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Abstract

The rapid proliferation of electronic payment media continues to change the way consumers shop and merchants sell goods and services. Many policymakers and economists agree that the digitization of payments is socially beneficial. However, there is considerable debate regarding the optimal pricing of these payment services. Payment markets are complex with many participants engaging in a series of interrelated bilateral relations and transactions. In this article, we survey the recent payment literature, identify the main economic bottlenecks, and study their implications for public policy.

Keywords: retail financial services, electronic payments, pricing, public policy

JEL Codes: L11, G21, D53
Introduction

Rapid advancements in computing and telecommunications have enabled us to interact with each other digitally. Instead of visiting a travel agent for information regarding our next vacation, we can purchase our vacation package online in the middle of the night. Prior to boarding the flight, we can purchase and download a book to our Kindle for the flight. We no longer have to return home to share our vacation experience with our friends and family but can instead share our digital pictures taken with our i-Phone via e-mail or post them on Facebook. Despite the digital economy being upon us, we still rely on paper payment instruments such as cash, checks, and paper giros for a significant amount of face-to-face and remote bill payments in advanced economies. While we have not attained the cashless society, we have made significant strides to adopt electronic payment instruments.

The proliferation of payment cards continues to change the way consumers shop and merchants sell goods and services. Recently, some merchants have started to accept only card payments for safety and convenience reasons. For example, American Airlines only accepts payment cards for inflight purchases on all its domestic routes since June 1, 2009. Also, many quick service restaurants and coffee shops now accept payment cards to capture greater sales and increase transaction speed. Wider acceptance and usage of payment cards suggest that a growing number of consumers and merchants prefer payment cards to cash and checks. Furthermore, without payment cards, internet sales growth would have been substantially slower.

The increased usage of cards has increased the value of payment networks, such as Visa Inc., MasterCard Worldwide, Discover Financial Services, and others. In 2008,
Visa Inc. had the largest initial public offering (IPO) of equity, valued at close to $18 billion, in U.S. history (Benner, 2008). The sheer magnitude of the IPO suggests that financial market participants value Visa’s current and future profitability as a payment network.

In addition to receiving attention by financial market participants, regulators and antitrust authorities have questioned the underlying fee structures and which participants’ surpluses are extracted. To date, there is still little consensus—either among policymakers or economic theorists—on what constitutes an efficient fee structure for card-based payments. There are several conclusions that we draw from the academic literature and recent interventions in payment card markets. First, advancements in computing and telecommunications infrastructure have made electronic payments safer and more efficient than their paper counterparts. Second, there are significant scale economies and likely scope economies in attracting consumers and merchants and payment processing. Third, the socially optimal fee structure, or the proportion of the total fees paid by consumers and merchants, may not be systematically lower than the network profit-maximizing fees. Fourth, allowing merchants to price differentiate among different types of payment instruments generally improves market price signals. Fifth, merchant, card issuer, or network competition may result in lower social welfare contrary to generally accepted economic principles. Sixth, the motivation for why public authorities intervene differs across jurisdictions. Finally, public authorities should not only consider costs but also benefits received by consumers and merchants, such as convenience, security, and access to credit that may result in greater sales if they choose to intervene in payments markets.
The rest of our article is organized as follows. We first explain the structure of payment networks. Having established a framework, we discuss consumer choice and the migration to electronic payments. Next, we describe the provision of payment services emphasizing the economies of scale and scope that are generally present. Then, we summarize the key contributions to the theoretical payment card literature focusing on economic surplus and cross subsidies and their impact on social welfare. In the following section, we discuss several market interventions by public authorities. Finally, we offer some concluding remarks and suggest future areas for research.

**Structure of payment markets**

When focusing on payment cards, most card transactions occur in three- or four-party networks.¹ These networks comprise consumers and their banks (known as issuers), as well as merchants and their banks (known as acquirers). Issuers and acquirers are part of a network that sets the rules and procedures for clearing and settling payment card receipts among its members. In principle, other forms of electronic payments, such as credit transfers and direct debits, have the same three or four party structure, except that the availability of real time exchange of information between the merchants and banks used to authenticate and authorize the transaction may be absent.

