Micropayments: The Final Frontier for Electronic Consumer Payments

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June 2006

Summary: *Small payments of less than $5 have resisted the wave of electronification that has swept consumer payments in recent years. However, a number of innovations — both new technologies and new ways of doing business — have done much to make such electronic "micropayments" less expensive and more convenient. Now, having proven themselves in several online markets, micropayments are poised to make inroads at the physical point of sale. This paper looks at some of the success stories (and failures), both in the U.S. and abroad, to identify possible conditions for success and to gauge the outlook for the future. It finds that industry structure, the coordination of standards, and customer preferences and experiences have all influenced the development of these products. While different markets around the world have supported different types of solutions, the successful products have delivered clear utility to the consumer, along with compelling economics for the different parties in the value chain. With critical mass in sight, the future looks promising.*

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1. Introduction

While the ongoing transition from checks toward payment cards and other electronic mechanisms has gained momentum in recent years,[1] the very smallest payments have stubbornly remained the domain of cash and coin. There is growing evidence that this is changing. Transactions of less than $5,[2] commonly known as micropayments, have recently started to garner attention from payment card associations, banks, technology firms, and entrepreneurs searching to profit from further adoption of electronic payments. For the many different stakeholders involved, a move away from coin- and paper-based payments for small purchases is expected not only to further increase the efficiency of the payments system[3] but also to facilitate entirely new types of markets and change the competitive landscape in others.

Micropayments, while trivial individually, are substantial in the aggregate. According to TowerGroup, micropayments of under $5, both electronic and paper-based, accounted for more than $1 trillion in consumer spending in 2003 at the point of sale (POS), across 400 billion transactions.[4] However, much room for greater electronification remains: In 2004, credit and

[1] Geoffrey Gerdes and colleagues at the Federal Reserve Board of Governors report that the annual number of electronic payments now exceeds the number of checks in the U.S. Much of the displacement of checks for medium-size transactions, according to Gerdes, has been driven by the rapid adoption of debit cards for POS transactions. See Geoffrey R. Gerdes, et al., "Trends in the Use of Payment Instruments in the United States," Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin*, 91, 2 (2005), pp. 180-201.

[2] Five dollars is an arbitrary, but frequently cited standard for delineating micropayments from conventional transactions. Some commentators, however, have used $10 or even $25 as the dividing line. This paper uses the smaller standard because, generally, the unique issues and challenges associated with micropayments are most pronounced among the smallest transactions.

[3] While the overall efficiency of the payment system should increase, apportioning the gains is not trivial. One complication is that as the number of cash transactions declines, the average cost of each transaction will likely increase. Further work will be necessary to disentangle and quantify these effects and determine the impact on the different parties to a transaction.

[4] According to *The Nilson Report*, cash still accounts for 21 percent of the *dollar volume* of transactions but over 38 percent of the total *number* of transactions. This compares to 38 percent and 35 percent, respectively, for payment cards of all types (including credit, debit, prepaid, and EBT cards.) Not surprisingly, of all the instruments surveyed, cash had the smallest average transaction amount — $27. See *The Nilson Report* (December 2005), p. 6.

debit transactions under $5 totaled $13.5 billion. In comparison, Visa processes a total of about $2 trillion in global transactions each year.[5]

Given the ubiquity and maturity of payment cards and the pace of technological innovation in other areas of payments, how are these and other factors playing out with respect to micropayments? Can we identify the forces or conditions of changes that may help us to anticipate future developments?

This paper aims to answer these questions. It proceeds by first addressing the impact of conventional payment mechanisms in the small payments area, discussing the size of the traditional market for micropayments for POS purchases, and introduces the implications for new markets related to payments for online content. It then identifies some of the reasons that electronification of small payments has lagged and how further progress in this area may benefit consumers and merchants. Next, it looks at several examples of current and past attempts to capture parts of this market in order to infer some specific contributors to success. Finally, the paper applies basic economic intuition to deduce more general conditions that may be required for continued progress and considers how the market may further evolve.

The paper concludes that, despite some structural limitations, the existing payment card infrastructure and related products are likely to be the primary vehicles for electronifying micropayments in the U.S. in coming years. Outside the U.S., smart card applications will likely remain relevant, and phone-based micropayments could become even more important. At the same time, nontraditional financial services entities and technology companies may also play an important supporting role. Particularly in the U.S., but in other national markets as well, the paper concludes that we may be nearing a "tipping point," where the requirements for development in these network businesses are coming together, suggesting more rapid growth rates in the future.

[5] Robin Sidel, "Credit-Card Firms Go for Small," *Wall Street Journal*, November 1, 2005.

2. Market Size, Prospects, and Challenges

The potential market for POS-based micropayments in the U.S. is very large. A first order approximation of the magnitude of these transactions can be gleaned from looking at aggregate personal consumption expenditures (PCE) compiled by the Bureau of Economic Analysis at the U.S. Commerce Department. In 2004, PCE reached $8.214 trillion — 78 percent, or $6.4 trillion of which was payments for goods and services.[6] Cash was estimated to account for $1.32 trillion, or 20.55 percent of that spending total; 38 percent was attributed to payment-card-based transactions of all types.[7] Because the average ticket amount of a cash transaction is the smallest of the payment methods considered ($27), cash accounts for a disproportionately high percentage of the number of transactions — over 38 percent.

From another perspective, it may be useful to consider where many of these transactions actually occur. Quick service restaurants (QSRs), gas stations (for nonfuel purchases), convenience stores, movie theaters, parking garages, transit services, and unattended vending areas are good examples of retail environments that still mostly handle cash-based transactions.

In particular, electronification of unattended purchases has often been seen as the "killer application" for the smallest sort of micropayments. These include pay phones, parking meters, vending machines,[8] and coin-operated laundries — all items for which coin usage is required, but is often especially inconvenient, for both the user and the vendor.[9] Adding transit expenditures, which includes consumer spending for taxis as well as municipal transportation, contributes

[6] The remainder, approximately $1.8 trillion, consists of imputed values for nonpurchases, such as the rental value of owner-occupied housing.
[7] Bureau of Economic Analysis, U.S. Department of Commerce, "National Income and Product Accounts Tables: Table 2.3.5. Personal Consumption Expenditures by Major Type of Product," revised April 28, 2006, and *The Nilson Report*¸ Consumer Payment Systems (December 2005).
[8] In 2004, vending machines were estimated to have taken in $24 billion in cash and coins at the POS. See Leo Van Hove, "Cash Substitution: Why and How," *Journal of Payment Systems Law*.
[9] For more information, see Leo Van Hove, "The New York City Smart Card Trial in Perspective: A Research Note," *International Journal of Electronic Commerce* (Winter 2000-2001), pp. 119-231..

another $14.1 billion,[10] leading to a reasonable (if conservative) lower bound for an estimate of the potential size of the POS micropayment market of approximately $160 billion (Exhibit 1).

While small cash and coin purchases have, for decades, defined the market for micropayments, more recent developments in e-commerce have brought about a completely new, parallel market for online micropayments. Most of these transactions are for so-called digital content. Services like Apple's iTunes[11] have made tremendous progress in just a few years, changing the entire competitive landscape of a major industry through technological innovation and new business models that marry product, price, and convenience.[12] More broadly, through 2006, music purchased entirely through digital channels is expected to account for 20 percent of all music industry revenues, with 8 percent of this for downloads to a computer and 12 percent for cell-phone ring tones.[13] All told, in 2005, more than 350 million songs were purchased for download,[14] in a market for recorded music, both physical and digital, that is estimated to account for total sales of between $32 billion and $40 billion.[15] The market share of the digital outlets is expected to grow significantly as this distribution channel matures. In the future, electronic micropayments may also facilitate online merchandizing of podcasts, video content, and much more — creating yet another potentially huge market.

For POS micropayments in particular, cost has traditionally been a main deterrent to electronification. Simply put, many merchants engaging in small transactions have not encouraged the use of payment cards — despite the instruments' pervasiveness and steadily

[10] See the Bureau of Transportation Statistics' National Transportation Statistics (NTS) report, available at http://www.bts.gov/publications/national_transportation_statistics/

[11] iTunes accounts for 83 percent of all online music sales. See *The Economist*, "Your Fix or Mine? Online Music," March 11, 2006.

[12] The market for digital content is different from that of most goods sold in the physical world. Digital content is distinguished by having very low (effectively zero) marginal cost. Therefore, producing and selling additional product does not incur much incremental expense for the merchant. Because of this, once the cost of making payments is reduced (with a negligible cost of goods sold, payments expense is one of the largest cost factors for such products) the economics of selling digital content can be compelling, suggesting growing opportunities in this market.

