monopoly provider of the messaging network, SWIFT is both intermediary and infrastructure within the CB infrastructure.

Following Callon's (1986) terminology, the places in which correspondent banks, SWIFT and its data centres are anchored (Figure 2) can be characterized as 'obligatory passage points' in the global financial system (cf. Bassens & van Meeteren, 2015). SWIFT's significance stems from its quasi-monopoly intermediary position in global finance, a position of geopolitical consequence. Infrastructure is territorially grounded and thus subject to the regulations of a respective jurisdiction. Headquartered in Belgium, SWIFT has offices all over the world. Its operating centres (OPCs), in which every message is processed and stored for up to 124 days, are embedded in select institutional environments: the Netherlands, Switzerland, and the United States. While many data providers and users consider the importance of the jurisdiction and potential legal consequences when storing data, SWIFT data can carry geopolitically sensitive information, as revealed by SWIFT's involvement in international political controversies that highlight the intricate interplay of its governance, oversight and territorial embeddedness.

In what became known as the 'SWIFT affair', following the 9/11 terrorist attacks in the United States, SWIFT supplied data to U.S. authorities to allow them to analyse financial flows and thereby identify and thwart terrorist activity (de Goede, 2012). Due to having a branch in the United States, SWIFT was legally compelled to comply with U.S. subpoenas to provide access to the data. However, despite wanting to preserve its neutral and trusted position, the nationally focused and unequal nature of SWIFT's internal governance and oversight also played a part (Zarate, 2013). Having made confidentiality agreements with the United States regarding the data transfer and not informed EU data protection authorities, SWIFT subsequently found itself under investigation by the Belgian Privacy Commission when knowledge of the program became public in 2006. Incorporated in Belgium, SWIFT is subject to Belgian data protection law, which implements the EU Data Protection Directive (Fuster et al., 2008). This prompted SWIFT to re-design its OPC architecture to that depicted in Figure 2, so that intra-EU transaction data are no longer stored outside the European Union. Messages are always stored in two OPCs for resilience in case of disaster recovery (SWIFT, 2016), but given its footprint, data residing in both the Dutch and Swiss OPCs ensure intra-EU messages remain within the European Zone.

SWIFT stresses its apolitical nature and has created 'a "grand narrative" about itself as the world's foremost secure trusted third party' (Scott & Zachariadis, 2014, p. 138). However, it has been unable to avoid being further used as a geopolitical tool, as interdependence on it has been weaponized (Farrell & Newman, 2019) and has disconnected

banks from particular countries, such as Iran and most recently Russia, as part of sanctions imposed by the European Union and the United States (Milne, 2022). Disconnection from SWIFT makes it very difficult to conduct cross-border financial transactions but not impossible: information can still be transmitted using less efficient means, such as telephone, fax or email. Targeting the information leg of financial transactions is thus one means of enacting sanctions, but targeting the settlement leg of CB is another.

Power is crucially connected to money, but not all currencies are equal. The dollar is at the apex of the currency hierarchy (Kaltenbrunner & Lysandrou, 2017) due to its dominance in financial markets, central bank reserves and trade. This grants the United States autonomy, and the potential to exert influence, for example through sanctions (Cohen, 2013). As dollar transactions must ultimately be cleared in the U.S. payment system, access is through U.S. correspondent banks (Robertson, 2021) whose processing of large amounts of dollar flows means they are large users of SWIFT messages and subsequently also maintain a dominant role in its governance. Under the current sanction regime following Russia's invasion of Ukraine, the United States has leveraged SWIFT for sanctions against Russian banks but has also denied them correspondent relationships in the United States. This effectively means that they cannot conduct dollar transactions, a massive blow given the dollar's supremacy (Tooze, 2022). As a consequence, infrastructural assemblages allow the circulation of power (Pickren, 2018), in which the location of the financial institution performing settlement is important. Both the messaging and settlement legs of SWIFT and CB are thus key ways in which financial power is exercised across space.