In figure 1, we diagram the four participants and their interactions with one another. First, a consumer establishes a relationship with an issuer and receives a

¹ There are two types of payment card networks—open (four-party) and proprietary (three-party) networks. Open networks allow many banks to provide payment services to consumers and merchants, whereas in proprietary networks, one institution provides services to both consumers and merchants. When the issuer is not also the acquirer, the issuer receives an interchange fee from the acquirer. Open networks have interchange fees, whereas proprietary systems do not have explicit interchange fees because one institution serves both consumers and merchants using that network’s payment services. However, proprietary networks still set prices for each side of the market to ensure that both sides are on board.
payment card. Consumers generally do not pay per transaction payment card fees but often pay annual membership fees to their issuers. In addition, many payment card issuers give their customers per transaction rewards, such as cash back or other frequent-use rewards. Second, a consumer makes a purchase from a merchant. Generally, the merchant charges the same price regardless of the type of payment instrument used to make the purchase. Third, if a merchant has established a relationship with an acquirer, it is able to accept payment card transactions. The merchant either pays a fixed per transaction fee (more common for debit cards) or a proportion of the total purchase amount, known as the merchant discount fee (more common for credit cards), to its acquirer.\(^2\) For credit cards, the merchant discount can range from one percent to five percent depending on the type of transaction, type of merchant, and type of card, as well as whether the card is present or not, and other factors. Fourth, the acquirer pays an interchange fee to the issuer.

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Debit, credit, and prepaid cards are three forms of payment cards. Debit cards allow consumers to access funds at their banks to pay merchants; these are sometimes referred to as “pay now” cards because funds are generally debited from the cardholder’s account within a day or two of a purchase.\(^3\) Credit cards allow consumers to access lines of credit at their banks when making payments and can be thought of as “pay later” cards because consumers pay the balance at a future date. Prepaid cards can be referred to as

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\(^2\) In some instances, merchants are charged a fixed fee and a proportional fee.

\(^3\) There are countries, for example, France, where the cardholder’s account is debited much later. These types of cards are referred to as delayed debit cards.
“pay before” cards because they allow users to pay merchants with funds transferred in advance to a prepaid account.4

Payment choice and migration to electronic payments

The rapid growth in the use of electronic payment instruments, especially payment cards, is a striking feature of most modern economies. In Table 1, we have listed the annual per capita payment transactions for ten advanced economies in 1988 and 2008. In all cases, there was tremendous growth but countries have a wide range of values for per capita payment card transactions within a year ranging from .33 for Italy and 36.67 for the United States in 1988 and 23.5 for Italy and 191.1 for the United States in 2008. Also note that differences within Europe remain large. Countries like Italy, Germany, and Switzerland still have a strong dependence on cash use, whereas countries like the Netherlands, France, and Sweden show high payment card volumes. Amromin and Chakravorti (2009) find that greater usage of debit cards has resulted in lower demand for small-denomination banknotes and coins that are used to make change although demand for large-denomination notes has not been affected. From Table 1, the United States where credit cards have traditionally been popular at the point of sale, shows the highest per capita payment card use in 2008.

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The current payments literature stresses consumer payment choice and merchant acceptance in response to price and non-price characteristics and incentives. Attempts to determine the main drivers of changes in payment composition across and within

4 For a summary of the U.S. prepaid card market, see Chakravorti and Lubasi (2006).
countries are difficult due to a lack of time-series data, and often only reported as annual national-level aggregates. Moreover, data on the use of cash is typically full of uncertainties so that the migration from paper-based toward electronic means of payment is hard to measure.