[13] Deloitte Touche Tohmatsu's *Technology, Media and Telecommunications* report, 2006.

[14] Nielsen Soundscan.

[15] Ed Welsch, "Digital Music Group Sets IPO, in Bet That Oldies Will Still Rock," *Dow Jones Newswires*, October 26, 2005.

growing share of the market for larger transactions. In a credit purchase, although the interchange paid to the issuing bank is variable — charged as a percentage of the transaction amount — there is a flat fee component as well. Debit, while having a lower interchange rate, has a similar cost structure. For smaller purchases, the fixed component becomes much more pronounced as a percentage of the transaction amount, and interchange, always a significant marginal cost concern, remains a stumbling block. Therefore, many retailers may consider accepting a credit card for a $50 transaction to be economically defensible, but not for a $2 one. Thus, billions of small transactions have been allowed to take place outside the payment card net.

Other factors are at play as well. The need to wait for a receipt, sign it, and verify a signature or enter a PIN is often seen by consumers and merchants to take too much time when a small amount of cash and change would do just as well. This problem is especially acute at merchants like QSRs or when making transit purchases, especially for trips on city buses or taxis. In these situations, even small delays can cause queuing, which may lead to lost revenue or customer dissatisfaction. Technological innovations have now made card acceptance theoretically feasible in many of these locations. Nonetheless, despite electronic payments potentially being more convenient than cash for both buyer and seller, inertia from both parties has continued to sustain cash acceptance in many of these areas.

In summary, despite challenges, innovative products and approaches from card networks and issuers and payments processors, as well as from some unexpected quarters such as transit companies and online media, have moved beyond the proof-of-concept phase. The paper's next section will outline a framework for categorizing the diverse collection of products and business models that have been developed to serve this market. The paper will then look at some examples in more detail, emphasizing recent success stories to illustrate why the future for electronic micropayments looks increasingly promising.

3. Survey of Instruments and Business Models

Taxonomy and Framework

Given the wide range of product types, business models, and entities involved in micropayments, it is useful to apply a framework to categorize the industry and organize the discussion. An approach proposed by James McAndrews, of the Federal Reserve Bank of New York, may be helpful in this regard.[16]

According to McAndrews, payment products generally fall into three broad categories. First, there are techniques that allow such payments to be made via credit cards or equivalents over proprietary communication networks or open networks such as the Internet. Although McAndrews uses somewhat different language, for the purposes of this paper, such methods can be described as credit-based. Second, there are approaches, such as debit, electronic checks, or ACH, that involve transmitting instructions to banks to transfer funds between demand deposit accounts or equivalents. These may be called account-based, since they essentially provide directions to move funds between depositories. Finally, there is the diverse group of stored-value[17] applications, such as transit cards, digital cash, or electronic purses, that are functionally quite similar to currency, providing a means to make payments from funds loaded on a card or similar device without the need to authenticate or clear the transaction through a central network.[18]

McAndrews' structure provides a means to categorize and identify the key aspects of a wide array of novel products. Understanding the predecessor technologies and the relationships

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[16] James J. McAndrews, "E-Money and Payment System Risks," *Contemporary Economic Policy* (July 1999).

[17] These cards are different from the "prepaid" debit card product growing increasingly popular in America. That product combines a conventional magnetic stripe card with a prefunded "account" domiciled at a financial institution. Prepaid cards are authenticated and transactions are cleared "online" through EFT or credit card networks. Aside from their unique, "pay-early" funding arrangement, these cards, often branded with a card association logo, offer functionality similar to that of conventional debit cards and, thus far, have not targeted micropayments in particular. For this reason, they are not discussed as a distinct category.

[18] Some stored-value applications, for example, the Proton card, reduce risk by actually reconciling "online" between merchants and the issuing bank at least once a day. If transaction irregularities are discovered, the card can be deactivated.

between these categories of payments is important to appreciate the manner in which these disparate techniques have evolved and why. Doing so and teasing out the influences on their development are useful in understanding likely contributions to success and to anticipate how things may evolve further in the future.

Fundamentally, each of the examples that follow aims to address the challenges of cost and convenience at physical point-of-sale locations or in the newer marketplace for the purchase of online digital content. The survey includes several initiatives coming out of Japan and Hong Kong, where products aimed at electronification of micropayments have followed a different developmental path than in the U.S. It also touches on a set of European stored-value products that have been specially tailored for micropayment transactions. In the U.S., the more prevalent micropayment models are based on traditional payment cards. “Contactless” payments are clearly an extension of the familiar credit card product aimed at increasing both the speed of processing transactions and convenience at the POS. But even more novel solutions from Peppercoin and PayPal are predicated on the credit card infrastructure as well — They implement an additional layer of functionality designed to make cards less expensive for merchants or more convenient for consumers, both at the POS and online.

As in any new area with rapid innovation, there have also been many failures. To provide some context and cite one illustration of a failure to adequately address the costs, convenience, and consumer acceptance challenges noted above, this section closes with an account of the Mondex “smart card” experiment conducted in New York City during the 1990s.

Credit-Based Micropayments

Standard magnetic stripe credit cards — the most mature consumer electronic payment product — have historically not had a meaningful impact in facilitating micropayments. While extremely successful in general, a number of factors have discouraged their use for micropayments, foremost being unfavorable economics for merchants and a degree of

inconvenience when compared with cash.[19] Until rather recently, the card industry, experiencing steady growth in cards, transactions, and volume, was not compelled to address these shortcomings. However, as the U.S. card market has continued to mature, fewer opportunities for top line growth from traditional business models and strategies remain (Exhibit 2). In response, issuers and the card associations have taken steps to make the core credit card product more relevant for small purchases, especially at the POS. Their response has been: 1) to modify transaction economics or provide financial incentives to merchants, and 2) to reduce frictions and increase consumers' interest in electronic payments at the POS with new types of access devices.

To improve transaction economics, the major card associations have devised new pricing structures. For example, merchants who join the Visa "Small Ticket Payment Service" can realize a further 20 percent discount on fees for transactions of $15 or less. Such discounts apply to normal credit card interchange of 1.65 percent plus 4 cents. To increase convenience, Visa has eliminated the signature requirement for transactions of less than $25 in 17 historically low-fraud merchant segments.[20] MasterCard has a similar version of this program that offers reduced interchange fees for selected merchant categories.[21] American Express, while not currently offering discounted interchange, does waive the signature requirement on transactions of any size conducted via its contactless cards.

New access devices designed to facilitate such contactless payments are a rapidly expanding product category for each of the major credit card networks, intended specifically to increase consumers' use of payment cards and to improve throughput at the POS. Contactless

[19] As merchants have continued to install POS terminals based on Internet Protocol (IP), card authorization times have diminished, reducing the time required for payment card acceptance at checkout. (IP is a flexible communications protocol that offers more robust and potentially higher speed authorization connections when compared to traditional dial-up lines.) Yet impediments remain: Entering a PIN, or even waiting to sign a receipt as is done with signature debit and credit, is still thought to create a friction for POS transactions at very high volume merchants, such as QSRs, or for transit purchases. For this reason, an opportunity exists for other technologies, especially innovations such as contactless payments, and for other card association initiatives to bring about further throughput gains.

[20] Isabelle Lindenmayer, "Visa Eases Small-Ticket Restrictions," *American Banker*, November 1, 2005.

[21] CardLine, "Merchants Want Same Rules for All Cards," December 9, 2005.

payments have so far been mainly delivered in two forms around the world: 1) with RFID[22] chips embedded into standard magnetic stripe payment cards, and 2) with such chips embedded into cell-phone handsets. Another application, contactless toll-payment mechanisms, will be discussed separately.

For consumers, the value proposition of both of these approaches is one of convenience: Greater ease of use and speed of checkout are expected to encourage consumers to pay electronically rather than use cash. For credit-card-based contactless payments, beyond RFID devices and terminal enhancements at the point of sale, the transaction dynamics are the same as those for a normal card product. In many respects, card-based contactless payments may be seen as extensions of the core payment card product. While offering a slightly different customer experience at the point of sale, they are not generally being marketed to new customers and typically replace an issuer's existing card products. Delivery is entirely controlled by the issuing bank and is rather straightforward. While the technology is somewhat different, the products' inheritance from familiar payment card products is an important factor in overcoming any adoption challenges.