CONCLUSION AND OUTLOOK

This paper has analysed the organizational architecture of the global payments system and highlighted the actors and agencies within it, thereby elucidating the (changing) relationships between data/information, global geographies and geopolitical power. In combining these different dimensions, we foregrounded the global payment system—and its distinct twin organization of SWIFT (messaging) and CB (settlement)—as a key infrastructure that makes global economic and financial activity possible in the first place. The paper began by showing the importance and historical contingency of separate processes of information transmission and account settlement in account-based money. Allowing finance to transcend geographical distance through the formation of myriad global networks, these principles underpin the operations and architecture of financial infrastructure today. We showed that financial messaging flows are the lifeblood of the global banking system, constituting how money moves across borders. Bound up with the hierarchy of international currency usage, both settlement (financial) and messaging (information) components feature distinct geographies of territorial embeddedness that differ in some ways but in others match and intersect.

By condensing important functions in finance to information, it becomes clear that unpacking financial function-cum-location is a valuable exercise that helps better comprehend the global networks of money. The insights from this study have consequences for future research. First, scrutinizing both financial infrastructure and information in their joint relationship as 'glue' that binds together economic and financial activity allows for a deeper and broader understanding of not only what constitutes financial activity around the globe, but also how and why specific information-based financial activity is embedded and linked to and between specific places. Second, financial infrastructure is a vital precondition, and this paper appeals for forensic, mechanisms-based analysis to help develop in-depth comprehension of the changing geographies underpinning the global networks and to help inform a growing body of literature on financial infrastructures.

Signposting at least two large shifts placing cross-border payments at a crossroads, there is much at stake for future research: (i) information as a basic component has evolved into a strategic resource, with data as a new, exploitable asset class, often by centralized digital platforms, and (ii) given the technological ambitions and regulatory sandboxes around the globe, the financial infrastructure architecture revolving around CB and account-based money may change. Addressing the first of these, while CB was the basis for earlier financial globalization, the contemporary phase is based more on big data arrangements (Derudder & Taylor, 2020). Digital platforms, like Apple Pay, seek to allow

non-bank actors to insert themselves in payment chains and monetize transaction information, while actors like PayPal have created successful 'closed loop' payment networks atop banks' infrastructure, and the fintech firm Ripple has created improved financial messaging using blockchain. SWIFT has been driven to platformize, centralizing financial transaction management and big data analysis, to retain but also optimize CB (SWIFT, n.d.-a).

However, the second shift above arguably heralds greater change. The weaponization of SWIFT has driven Iran and Russia to develop their own messaging systems (Nölke, 2022). Network effects mean that it is difficult to avoid using SWIFT for global payments but regional payment blocs can be formed around alternatives. Thus far, however, Russia's system, SPFS, processes only a small proportion of domestic payments, has struggled to attract foreign members and lags operationally behind SWIFT (Shagina, 2021). As we saw earlier, avoiding sanctions means not just replacing SWIFT but also the dollar, and a shift towards a multipolar monetary system is already underway (Eichengreen, 2022). China is building alternative financial infrastructure, with its Cross-Border Inter-Bank Payments System (CIPS) designed to facilitate cross-border payments in renminbi and therefore to promote that currency's internationalization. CIPS uses the architecture of CB, but with Chinese correspondents directly connected to it, and for now still uses SWIFT messaging, although this may eventually be replaced (Wong & Nelson, 2021). Until then, China has formed a 'defensive' joint venture with SWIFT (called Finance Gateway Information Service Co.) to locally store and monitor financial messages (Yeung, 2021). Other initiatives could replace the CB model by directly connecting national payment systems regionally (BIS Innovation Hub, 2021), but more radical change could come from new money forms, which involve changing the fundamental roles of some established actors, markets, networks and trust relationships (with)in networks. Based on cryptocurrency, digital tokens are a money form combining the separate messaging and settlement processes in one atomic peer-to-peer transaction on a shared distributed ledger, obviating the needs for settlement across accounts at different intermediaries and for separate messaging. Central bank digital currencies are being actively explored by states, with China's e-CNY in the vanguard. This new money form could provide real-time peer-to-peer settlement, including for cross-border payments, without current payments infrastructure (Auer & Böhme, 2020).

These are all challenges, not only to SWIFT's historical core missions, but also for other financial infrastructures, banks and the centuries-old model of correspondent arrangements and their current geographies. Research to further explore and address these exciting challenges is well under way.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

ORCID

Gary Robinson https://orcid.org/0000-0002-7582-2557
Sabine Dörry https://orcid.org/0000-0002-3599-8371
Ben Derudder https://orcid.org/0000-0001-6195-8544

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