Given these data problems payment researchers have tried to infer consumer payment behavior from recurring household surveys in Europe and the United States (Stavins, 2001; Hayashi and Klee, 2003; Stix, 2003; Bounie and Francois, 2006; Mester, 2006; Klee, 2008; and Kosse, 2010). Analysis of demographic data indicates that age, education, and income influence the adoption rates of the newer electronic forms of making a payment. However, Schuh and Stavins (2010) show that demographic influences on payment instrument use are often of less importance than the individuals’ assessment of the relative cost, convenience, safety, privacy, and other characteristics of different payment instruments. Other survey-based studies by Jonker (2007) and Borzekowski, Kiser, and Ahmed (2008) that have incorporated similar payment characteristics find that payment instrument characteristics (real or perceived) importantly augment the socio-demographic determinants of the use of electronic payment instruments.5

The payment characteristics approach (requiring survey information on which characteristics are favored in one instrument over another) allows estimation of a “price equivalent” trade-off among payment instruments. This approach applies (ordered) probit/logit models to determine price responsiveness relationships among payment instruments. In their paper, Borzekowski, Kiser, and Ahmed (2008) find a highly elastic response to fees imposed on U.S. PIN debit transactions (an effort by banks to shift users

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5 For a brief survey on the empirical payment literature, see Kahn and Roberds (2009).
to signature debit cards where merchant interchange fees are higher, raising bank revenue). Zinman (2009) finds a strong substitution effect between debit and credit cards during 1995-2004, and he concludes that debit card use is more common among consumers who are likely to be credit-constrained in the United States. Another consumer survey suggests that consumers who often use debit cards hold approximately 20% less cash in Austria (Stix, 2003). Using French data, Bounie and Francois (2006) find that the type of transaction and its value clearly favor one type of payment instrument over another.

Another approach in the literature has been to infer consumer choice from aggregate data on payment systems and data from industry sources (e.g. Humphrey, Pulley and Vesala, 2000; Garcia-Swartz, Hahn and Layne-Farrar, 2006; Bolt, Humphrey and Uittenbogaard, 2008). Bolt et al. (2008) use the experience of Norway (which directly prices its payment services to consumers) and the Netherlands (which did not) over the time period 1990-2004 to try to determine what the incremental effect of transaction pricing may be on the adoption of card payments and electronic bill payments versus ATM withdrawals and paper-based giros. Overall, they find that payment pricing induces consumers to shift faster to more efficient electronic payment instruments. However, non-price attributes and terminal availability may play an even bigger role than payment pricing for point of sale payments.

There are only a few retail payment empirical studies that have used merchant or consumer level transactional data. Using data provided by a grocery retailer, Klee (2008) finds that a major determinant of consumers’ payment choice is transaction size, with cash being highly favored for small-value transactions. Analysis of the same dataset
shows a marked transaction-time advantage for debit cards over checks, helping to explain the recent popularity of the former. Rysman (2007) uses data from Visa to demonstrate that even though consumers carry multiple payment cards in their wallet, they tend to use the same card for most of their purchases.  

**Provision of payment services**

Significant real resources are required to provide payment services. Recent payment cost analyses have shown that the total cost of a nation’s retail payment system may easily approach 1% of GDP annually (Humphrey, 2010). Even higher cost estimates can be obtained depending on current payment composition and how much of bank branch and ATM network costs are included as being essential for check deposit, cash withdrawal, and card issue and maintenance activity.

On the supply side, cost considerations first induced commercial banks to shift cash acquisition by consumers away from branch offices to less costly ATMs. Later, similar cost considerations led banks to try to replace cash, giro and checks with cards using POS terminals although such transaction are likely to lower the demand for ATM cash withdrawals. Greater adoption of mobile payments and on-line banking solutions will enable a further shift from cash and other paper-based instruments towards more digitized payments. Indeed, payment data—albeit scarcely available—suggest that strong scale economies exist for electronic payments.

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6 In a theoretic model, Bedre-Defolie and Calvano (2010) distinguish between the fact that consumers make two distinct decisions (membership and usage) whereas merchants make only one (membership).
Costs and benefits of different payment methods