To encourage merchant adoption of card-based contactless payments, some major merchants, including McDonald's have received POS terminal subsidies from the card associations,[23] saving them $50 to $100 per checkout lane. The results have been promising. Visa reports that member banks have issued 4 million contactless cards as of early 2006, and MasterCard reports that 5 million of its "PayPass" branded cards have been distributed. These cards are being accepted at between 20,000 to 25,000 merchant locations in the U.S., including all Duane Reade and 7-Eleven locations.[24] While many more merchants do not yet have contactless-

[22] Radio Frequency Identification (RFID) is a short-range communications technology that uses modules containing silicon chips and antennas to receive and respond to radio-frequency queries from a nearby transceiver. The technology is used in retail inventory management, and more recently, to enable contactless payments on payment cards, cell phones, or other form factors.
[23] Jonathan D. Epstein, "Just Wave and Pay," *Buffalo News*, September 25, 2005.
[24] David Breitkopf, "Vendors Prepare for Growth in Contactless," *American Banker*, February 9, 2006.

enabled terminals, the rate of growth of cards and POS installations has been dramatic — especially given that these contactless payments initiatives are barely two years old.

In contrast, the provision of phone-based payments is more complex because of the variety of parties involved in providing the technology. It requires a more significant shift in consumer behavior and may potentially require new business models.

The success of cell-phone-based payments has been uneven around the world; there has been widespread adoption in Asia (both with credit cards serving as the back-end funding mechanism and, alternatively, with the phone company acting on its own), less in Europe, and very little in the U.S. except on a trial basis. One such U.S. trial was conducted by MasterCard International and Nokia in Dallas, Texas, in 2003. This trial used phones to initiate contactless payments, which were then settled by credit card.[25] However, because handset makers and wireless operators could not justify the costs associated with embedding specialized chips in phones that would only do one thing — payments — and not provide other functionality, the program never went beyond the test stage.

A subsequent trial, also involving Nokia, along with Cingular Wireless, Philips, JPMorgan Chase, and ViVOtech, was started at the Philips Arena in Atlanta, Georgia, in December 2005. Its relevance has similarly been limited by the fact that the technology required to participate is available only within one phone from a single manufacturer — in contrast to the wider acceptability and interoperability of RFID-based contactless payment card products.[26] For such an approach to be more compelling in the U.S., some have suggested that a different, more versatile technology may be required, one that could work across manufacturers and offer more features to justify the operational investments by banks. As of yet, no such alternatives have emerged.

[25] Digital Transactions, "How Contactless Payment Can Piggyback on NFC," January 2006.
[26] Electronic Payments International, "CASHLESS PAYMENTS: Contactless Cuts Out Cash and Cards," February 28, 2006.

Another potential impediment is the need for cell-phone operators to contend with unfamiliar regulations at both the federal and state level. Compliance with these different bodies of law could complicate this business model, especially for nonbanks. For instance, the Federal Reserve's Regulation Z, enacted to implement the federal Truth in Lending Act, is well known to banks that issue credit cards. If this regulation were deemed to apply to phone-based billing, operators would be required to provide the same degree of statement disclosures, detailed billing, error protection, and so forth, that credit card companies traditionally have granted.[27] Additionally, the Federal Communication Commission's "truth-in-billing" rules, which have just recently been extended to cellular service, may limit the flexibility of U.S. providers to present nontelecommunications charges on a phone bill.[28]

Public utilities commissions (PUCs), which operate at the state level, also have much to say about what sort of charges can be added to cell-phone bills for subscribers within their jurisdiction. Finally, cell-phone providers could be affected by other state laws, which, while not explicit, suggest privacy concerns for utilities regarding their ability to share customer data with payments firms or financial institutions. As a result, it may be more difficult for U.S. telecommunication providers to develop partnerships allowing for cell phones to be used as instruments for micropayments.[29] In light of these regulatory complications, it remains to be seen whether new business models or partnering arrangements with banks will be effective in helping to develop sustainable phone-based micropayment alternatives in the U.S.

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[27] See, e.g., Regulation Z § 226.1(c), which identifies the types of businesses subject to the regulation, and § 226.2(a)-17, which defines *creditors* as they pertain to the regulation and explains the types of credit covered. For a more detailed explanation, see Mark Furletti and Stephen Smith, "The Laws, Regulations, and Industry Practices That Protect Consumers Who Use Electronic Payment Systems: Credit and Debit Cards," Payment Cards Center Discussion Paper, January 2005.

[28] See 47 C.F.R. § 64.2401(a)(1).

[29] See American Public Power Association, "Consumer Privacy and Public Information Issues," June 13, 2003, available at http://www.appanet.org/aboutpublic/index.cfm?ItemNumber=9566&sn.ItemNumber=2102.

Contactless highway toll payments. Besides card- and phone-based products, another type of access device has been developed and promoted for use in toll-access highways across the U.S. by a completely different sort of sponsor. Several highway systems, some connecting multiple states, have experimented with these devices, which typically embed an RFID transponder in a windshield-mounted device for toll payment. The transponder identifies account holders and tracks toll-usage information, which is then immediately relayed to a central system where a user's account information is maintained. Most of these systems operate in a prepaid manner, in which a minimum credit balance, for instance, $25, is required. Such schemes can also be seen as novel ways to capture and aggregate a number of micropayments into single credit-based transaction.

E-ZPass, a toll-payment system in the northeastern U.S., is arguably the most recognized example of this approach. The E-ZPass system got started through the collaborative efforts of state tolling agencies in New York, New Jersey, and Pennsylvania,[30] which formed the E-ZPass Interagency Group (IAG) in 1991 to devise an interoperable system that allows electronic toll collection to reduce congestion around the New York metropolitan area.[31] Today, there are 11 million E-ZPass transponders in use, and the system supports $1.3 billion in toll purchases each year.

E-ZPass acceptance has been extended to related transit purchases. For instance, the devices are accepted for payments at parking lots at all three major New York City airports and the Albany, New York, airport. Additionally, there was a trial, since discontinued, to accept E-ZPass for payments at McDonald's drive-throughs in Long Island, New York.

[30] These agencies included the Pennsylvania Turnpike Commission, the Port Authority of New York and New Jersey, the New Jersey Turnpike Authority, the New Jersey Highway Authority (operator of the Garden State Parkway), the New York Metropolitan Transportation Authority, the New York State Thruway Authority, and the South Jersey Transportation Authority (operator of the Atlantic City Expressway.)

[31] See the E-ZPass (IAG) Interagency Group (http://www.e-zpassiag.com/IAG-Home.htm).

The E-ZPass example is illustrative for several reasons: 1) it demonstrates the need to build demand and supply in tandem; 2) it highlights the importance of efficient coordination among the parties involved in delivery — in this case, coordination was easier because of the roughly similar contributions and expectations of the different transit agencies involved; and 3) it suggests that price and convenience are of great importance in motivating acceptance. Its success also confirms that nonbank sponsors can motivate innovation outside of the traditional, bank-driven payments industry while still leveraging existing infrastructure — the payment card rails — in the background. At the same time, the apparent failure of E-ZPass to extend its franchise much outside the transit market, once it ran up against the flexibility and wider acceptance of general-purpose payment cards and cash, points to a critical limitation of closed-loop approaches. These issues of matching demand and supply are noted in several of the other payments products to be discussed and are revisited in the analysis section that concludes this paper.[32]

Aggregators: Peppercoin and online sales. Although it's a different type of product offering a novel back-end technology to aggregate small payments at a single merchant, Peppercoin shares many of the characteristics of E-ZPass and can ultimately be seen as a credit-based product as well. It, too, aims to address the cost and convenience challenges in the small payments business. It achieves cost savings through sophisticated algorithms that aggregate many smaller credit card transactions made at a single merchant into a single line item.

It does this primarily through technology developed by computer scientists from MIT, who remain involved with the firm. Today, the core technology, marketed under the rubric of "intelligent aggregation," allows merchants to analyze shopping patterns and dynamically adjust the way transactions are rolled up to maximize profitability. Doing so requires assessing a number of tradeoffs. For instance, intelligent aggregation enables merchants to weigh the

[32] The E-ZPass example demonstrates the benefits of coordinating expectations of *future* demand, a phenomenon important in network economies — such as that for payments.

complex economic tradeoff between reduced transaction costs by controlling interchange versus delayed cash flow from booking transactions later.[33]

The underlying Peppercoin technology has recently been extended to support a suite of different payment schemes, including pay-as-you-go, prepaid, subscription, and postpaid, all of which are ultimately billed to a customer's credit card. All of these variations are ultimately built on the intelligent aggregation technology, but they offer different funding dynamics to meet the needs of a range of buyers and sellers of different types of products. By developing a broader product set, Peppercoin has enabled the implementation of loyalty programs in markets that, when cash was the only option, allowed only anonymous transactions. Today, the firm's technology is being applied in a variety of previously cash-only, unattended applications: arcade video games, jukeboxes, and parking meters across the country.