Studying the costs to banks to provide payment services is difficult, given the proprietary nature of the cost data. However, there are some European studies that attempt to quantify the real resource costs of several payment services. In these studies, social cost refers to the total cost for society net any monetary transfers between participants, and reflects the real use of resources used in the production and usage of payment services. For the Netherlands in 2002, Brits and Winder (2005) report that the social costs of all point-of-sale (POS) payments (cash, debit cards, credit cards, and prepaid cards) amounted to 0.65 percent of GDP. The social cost of payment services for Belgium in 2003 was 0.75 percent of GDP (Quaden, 2005). Bergman, Guibourg, and Segendorff (2007) find that the social cost of providing cash, debit card payments, and credit card payments was approximately 0.4 percent of GDP in Sweden for 2002. For Norway, Humphrey, Kim, and Vale (2001) estimate the cost savings from switching from a fully paper-based system (checks and paper “giro,” or a payment in which a payor initiates a transfer from her bank to a payee’s bank) to a fully electronic system (debit cards and electronic giro) at the bank level at 0.6 percent of Norway’s GDP. Based on a panel of 12 European countries during the period 1987–99, Humphrey et al. (2006) conclude that a complete switch from paper-based payments to electronic payments could generate a total cost benefit close to 1 percent of the 12 nations’ aggregate GDP.

These numbers confirm the widespread agreement that the ongoing shift from paper-based payments to electronic payments may result in significant economic gains. Compared with cash, electronic payments also offer benefits in terms of greater security,
faster transactions, and better recordkeeping; in addition, electronic payments offer possible access to credit lines. Merchants may also benefit from increased sales or cost savings by accepting an array of electronic payment instruments. However, these benefits are often difficult to quantify.

Using U.S. retail payments data, Garcia-Swartz, Hahn, and Layne-Farrar (2006) attempt to quantify both the costs and benefits of POS payment instruments. They find that shifting payments from cash and checks to payment cards results in net benefits for society as a whole, but they also conclude that merchants may be paying a disproportionate share of the cost.

Economies of scale and scope in payments

As more consumers and merchants adopt payment cards, providers of these products may benefit from economies of scale and scope. Size and scalability are important in retail payment systems due to their relatively high capital intensity. In general, electronic payment systems require considerable up-front investments in processing infrastructures, highly secure telecommunication facilities and data storage, and apply complex operational standards and protocols. As a consequence, unit cost should fall as payment volume increases (when appropriately corrected for changes in labor and capital costs). In addition, scope economies come into play when different payment services can be supplied on the same electronic network in a more cost-efficient way than the “stand-alone” costs of providing these services separately.

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7 Some key benefits of using cash include privacy and anonymity that are not provided by other types of payment instruments.
8 Carbó Valverde et al. (2008) conduct a similar exercise for Spain, and find that when summing net costs and benefits across participants, debit cards are the least costly and checks are the most costly, with credit cards and cash ranking second and third, respectively.
In the United States, being able to operate on a national level allowed some issuers (banks that issue cards to consumers), acquirers (banks that convert payment card receipts into bank deposits for merchants), and payment processors to benefit from economies of scale and scope. We discuss two large consolidations that occurred within the Federal Reserve System over the last two decades that resulted in large cost savings. First, the Federal Reserve’s real-time gross settlement large-value payment system consolidated its 12 separate payment processing sites into a single site in 1996. As a result, Fedwire average cost per transaction fell by about 62% in real terms from scale economies due to the expanded volume and technological change which lowered processing and telecommunication costs directly. A similar process occurred in Europe where in 2007, 15 separate national real time gross settlement systems were consolidated into one single technical platform, TARGET-2, that guaranteed a harmonized level of service for European banks combined with one single transaction price for domestic and cross-border payments.

Second, with the passage of Check Clearing for the 21st Century Act in 2003 and the reduction in the number of checks written in the United States, the Federal Reserve reduced the number of its check processing sites from 45 to 1 by March 2010. Today, almost 99 percent of checks are processed as images enabling greater centralization in check processing. In addition, many checks are converted to ACH payments. Both check imaging and conversion have resulted in significant cost savings to the Federal Reserve and market participants.

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9 For empirical estimation of scale and scope economies resulting from Fedwire consolidation see Hancock, Humphrey and Wilcox (1999) and Adams, Bauer and Sickles (2004).
Some European payment providers might enjoy similar scale and scope benefits in the future as greater cross-border harmonization occurs with the introduction of the Single Euro Payments Area (SEPA). The goal of SEPA, promoted by the European Commission, is to facilitate the emergence of a competitive, intra-European goods market by making cross-border payments as easy as domestic transactions. Separate domestic national payments infrastructures are to be replaced with a pan-European structure which would lower payment costs through economies of scope and scale. Volume expansion can best be achieved by consolidating processing operations across European borders.

One of the first European scale economies study on payment systems was carried out by Khiaonarong (2003). He estimates a simple loglinear cost function by using data of 21 payment systems and found substantial scale economies. In Bolt and Humphrey (2007), a data set including 11 European countries over 18 years is used to explain movements of operating costs in the banking sector as a function of transaction volumes of four separate payment and delivery instruments (card payments, bill payments, ATMs, and branch offices), and wages and capital costs. Their primary focus is on scale economies of card payments. In particular, using a translog function specification, the average scale economy is (significantly) estimated in the range 0.25-0.30, meaning that a doubling of payment volume corresponds to only a 25%-30% increase in total costs.

Consequently, volume expansion should lead to significantly lower average costs per transaction. Based on cost data specific to eight European payment processor

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10 SEPA applies to all countries where the euro is used as the common currency. The implementation of SEPA started in January 2008 with the launching of the SEPA credit transfer scheme and should be completed when all national payment instruments are phased out; these instruments may not be entirely phased out until 2013.

11 His results were somewhat biased because the cost of labor across countries was not specified in the analysis.
operations over 1990-2005, Beijnen and Bolt (2009) obtain similar estimates of payment scale economies which allows them to quantify the potential benefits of SEPA arising from consolidation of electronic payment processing centers across the euro area. Finally, Bolt and Humphrey (2009) estimate payment scale and scope economies using previously unavailable (confidential) individual bank data for the Netherlands over 1997-2005. Their analysis confirms the existence of strong payment scale economies, furthering the goal of SEPA.

One key result stands out: payment costs can markedly be reduced through consolidation of payment processing operations to realize economies of scale. Ultimately, this allows banks and their customers, consumers and merchants, to benefit from these cost efficiencies in the form of lower payment fees. However, where this reduction of unit payment costs exactly ends up—in lower payment and service fees, lower loan rates, higher deposit rates, or higher bank profits—is an issue of great interest to competition policy authorities.

**Economic surplus and cross subsidies**

To study the optimal structure of fees between consumers and merchants in payment markets, economists have developed the two-sided market or platform framework to conduct social welfare analysis. This literature combines the multiproduct firm literature, which studies how firms set prices on more than one product, with the network economics literature, which studies how consumers benefit from increased participation in networks by other consumers.\(^\text{12}\) The price structure or balance is the share that each

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type of end-user pays of the total price of the payment service. Rochet and Tirole (2006b) define a two-sided market as a market where end-users are unable to negotiate prices among themselves and the price structure affects the total volume of transactions. An important empirical observation of two-sided markets is that platforms tend to heavily skew the price structure to one side of the market to get both sides “on board,” using one side as a “profit center” and the other side as a “loss leader,” or at best financially neutral. In the rest of this section, we will discuss several externalities that arise in payment networks.

Adoption and usage externalities

A key externality examined in the payment card literature is the ability of the network to convince both consumers and merchants to participate in a network. Baxter (1983) argues that the equilibrium quantity of payment card transactions occurs when the total transactional demand for payment card services, which are determined by consumer and merchant demands jointly, is equal to the total transactional cost for payment card services, including both issuer and acquirer costs. A consumer’s willingness to pay is based on her net benefits received. The consumer will participate if her net benefit is greater than or equal to the fee. Similarly, if the merchants’ fee is less than or equal to the net benefit they receive, merchants will accept cards. Pricing each side of the market

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13 For a review of the academic literature on two-sided payment networks, see Bolt and Chakravorti (2008b).
14 For more details, see Bolt and Tieman (2008).
15 In this section, we build upon Chakravorti (2010) and Rochet and Tirole (2006a).
16 He considers an environment where consumers are homogeneous, merchants are perfectly competitive, and the market for issuing and acquiring payment cards are competitive.
17 Net benefits for consumers and merchants are defined by the difference in benefits from using/accepting a payment card and using/accepting an alternative payment instrument.
based on marginal cost—as would be suggested by economic theory for one-sided competitive markets—need not yield the socially optimal allocation.