Similar approaches to aggregating small payments have been a very powerful force in enabling the growth of online content sales. It is interesting to note that many digital media companies made their initial forays into this market by charging for content through a subscription model. They soon learned that too many consumers resisted paying fixed monthly fees for unlimited content when they were interested in only a few specific content purchases. Simplified à la carte pricing provided the flexible value proposition that enabled this category to gain traction. iTunes became successful by using its own proprietary software to aggregate several individual song purchases into a single transaction that would appear as a single line item on a customer's credit card bill.

Today, as companies like Peppercoin are doing the same — marrying the flexibility of credit cards with improved economics — it is possible that the same dynamic may be repeated

[33] Recognizing its dependence on acceptance of this methodology by credit card networks, Peppercoin has sought to cultivate relationships with the major payment networks. It has recently announced a formal alliance with MasterCard for joint promotion. Under the terms of the deal, vendors who use Peppercoin will get a discount on their fees if the buyer uses a card with the MasterCard brand. The firm emphasizes that its technology offers the prospect of extending credit card penetration into inaccessible markets, leading to revenue gains that more than offset the decreases in fixed costs of transaction processing.

more broadly. The “pay as you go” approach made possible through aggregation and validated through the incredibly successful market for music and related digital content can likely be extended to purchases made through a variety of channels. In the process, acceptance of micropayments may bring about new markets or reorder existing ones.

However, potential challenges remain. The additional layer of disintermediation between issuers and customers brought about by aggregation may cause additional complexity for banks, especially with respect to authorization/authentication and customer service. Banks must be able to confirm that a customer is actually permitted to make a purchase of an individual item. With the potential need to repeat this process many times, especially in the case of very inexpensive digital content, confirming such permission introduces additional frictions into transaction processing. At the same time, issuing banks, which maintain the proximate relationship with the consumer, are contacted first in the case of billing questions or disputes. If banks have incomplete data about the details of an aggregated transaction, they may find it challenging to deliver a high level of customer service. Both of these challenges could be mitigated if providers of aggregation services and issuing banks continue to work together to improve the integration of operational and data communications.

Account-Based Micropayments

Account-based products have had a mixed record in facilitating micropayments. With average ticket sizes significantly smaller than credit card purchases, the standard debit product would seem close to being a viable vehicle for micropayment transactions as currently configured. But debit cards share many of the same limitations as credit cards and may suffer from lingering consumer confusion over differences between the PIN/signature functionality. For the smallest transactions, issuers, to date, have not done as much to improve the economics and convenience of debit as they have with credit.

There are several possible explanations for why more innovation has occurred with credit products than with debit. Most relate to economics. First, with greater interchange revenue, credit cards are more profitable to issuers, allowing greater margins to support product development and provision of infrastructure. At the same time, with slowing growth and a crowded market, issuers are seeking ways to differentiate their products and move them to the "top of the wallet." Second, the credit card industry is heavily concentrated among the top issuers operating in broad national markets. This means that, e.g., a credit card from Citibank could be marketed and used across the country, whereas a debit card from the same bank would likely be relevant only in states where the bank has a retail presence. This fragmentation makes product innovation more costly and, to the extent that innovations require investments by merchants, less attractive to national retailers.

Automated clearinghouse (ACH) transactions are another form of account-based service, which, despite being inexpensive, are not inherently well suited to micropayments. ACH was developed as a robust and highly efficient nationwide electronic funds transfer system to facilitate the interbank clearing of electronic payments between participating depository financial institutions. However, because it was designed primarily as a back-end system built around a batch-processing dynamic, it lacks many of the features that have made payment cards so successful at the POS. Although a number of efforts are underway to adapt ACH for retail payments, there is no evidence that these initiatives will be especially suitable to micropayments. However, ACH, much like credit card accounts in the EZ-Pass example, can be packaged as a settlement mechanism for a number of more elaborate payment platforms or products that could be. PayPal is a notable example.

PayPal. PayPal, a division of online auction house eBay, has more than 86 million account holders worldwide and is available in 56 countries.[34] It is best known for facilitating

[34] Paul Lima, "E-tailer Credits Cheap Billing for Success; Third-Party Firms Cater to Small Merchants," *The Globe and Mail*, October 27, 2005.

payments on the eBay Internet auction site, but it also offers a diverse set of products and services, both retail oriented and commercial, including a merchant-acquiring business. However, this analysis focuses on its recent initiatives to be a more important player in small online payments and efforts to adapt its technology for small payments in the physical world.

At present, while credit cards are the ultimate funding mechanism for more than 50 percent of eBay's transactions, it provides for multiple ways of paying for purchases.[35] In some respects, PayPal blurs the categories of a simple payment taxonomy, since buyers can use it in conjunction with a regular payment card, or they can deposit funds into an "account" via low-cost ACH debits from a depository institution for purchases to be completed later. In fact, PayPal effectively offers a third means as well — because transactions can be funded directly from funds "on deposit," a person who buys and sells frequently can immediately apply sale proceeds to make new purchases, obviating the need for major ongoing "topping up" transactions.

This online virtual account feature affords PayPal certain unique capabilities in its pursuit of micropayment opportunities. The company encourages frequent transactors to keep money in their PayPal accounts, which provide a potential source of "float" income and lowers the costs of processing transactions. Because PayPal handles dispute resolution entirely through online channels, it incurs lower overhead costs. Less overhead, along with its integrated acquiring and processing, allow the firm to enjoy a relatively low-cost business model. These attributes arguably put PayPal in a stronger position to offer favorable pricing terms for the small transactions that demand them.

Accordingly, seeking to share in the success enjoyed by iTunes and other digital content vendors, PayPal has devised a new small-dollar payment-pricing scheme for purchasing online media such as individual songs. Under this pricing structure, for transactions under $3, sellers

[35] PayPal has provided additional utility to consumers by serving as a trusted intermediary. By building a well-regarded brand, it was able to convince wary consumers, who may have been unwilling to carry out transactions online, to divulge their credit card or banking information. By doing so, security-conscious consumers would be able to make transactions comfortably online, without the need to repeatedly reveal their financial information to unfamiliar counterparties.

will pay only 5 percent of each transaction plus 5 cents, which would amount to considerable savings versus the old standard payment-card pricing model.[36] This plan also offers considerable savings compared with PayPal's normal pricing scheme, which charges 1.9 to 2.9 percent of a transaction plus a flat fee of 30 cents.[37] This translates into a reduction of the fees merchants are charged from 35 cents to 15 cents on a $2 sale.

PayPal has also recently made limited forays into POS micropayments. Employees at Cisco Systems Inc., Palm Inc., and PayPal and its parent company eBay can use their employee ID cards to pay for lunch in their company cafeteria, with funds debited from their PayPal account. These employee ID accounts are prefunded by employees via a page on their company's internal website.[38] Despite this pilot, PayPal's limited POS presence suggests it is likely to remain a more viable option for online micropayments than physical transactions for some time.

The PayPal example is important for several reasons. While initially a proprietary network, it leveraged existing payment methods to provide settling capability while using its technological capabilities to facilitate new types of transactions in a new type of market. It was able to build infrastructure, a brand, and a customer base in a less contested market than stand-alone retail consumer payments. Once the initial infrastructure investments were made, PayPal, using robust fraud controls and structural efficiencies, extended its franchise, with favorable economics for itself and its merchants, to offer micropayments more broadly. As will discussed further, similar capabilities have contributed to the success of other recent micropayment initiatives.

Stored-Value Micropayments

The micropayment products that fall under McAndrews' third category, stored value, specifically relate to those that embed monetary value on an access device — typically using a

[36] Dan Weisman, "Merchants Tap into Small-Ticket Sales," *Cards and Payments*, October 2005.
[37] Electronic Payments International, "PayPal Launches Micropayments Fee Structure," September 2005.
[38] http://www.digitaltransactions.net/newsstory.cfm?newsid=790

card-based form-factor — which may also include a chip that provides functionality beyond that of a conventional credit or debit card. While stored-value and credit functionality can be combined in a single product, the card-based examples cited here were developed as offline products and deployed independently of MasterCard, Visa, and other major payment networks. Such proprietary devices rely on the chip to track value between purchases without the need to verify account balances for each transaction with a central system. For authentication purposes, some products allow customers to use a POS terminal to enter a PIN that is verified against the data encoded on the card itself.