To arrive at the socially optimal equilibrium, a side payment may be required between the issuer and acquirer if there are asymmetries of demand between consumers and merchants and/or of costs to service consumers and merchants. This result is critically dependent on the inability of merchants to price differentiate between card users and those who do not use cards or among different types of card users. While most economists and antitrust authorities agree that an interchange fee may be necessary, the level of the fee remains a subject of debate.

Schmalensee (2002) extends Baxter’s (1983) analysis by considering issuers and acquirers that have market power, but still assumes that merchants operate in competitive markets. His results support Baxter’s conclusions that the interchange fee balances the demands for payment services by each end-user type and the cost to banks to provide them. Schmalensee finds that the profit-maximizing interchange fee of issuers and acquirers may also be socially optimal.

Instrument-contingent pricing

In many jurisdictions, merchants are not allowed to add a surcharge for payment card transactions because of legal or contractual restrictions.18 If consumers and merchants were able to negotiate prices based on differences in costs that merchants face and the benefits that both consumers and merchants receive, the interchange fee would be neutral,

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18 No-surcharge restrictions do not allow merchants to impose surcharges for payment card purchases. However, merchants may be allowed to offer discounts for noncard payments. In the United States, the Durbin Amendment, a part of the recently passed financial reform legislation, expands the ability of merchants to discount one type of payment instrument vis-à-vis another. For more discussion about no-surcharge rules and discounts, see Chakravorti and Shah (2003).
assuming full pass-through. The interchange fee is said to be neutral if a change in the interchange fee does not change the quantity of consumer purchases and the profit level of merchants and banks. There is general consensus in the payment card literature that if merchants were able to recover their payment costs, the impact of the interchange fee would be severely dampened.

Even if price differentiation based on the payment instrument used is not common, the possibility to do so may enhance the merchants’ bargaining power in negotiating their fees. Merchants can exert downward pressure on fees by having the possibility to set instrument-contingent pricing. Payment networks may prefer non-instrument-contingent pricing because some consumers may not choose payment cards if they had to explicitly pay for using them at the point of sale (POS).

Carlton and Frankel (1995) extend Baxter (1983) by considering when merchants are able to fully pass on payment processing costs via higher consumption goods prices. They find that an interchange fee is not necessary to internalize the externality if merchants set pricing for consumption goods based on the type of payment instrument used. Furthermore, they argue that cash users are harmed when merchants set one price because they subsidize card usage.

Schwartz and Vincent (2006) study the distributional effects among cash and card users with and without no-surcharge restrictions. They find that the absence of pricing based on the payment instrument used increases network profit and harms cash users and

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19 Frankel (1998) refers to merchants’ reluctance to set different prices even when they are allowed to do so as price cohesion.
20 More recently, McAndrews and Wang (2008) argue that card users may be subsidizing cash users.
merchants. The payment network prefers to limit the merchant’s ability to separate card and cash users by forcing merchants to charge a uniform price to all of its customers. Issuer rebates to card users boosts their demand for cards while simultaneously forcing merchants to absorb part of the corresponding rise in the merchant fee, because any resulting increase in the uniform good’s price must apply equally to cash users.

Gans and King (2003) argue that, as long as there is “payment separation,” the interchange fee is neutral regardless of the market power of merchants, issuers, and acquirers. When surcharging is costless, merchants will implement pricing based on the payment instrument used, taking away the potential for cross-subsidization across payment instruments and removing the interchange fee’s role in balancing the demands of consumers and merchants. In effect, the cost pass-through is such that lower consumer card fees (due to higher interchange fees) are exactly offset by higher goods prices from merchants. Payment separation can occur if one of the following is satisfied: There are competitive merchants, and they separate into cash-accepting or card-accepting categories, in which each merchant only serves one type of customer and is prevented from charging different prices; or merchants are able to fully separate customers who use cash from those who use cards by charging different prices.

Merchant, network and issuer competition

When asking merchants why they accept certain types of payment cards if they are too costly, they answer that they would lose business to their competitors. Rochet and Tirole (2002) were the first to consider business stealing as a motivation for merchants to accept

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21 Schwartz and Vincent relax the common assumption made in the literature that the demand for the consumption good is fixed. However, they assume that consumers are exogenously divided into cash and card users and cannot switch into the other group.
They have two main results. First, the interchange fee that maximizes profit for the issuers may be more than or equal to the socially optimal interchange fee, depending on the issuers’ margins and the cardholders’ surplus. Second, merchants are willing to pay more than the socially optimal fee if they can steal customers from their competitors. However, overall social welfare does not improve when merchants steal customers from their competitors by accepting payment cards. Wright (2004) extends Rochet and Tirole (2002) by considering a continuum of industries where merchants in different industries receive different benefits from accepting cards. Wright also concludes that the interchange fee that maximizes overall social welfare is generally higher than the interchange fee that maximizes the number of transactions.

Economic theory suggests that competition among suppliers of goods and services generally reduces prices, increases output, and improves welfare. However, with two-sided markets, network competition may yield an inefficient price structure. A key aspect of network competition is the ability of end-users to participate in more than one network. When end-users participate in more than one network, they are said to be “multihoming.” If they connect only to one network, they are said to be “singlehoming.” As a general finding, competing networks try to attract end-users who tend to singlehome, since attracting them determines which network has the greater volume of

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22 Rochet and Tirole consider two identical Hotelling merchants in terms of their net benefits of accepting a payment card for sales and the goods that they sell. Consumers face the same fixed fee but are heterogeneous in terms of the net benefits they derive from using the payment card. They assume that the total number of transactions is fixed and changes in payment fees do not affect the demand for consumption goods.

23 In Wright’s environment, both consumer and merchant fees are per transaction fees. Each consumer buys goods from each industry. Issuers and acquirers operate in markets with imperfect competition. Wright assumes that consumers face the same price regardless of which instrument they use to make the purchase.
business. Accordingly, the price structure is tilted in favor of end-users who singlehome.24

Some models of network competition assume that the sum of consumer and merchant fees is constant and focus on the price structure. Rochet and Tirole (2003) find that the price structures for a monopoly network and competing platforms may be the same, and if the sellers’ demand is linear, this price structure in the two environments generates the highest welfare under a balanced budget condition. Guthrie and Wright (2007) extend Rochet and Tirole (2003) by assuming that consumers are able to hold one or both payment cards. They find that network competition can result in higher interchange fees than those that would be socially optimal.

Chakravorti and Roson (2006) consider the effects of network competition on total price and on price structure where networks offer differentiated products.25 Like Rochet and Tirole (2003) and Guthrie and Wright (2007), they find that competition does not necessarily improve or worsen the balance of consumer and merchant fees from the socially optimal one. However, they find that the welfare gain from the drop in the sum of the fees from competition is generally larger than the potential decrease in welfare from less efficient fee structures.

Competition does not necessarily improve the balance of prices for two-sided markets. Furthermore, if competition for cardholders is more intense because consumers ultimately choose the payment instrument, issuers may provide greater incentives to

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24 For more discussion, see Evans (2003).
25 Chakravorti and Roson only allow consumers to participate in one card network, whereas merchants may choose to participate in more than one network. However, unlike Guthrie and Wright (2007) and Rochet and Tirole (2003), Chakravorti and Roson consider fixed fees for consumers. They compare welfare properties when the two networks operate as competitors and as a cartel, where each network retains demand for its products from end-users but the networks set fees jointly.
attract them even both issuers belong to the same network. If issuers have greater bargaining power to raise interchange fees, they can use this power to partially offset the cost of consumer incentives.26

**Credit functionality of payment cards**

The payment card literature has largely ignored the benefits of consumer credit.27 Given the high level of antitrust scrutiny targeted toward credit card fees, including interchange fees, this omission in most of the academic literature is rather surprising. In the long run, aggregate consumption over consumers’ lives may not differ because of access to credit, but such access may enable consumers to increase their utility. In addition to extracting surplus from all consumers and merchants, banks may extract surplus from consumers that borrow in the form of finance charges.28