Notably, most of these products in regular use today are found outside the United States. Consumers in many countries have adopted, often outside of traditional banking relationships, a single brand "smart-card" product, also known as an e-purse.[39] An attractive feature of many of these e-purses is their efficiency at the POS. These payments are clearly faster than cash they are designed to replace: One study has estimated e-purse purchase times to be only 14 seconds compared with 19 for cash, a 35 percent savings. By contrast, conventional magnetic stripe debit transactions were found to have taken 26 seconds to complete — *longer* than cash transactions.[40]

Yet these products have had mixed records, with early success in both Asia and Europe, although recent indications show that these products may not realize their expected potential. Nonetheless, both regions have demonstrated that such products can work: Their early success contrasts with attempts in the United States to provide the same sort of smart-card-based micropayment products.

Hong Kong's Octopus E-Purse. The Octopus stored-value card in Hong Kong, once used exclusively for transit purchases, is now accepted for small purchases throughout the city.

[39] An electronic purse is a reloadable, general-purpose stored-value card with an embedded computer chip that tracks the card's value.
[40] Leo Van Hove, "Cost-Based Pricing of Payment Instruments: The State of the Debate," *De Economist*, 152, 1, 2004.

With 12 million cards outstanding in Hong Kong, Octopus facilitates 9 million transactions daily, accounting for $2.2 billion in annual transaction volume. Each transaction represents about 7.7 Hong Kong dollars, or $1 U.S., on average. The cards can be reloaded three ways: 1) at ATMs, 2) at partners such as 7-Eleven, Circle K, McDonald's, and Starbucks, and 3) via direct linkages to a bank account or credit card that will replenish the card when the balance falls below a certain level. Its penetration of the market is tremendous; over 95 percent of Hong Kong residents actively use the product.[41]

This product is also noteworthy because banks were not directly involved in its roll-out.[42] A consortium of transportation firms has supported its development, and this group issues the cards.[43] Another important aspect of Octopus is that it was able to effectively corner a sizable market. Though small in land mass, Hong Kong has a large population. Most residents heavily use public transportation, which is provided by a small number of affiliated services. Octopus exploited this extremely productive closed-loop environment to get its cards broadly and quickly adopted — a feat that may not be easily replicable outside a tightly integrated, cohesive market. In some respects, it is similar to the E-ZPass experience, but the greater density of the Hong Kong market and the portability of the form-factor have made it practical for consumers and merchants to use beyond the transit market.

Japanese Stored-Value Products. Like Hong Kong, Japan presented a special set of conditions that made a stored-value product attractive. First, fixed-line communications costs have traditionally been high, making online credit card authorization more expensive. Second, belying the fact that Japanese consumers are renowned for being very heavy cash users, Japan's currency itself is not particularly convenient: The lowest denomination of paper money is the

[41] Eric Tai, "Incentives Keynote Address," *Journal of Payment Systems Law*.
[42] However, once Octopus moved outside its closed-loop environment into retail payments, it did need to secure a limited Hong Kong banking license as a deposit-taking company.
[43] Andrei Hagui, "i-Modes and Octopi: Will Asia Reshape World's Payment Industry?" *Market Platform Dynamics* (January 2006).

1,000-yen note, roughly worth about $8.80 at current exchange rates. In general, it has been difficult for people to carry around the necessary cash to make a purchase or the change they get from doing so. With bank cards of negligible importance in the country, the advent of stored-value and other alternatives to unwieldy cash and coin proved to be especially attractive to Japanese consumers.

In response, Japan has developed two similar e-purses for POS micropayments. The Suica card, launched in November 2001 by the regional railway operator JR East to pay for ticket purchases in and around Tokyo, now has over 13 million cardholders and is used 120,000 times a day.[44] It is now being promoted for use for retail purchases. The Edy e-purse, on the other hand, has been targeted to retail purchases from the outset. It is now accepted at approximately 22,000 different retail establishments. The large number of cardholders and transactions is one measure of these products' success in Japan; another is the recently observed changes in coin usage. The Bank of Japan has reported that coins in circulation dropped by 0.05 percent in 2005, marking the first time that such a decrease has been observed since the bank started keeping records 30 years ago.[45] The first few months of 2006 show additional declines.[46] Like many of the products discussed above, these card-based products became successful in Japan by offering convenience that legacy payment products could not.

European E-Purses. E-purses have been in use in Europe for over 10 years. For much of that time, especially around the turn of the 21st century, they showed steady growth in cards and transaction volume. The Belgium-based Proton card is one of the most long-lived of this crop of products. It gained substantial recognition in several major EU markets, and after nearly a decade

[44] Electronic Payments International, "Contactless Chips Drive Mobile Payments in Japan," Lafferty Limited, August 29, 2005.
[45] Asia Pulse, "Japan's Coin Circulation Growth Down for 1st Time," September 5, 2005.
[46] See http://www.boj.or.jp/en/type/stat/dlong/fin_stat/money/cdab0010.csv

of operation, it is still an ongoing business, with 10.1 million cards outstanding.[47] Today, in some cities in the Netherlands, it is the only way to pay for public parking. Nonetheless, this "success" story can boast having displaced only 4 percent of transactions that would otherwise be done with cash.[48]

Going forward, the outlook does not appear to be more favorable for Proton or similar products. Over the past few years, cardholder growth has flattened, the number of transactions has fallen, and only a fraction of the outstanding cards are deemed to be "active," generating 107 million transactions in the core Belgian market in 2004 — a paltry 10 per card per year. Other products based on the Proton or similar technology have shut down or retrenched over the past year, suggesting that despite early promise, these products are unlikely to garner a much larger share of the small payments mix.

It is interesting to note that the relative decline in interest in stand-alone e-purse products in Europe has coincided with an increasingly prominent role for bank cards. In 2000, the share of bank-card purchases in the U.S. dominated that of Europe, 52.6 percent to 26.0 percent. Today, the margin is 45.6 percent to 32.1 percent and is even closer with respect to total volume. By that measure, the United States outpaces Europe 38.3 percent to 31.9 percent.[49]

Simply put, as credit and debit have grown to be more widely accepted, they have become the focal point of consumers' retail payment.[50] While the European stored-value cards still offer some technical advantages, consumers appear to find them less attractive when compared with more flexible and more widely accepted bank cards. Here, e-purses' initially uncontested value proposition of greater convenience was gradually usurped by payment cards

[47] Kevin Woodward, "Saving Europe's Electronic Purses," *Card Technology*, December 1, 2005.
[48] Leo Van Hove, "Cash Substitution: Why and How," *Journal of Payment Systems Law*.
[49] *The Nilson Report*, "Top Bank Card Issuers Worldwide-2004," *The Nilson Report*, December 2005.
[50] Another explanation for the rapid bloom and decline of the e-purse payment model in Europe may be the advent of the euro in 2002. When faced with the prospect of dealing with unfamiliar new coin and currency, consumers may have felt especially attracted to a device that could simplify their POS transactions. Now that the learning curve has been surmounted, this particular benefit of an e-purse product is no longer a major selling point.

that offer the same ease of use but greater merchant acceptance and a less costly technology for issuers. Moreover, while the embedded chip technology offers the possibility of more sophisticated applications, this functionality has largely failed to materialize, making the provision of these relatively more costly cards less compelling for issuers.

Mondex. In the U.S., smart-card-based stored-value cards have often been regarded as a "solution in search of a problem." Domestically, the end-to-end communication to process a payment card transaction has been so efficient for so long that another plastic cash substitute was not deemed necessary. The Mondex card, one of the very earliest electronic cash products, is a case in point. This product, already deployed in Europe, was rolled out in New York City in 1997 and 1998 on a trial basis. It had several limitations when compared with magnetic stripe cards: Merchants had to invest in substantial new infrastructure to accept these cards; for consumers, the need to reload the card, along with the difficulty in knowing how much value remained, caused frustration. Also, it could not adequately compete with the ubiquitous payment and acceptance standard offered by credit cards. Moreover, the individual cards were considerably more expensive for banks to issue because of the additional complexity contributed by the onboard chip. Because of these challenges, the card never gained the critical mass needed to be compelling for merchants or consumers.

This example is illustrative for other reasons. Its ambition to be a perfect facsimile of cash in an electronic package proved to be one of its undoings. The product was structured so that users could conduct direct, person-to-person fund transfers, debiting one chip-based card and crediting the other. But by not clearing each transaction through a central clearing network, this process exposed the overall network to overwhelming security risk, since a single point of compromise could result in prodigious losses. This trial also highlights other challenges with card-based cash substitutes. With a physical medium of exchange, it is theoretically possible for a recipient, especially a well-trained one, to detect counterfeits. With a digit device, such as a

magnetic stripe card or even an embedded-chip smart card, an exact digital counterfeit is indistinguishable from the genuine original.

5. Analysis

Having looked at specific products, we can use economic intuition to analyze the structural factors that have caused the micropayments landscape to look one way in America, another way internationally, and to gain insight into the necessary conditions for a successful product.

One difference cannot be understated: Payment cards, especially credit cards, are a mature application in the United States and have been for many years. This is not necessarily the case internationally. While it is the case that credit cards are accepted in most advanced countries — certainly the ones considered in this analysis — the relative strength of the different players varies greatly. A cross-sectional comparison helps to make this clear.

Of the $3.3 trillion in total purchase volume charged on general-purpose bank cards in 2004, nearly 46 percent was done in the United States. This compares with 32.1 percent in Europe and only 13.9 percent in the entire Asia/Pacific region.[51] There are nearly 796 million cards outstanding in the U.S., or almost three per person, as compared to 129 million in Japan, 41 million in France, 20 million in Germany, and 13 million in Hong Kong — another area that, with 1.9 cards per person, currently has a well-developed credit card market. The U.S. also clearly leads in purchase transactions, with 24 billion, compared with 1.5 billion in Japan, 4.2 billion in France, 339 million in Germany, and 231 million in Hong Kong. The size of the U.S. tends to distort these figures, but when the numbers are scaled by population, the primacy of the credit card to the U.S. consumer and its now growing importance to many European consumers are obvious (Exhibit 3).

[51] *The Nilson Report*, "Top Bank Card Issuers Worldwide-2004," December 2005.

The contrast between the U.S. and Japan is particularly noteworthy. Despite a home-grown payment card with worldwide reach (the JCB card), Japanese consumers continue to use cash, direct debit, and giro payments; payment cards account for less than 10 percent of spending and checks for less than 5 percent. [52] Part of the unpopularity of credit cards may stem from a Japanese cultural touchstone: the reluctance to finance purchases. But differences in the legal system and financial institutions have also played a role.

Legal Systems and Market Structure

Legal differences — in structure, precedent, and scope — have affected the development of payment systems in the U.S. and other nations. The U.S. legal system differs largely from that in Europe and Asia.[53] The U.S. system is seen to be accommodative of commercial ventures and offers well-understood, effective banking regulation and oversight. The legal system and banking regulations have emphasized the role of banks in the payment system in the U.S. and have facilitated the development and maturation of retail banking products such as payment cards. But, internationally, legal systems' relationships with the banking industry are often quite different.

For instance, Japan's delay in introducing credit cards and the lack of an American-style checking type product produced a consumer payments system very different from that of the U.S. The Japanese regulatory structure has traditionally made banks' participation in the credit card market difficult. Banks could not issue credit cards until 1982, and even once they could, they could not offer a revolving credit feature until 1992.[54] While in the years since, credit card usage

[52] See Bank for International Settlements, Committee on Payment and Settlement Systems, "Retail Payments in Selected Countries: A Comparative Study," September 1999, available at http://www.bis.org.
[53] The U.S. legal system is unique in that both state and federal courts have a say on commercial and payments issues. At the national level, entities like the Federal Reserve, the OCC, the FDIC, the Treasury Department, and others have input into banking and credit regulation; contract law and many commercial issues are adjudicated at the state level.
[54] Ronald J. Mann, "Credit Cards and Debit Cards in the United States and Japan," *Journal of Monetary and Economic Studies* (January 2002).

in Japan has increased, it still does not begin to approach the U.S. level. Consequently, Japanese credit card companies enjoy relatively less market power than comparable firms in the U.S. The weakness of credit card issuers stands in contrast to the market power enjoyed by Japanese telecommunications companies, which, rather than banks, have pushed innovations in consumer payments.

Coordinating Standards

The relative balance of power between the different entities involved in a market also plays an important role in determining standards, which is critical when deploying products that depend on new technologies. When one party has more bargaining power or leverage, it can influence standard setting and adoption of new technologies more quickly. This can be seen if we contrast the success of mobile-phone-enabled micropayments in the U.S. and Asia. The differing results reflect the inherent challenge in rolling out a contactless payment system on mobile phones, a system that demands effective coordination between financial institutions, mobile phone operators, handset manufacturers, and merchants.

Mobile phones have made inroads in the U.S.: 60 percent of the adult population subscribes to some sort of service. But there are at least four “national” carriers, two incompatible handset technologies, and a variety of manufacturers. In contrast, in Asia and most of Europe, where there is at least one cell phone per adult, most markets also generally offer more sophisticated and mature technology, operating on a common standard. Additionally, in most countries, there are fewer operators than in the U.S. This ubiquity and standardization means that cellular phones outside the U.S. offer substantially better economies of scale and reach.

In the U.S. it has been relatively easy for major card issuers to tackle micropayments by rolling out RFID enhancements that complement their core payment card technology and settlement infrastructure. It becomes more difficult if they attempt to come to terms with the many independent players active in the telecommunications arena, a step that would be needed to

offer cell-phone-based payments. In contrast, in Japan, where NTT DoCoMo enjoys significant market power and countrywide reach, it has proven easier to add payments technology to the core phone product.

DoCoMo has nearly 50 million mobile Internet subscribers, compared with a total of 32 million for the two other Japanese telecommunication firms, KDDI and Vodafone Japan.[55] It is clearly the market leader, with broad reach and a long history. It owns and has promoted, along with Sony and the JR East rail company, contactless FeliCa chip technology that enables phone-based e-purses. This standard is now being quickly adopted by KDDI and Vodaphone.[56] The ease with which this standard has been propagated reflects the market clout of its sponsor. In the U.S. phone industry, no single phone operator can currently exert similar influence.

In the U.S., however, similar contactless standards are being set by the card industry. Credit card issuers have all settled on a single radio frequency chip standard, ISO 14443. This means that the products from MasterCard, Visa, American Express, and Discover have the potential to work with the same type of terminal readers, increasing the product's appeal to merchants because of its easy interoperability, which is another important feature of successful micropayment products. Accepting one issuer's card enables a merchant to accept all. With this sort of flexibility and the control exerted by issuing banks and payment networks, contactless card-based payments are much closer than phone-based payments to being a viable product in the U.S.

Payment Products as Experience Goods

Another economic principle that applies to the adoption of new micropayments products around the world is that of "experience goods." As the term suggests, experience goods demand a

[55] Electronic Payments International, "Contactless Chips Drive Mobile Payments in Japan," Lafferty Limited, August 29, 2005.
[56] Dan Balaban, "The Brave New World of Contactless Mobile Credit," *Card Technology*, November 1, 2005.

trial-and-error approach to resolve uncertainty about their features and value for a prospective user.[57] Experience goods tend to reward reputation and established brands, in a sort of re-affirming cycle. A corollary of this is that the market power of an experience good is greater if consumers know about the quality of only a few versions or brands of that class of goods.[58] The Visa and MasterCard brands in the U.S., cell-phone operators in Japan, and the Octopus card in Hong Kong all benefit from this effect.

For a merchant contemplating accepting a new type of payment, this principle holds sway. In such circumstances, the merchant must make an initial fixed investment prior to knowing with certainty whether a product will be successful. The decision process involves weighing the probability of success against the size of investment required and the value of a positive outcome. For example, in the U.S., this is relevant when considering contactless payment methods that demand incremental fixed investments to provide for acceptance at the POS acceptance.

The theory behind experience goods applies to the consumer's evaluation of payment technologies as well. Consumers in the U.S. have been conditioned to use magnetic stripe cards at the POS for larger transactions, reflexively swiping their cards to initiate payment at most retailers. Issuers recognized this and leveraged years and, in some cases, decades of familiarity and comfort with credit cards to generate consumer acceptance of similarly functioning debit products.

Arguably, much of the early success of PayPass, "blink,"[59] and other card-based contactless offerings may be due to their reliance on such a recognized form-factor. The least

[57] These products tend to be less price sensitive than "search" goods because buyers may attribute the lower prices of competing products to expected (unobservable) shortcomings. Generally, consumers may prefer to acquire information about products from experience rather than by search as the latter is often more expensive and less convenient.
[58] Philip Nelson, "Information and Consumer Behavior," *Journal of Political Economy*, 78, 2 (March-April 1970).
[59] Blink is an overarching brand created by JPMorgan Chase, which offers both MasterCard- and Visa-branded contactless cards, as an integrated tool to promote contactless payments nationwide.

intrusive means of rolling out this new capability was to add functionality to magnetic-stripe-enabled payment cards and to encourage existing cardholders to replace old cards with dual-mode ones. Acceptance and growth have been strong to date. For continued success, issuers and merchants must ensure that the value proposition of these products remains intact and well communicated. Customers are led to expect contactless payments will be fast and reliable; therefore, even the perception of delay or inaccurately booked transactions could quickly dampen early adopters' enthusiasm. The Mondex example highlighted the need, when building acceptance of a novel payment method, to generate favorable first impressions and ensure that the product works as promised before it is promoted more broadly. Ensuring that cashiers are properly trained in processing contactless payments, while potentially costly to merchants, will be critical for this technology to deliver its promise.

Going further, some issuers, in an effort to encourage electronic payments for new types of small transactions for which a payment card may not be the first choice, are embedding contactless technology in key fobs or similar devices. The notion is that consumers would be able to make payments without rummaging in a wallet. An anticipated benefit is that the seamlessness of the transaction may encourage more convenience-type purchases, since such transactions are easier than those with cash or traditional cards.

But consumer acceptance of these more novel approaches, as with any experience good, will require a fixed "investment" of time and effort to determine whether it is a compelling proposition and to acquire necessary information and skills.[60] For instance, initial participation in the Illinois I-PASS system was seen to be limited by this effect. In response, the sponsoring agency took steps to reduce that cost to consumers by entering into a distribution agreement with a major regional grocery chain, Jewel-Osco, to sell the devices, at cost, in their stores. At the same time, I-PASS met with a variety of civic groups and editorial boards to communicate the

[60] See Gene Amromin, Carrie Jankowski and Richard Porter, "Inducing More Efficient Payment on the Illinois Tollway," *Chicago Fed Letter*, April 2006.

cost and time savings that would arise if more people started using the devices. These initiatives surmounted consumer resistance, encouraging adoption of an unfamiliar product by reducing the risk and initial costs in time and effort.

The same principle is directly applicable to Japanese mobile phone payments. In 2005, Japanese cell-phone leader NTT DoCoMo announced it was acquiring a $1 billion stake in the number two credit card company in Japan, Sumitomo Mitsui, in order to provide credit-card-type functionality under DoCoMo's own i-mode FeliCa brand. By further extending the product's financial services capabilities, this initiative makes the DoCoMo FeliCa platform even more compelling and further cements its dominant market position. This phone-centered credit initiative reflects the relative preferences and expectations of Japanese consumers. For them, the cell phone itself is a product with which they are very familiar and comfortable. As such, adding functionality to this existing platform is seen to be easier than attempting to change consumer preferences to embrace the less familiar U.S. model of a bank-card system. The lesson from both of these examples is that unfamiliarity may need to be overcome by educating consumers or, alternatively, by adding functionality incrementally to products that are already understood.

The Network Economics of Payments

The principles of network economics are a third factor to consider in developing new micropayments solutions. Two precepts are especially relevant. First is the notion that network economies are "tippy" — that is, once a competing standard is able to demonstrate its worth and gain an advantage, it can very quickly become ubiquitous and displace its competitors.[61] This is essentially a "critical mass" effect. Second, in network economies, it is not necessarily the level of current sales that matters but rather the expectations of the eventual size of the market — essentially, the product with anticipated leading market share will dominate.

[61] Stanley M. Besen and Joseph Farell, "Choosing How to Compete: Strategies and Tactics in Standardization," *Journal of Economic Perspectives*, 8, 2 (Spring 1994), pp. 117-31.

These principles, which affect payments markets generally, are often described as the "chicken and egg" problem. A new payment product is useful to users only to the extent that there are merchants that accept it. Conversely, merchants will incur the initial investments required to accept that product only if they think it has or will have critical mass. Hence, before the tipping point, an upstart product faces considerable roadblocks.

At the same time, once a product has an established user base, newer products or techniques may not necessarily be able to displace it easily. In the U.S., the ubiquity of the payment card makes it less compelling for innovators to experiment with radically different types of products. The payment card standard, both its form-factor and back-end infrastructure, has been embraced by merchants and consumers alike. Therefore, to a large degree, the nonbanks that have developed micropayment products in the U.S. have followed the familiar payment-card form-factor, and they have worked to integrate product or business model innovations into this framework.

Network economic effects relate to almost every noncredit-card-based micropayment discussed above. For instance, the time savings and reduction in congestion promised by the agencies promoting the I-PASS system were held up because there weren't enough enabled toll lanes or enough I-PASS users to justify more. Only once differential pricing was implemented (providing a consumer incentive) did adoption increase. Then, at a certain point, the network effect began to work in the opposite direction as nonparticipants in the system began to see a substantial increase in the relative time they needed to negotiate toll plazas.

Network economics also helps to explain the success of the Octopus card in Hong Kong. Its sponsors solved the chicken and egg problem through leveraging a very large installed user base to entice unaffiliated merchants to start accepting it for retail POS purchases. Now that Octopus is firmly entrenched, a conventional bank, credit card firm, or cell-phone operator that wanted to issue a competing stored-value micropayment product would face a strong headwind.

Likewise, the same principles help to explain the failure of the Mondex card. Quite simply, consumers became frustrated that their cards had limited acceptance; merchants were not willing to make the infrastructure investments necessary to accept cards from a limited user base. Such hold-up problems can be tackled through incentives, to either consumers, merchants, or both. In the case of contactless cards in the U.S., issuers have resorted to incentives to encourage merchant adoption and have promoted the cards aggressively to potential users. By stimulating both sides of the market, issuers in the U.S. are driving the current crop of payment-card-based micropayment products toward critical mass.

6. Conclusion

The successful micropayments products and business models around the world have delivered utility to the consumer as they fill a definable need. Different products have been successful in Japan, Hong Kong, the U.S., and Europe for different reasons. Industry structure and legal and behavioral issues have had an impact on how the products are developed, marketed, and provided and by whom.

While payment cards are a component, on a certain level, of most of the micropayments solutions in the U.S., other types of firms and products have taken the lead elsewhere. In Hong Kong, Octopus has generated broad acceptance by merchants, but it may now face challenges to expand outside the city or its base of transit users. There have been similar, if more limited success stories in Europe with value propositions similar to the Octopus product. In these cases, closed-loop stored-value cards proved successful because they offered payment-card-like functionality with limited infrastructure investment. Because of unreliable, limited, or expensive telecommunications in many locations, merchants often did not have the flexibility to swipe and clear a payment card transaction over the network rails. In other places, doing so was too slow. However, now that the European payment card industry is gaining momentum, the growth of

basic stored-value cards has slowed, suggesting that a two-card model is not a sustainable or consumer-friendly solution when a more flexible alternative exists.

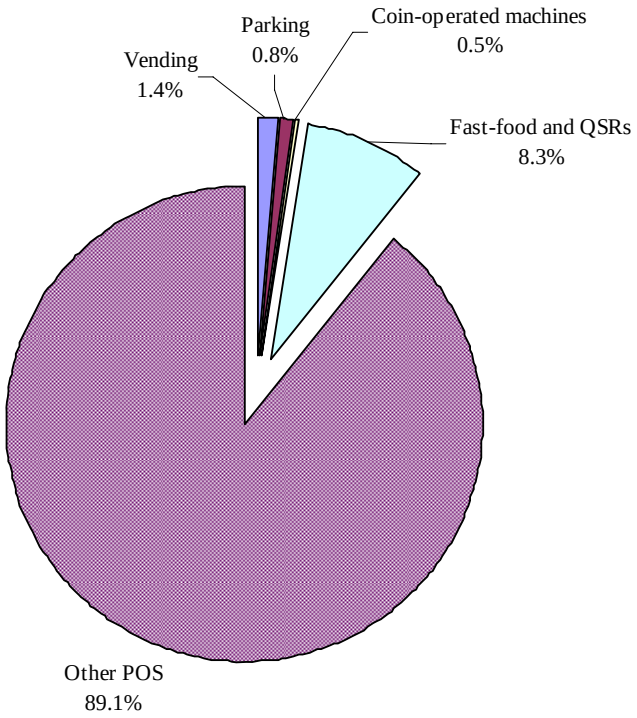
Around the world, the welter of contactless offerings, whether card based or phone based, all depend on building effective relationships among issuers, operators, merchants, and other stakeholders while simultaneously building customer acceptance. For instance, phone-based payments look increasingly viable in Japan, while contactless payment-card micropayments seem to be successful in the U.S. In part, the landscape differs in these two markets owing to the differing levels of cohesiveness and market power of the critical players, which affects the ability to establish standards, and to the differing preferences and "experiences" of the consumers in each.

Economic intuition suggests that, once the chicken and the egg problem is addressed and a product in a network economy gains sufficient market share, adoption can blossom. The U.S. micropayments market seems to be nearing that point. In the online world, iTunes and many imitators have used aggregation technologies to accept micropayments for inexpensive digital content and, in doing so, have created a billion-dollar industry. Likewise, PayPal is extending a proven business model and popular brand, offering the potential to facilitate electronic micropayments both in its auction market and elsewhere. Peppercoin and other firms are applying similar technologies to smooth over the barriers to very small micropayments at the POS.

Finally, card association and issuer initiatives to promote efficiency-enhancing contactless payments, while offering merchants incentives such as rebates and improved economics, means that consumers are beginning to consider cards as a viable, and often superior, alternative to cash for small purchases in many different settings.

Exhibit 1

Of the $1.32 trillion in cash spent at the physical POS in the U.S., over 10 percent is used for purchase categories especially suited to electronic micropayments.[62]

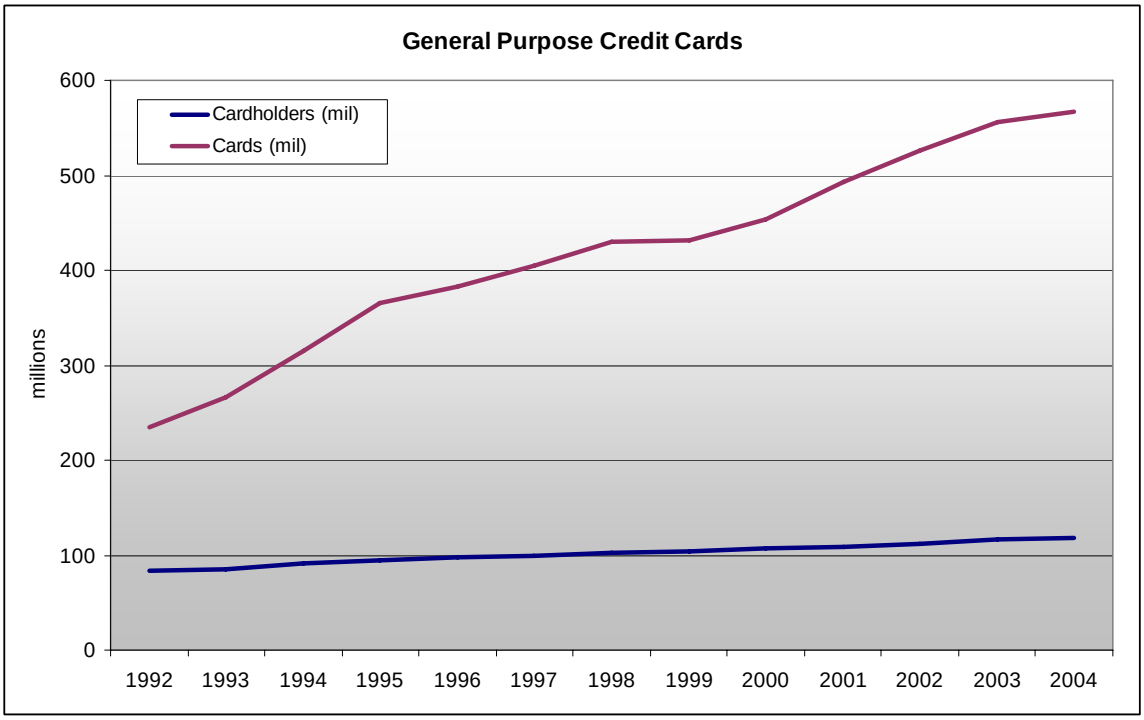


Share of cash payments at physical POS	
Vending	$18
Parking	$10
Coin-operated machines	$6
Fast-food and QSRs	$110
Other POS	$1,176
Total	$1,320

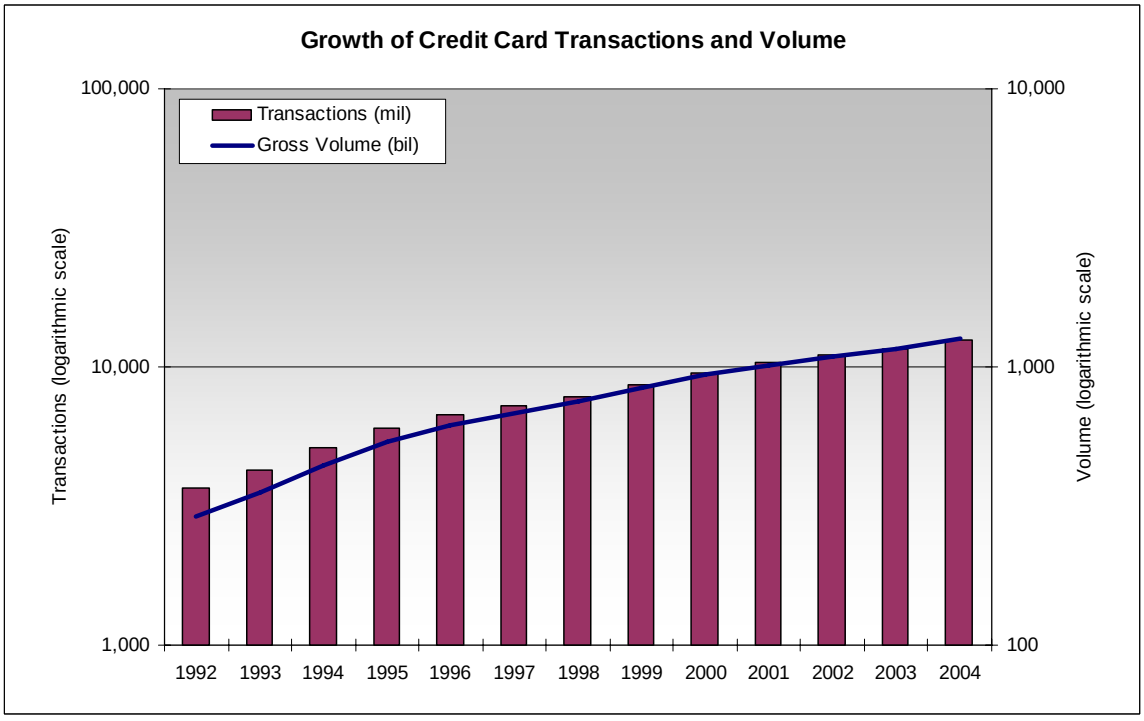
[62] Based on survey results from Ipsos-Reid. (http://www.ipsos.ca/reid/)

Exhibit 2

Growth in general purpose credit cardholders has slowed as the market has become saturated.



At the same time, the growth rate of transactions and growth in gross dollar volume has lessened.



Source: *The Nilson Report*, various issues, and author's calculations.

Exhibit 3

Card volume by region and country

Bank Card Volume, 2004

	Total Volume (trillions $)	Purchase Volume (trillions $)	% Total Volume	% Purchase Volume
United States	1,960	1,472	38%	46%
Europe	1,633	1,037	32%	32%
Asia/Pacific	947	449	19%	14%
Latin America	297	87	6%	3%
Canada	154	132	3%	4%
Middle East/Africa	133	52	3%	2%
Total	5,118	3,229	100%	100%

Source: *The Nilson Report*, "Top Bank Card Issuers Worldwide-2004," December 2005.

Bank Card Volume, 2004 (Normalized by Population)

	Total				Per unit population		
	Population (thousands)	Cards (millions)	Purchase Transactions (millions)	Volume (billions $)	Cards	Purchase Transactions	Total Volume ($)
US	284,154	795.54	23,952.78	1,956.86	2.80	84.30	6,886.62
Japan	127,034	129.29	1,452.68	164.42	1.02	11.44	1,294.30
Germany	82,344	19.70	338.53	44.10	0.24	4.11	535.56
France	60,496	40.61	4,223.40	333.69	0.67	69.81	5,515.90
United Kingdom	59,668	111.61	3,933.44	560.48	1.87	65.92	9,393.31
Hong Kong	6,637	12.62	230.59	NA	1.90	34.74	NA

Source: *The Nilson Report*, "Top Bank Card Issuers Worldwide-2004," December 2005; The United Nations, "World Population Prospects: The 2004 Revision Population Database," *The United Nations, Population Division* (http://esa.un.org/unpp/); and author's calculations.