Chakravorti and Emmons (2003) consider the costs and benefits of consumer credit when consumers are subject to income shocks after making their credit card purchases and some are unable to pay their credit card debt.29 To our knowledge, they are the first to link the insurance aspect of credit cards to their payment component. Observing that over 75 percent of U.S. card issuer revenue is derived from cash-constrained consumers, they consider the viability of the credit card system if it were

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26 Donze and Dubec (2009) discuss the impact of collective setting of interchange fees and downstream competition in the ATM market.
27 We limit our focus here to consumption credit. Payment credit—the credit that is extended by the receiver of payment or by a third party until it is converted into good funds—is ignored. For more discussion, see Chakravorti (2007).
28 The empirical literature on credit cards has suggested interest rate stickiness along with above-market interest rates, although some have argued that the rate is low compared with alternatives such as pawn shops. For more discussion, see Ausubel (1991) and Brito and Hartley (1995).
29 Chakravorti and Emmons assume that all markets for goods and payment services are competitive. They impose a participation constraint on individuals without liquidity constraints such that the individuals will only use cards if they are guaranteed the same level of consumption as when they use cash including the loss of consumption associated with higher prices for consumption goods.
completely funded by these types of consumers.\textsuperscript{30} They find that if consumers sufficiently discount future consumption, liquidity-constrained consumers who do not default would be willing to pay all credit card network costs ex ante, resulting in all consumers being better off. However, they also find that the inability of merchants to impose instrument-contingent prices results in a lower level of social welfare because costly credit card infrastructure is used for transactions that do not require credit extensions.

Chakravorti and To (2007) consider a scenario with monopolist merchants and a monopolist bank that serves both consumers and merchants where the merchants absorb all credit and payment costs in a two-period dynamic model.\textsuperscript{31} Their model yields the following results. First, the merchants’ willingness to pay bank fees increases as the number of credit card consumers without income increases. Note that up to a point, merchants are willing to subsidize credit losses in exchange for additional sales. Second, a prisoner’s dilemma situation may arise: Each merchant chooses to accept credit cards, but by doing so, each merchant’s discounted two-period profit is lower. Unlike other models, business stealing occurs across time and across monopolist merchants.

\textsuperscript{30} For a breakdown of issuer revenue percentages, see Green (2008).
\textsuperscript{31} Chakravorti and To depart from the payment card literature in the following ways. First, rather than taking a reduced-form approach where the costs and benefits of payment cards are exogenously assigned functional forms, they construct a model that endogenously yields costs and benefits to consumers, merchants, and banks from credit card use. Second, their model considers a dynamic setting where there are intertemporal tradeoffs for all participants. Third, they consider consumption and income uncertainty.
Competition among payment instruments

Most of the payment card literature ignores competition between payment instruments.\textsuperscript{32} If consumers carry multiple types of payment instruments, merchants may be able to steer them away from more costly payment instruments.\textsuperscript{33} Rochet and Tirole (2010) argue that merchants may choose to decline cards after they have agreed to accept them. They define the “tourist test” as when the merchant accepts cards even when it can “effectively steer” the consumer to use another payment instrument. However, if the consumer is unable to access cash or another form of payment, the merchant would lose the sale.

Merchants may steer consumers through price incentives, if allowed to do so. Bolt and Chakravorti (2008a) study the ability of banks and merchants to influence the consumers’ choice of payment instrument when they have access to three payment forms—cash, debit card, and credit card.\textsuperscript{34} Unlike most two-sided market models, where benefits are exogenous, they explicitly consider how consumers’ utility and merchants’ profits increase from additional sales resulting from greater security and access to credit.\textsuperscript{35} Bolt and Chakravorti’s (2008a) key results can be summarized as follows. First, with sufficiently low processing costs relative to theft and default risk, the social planner sets the merchant fee to zero, completely internalizing the card acceptance

\textsuperscript{32} Farrell (2006) studies the impact of higher interchange fees on consumers who do not use cards and argues that policymakers should not ignore these redistributive effects. Wang (2010) finds that given a monopolistic network with price taking issuers and acquirers, networks tend to set higher than socially optimal interchange fees to boost card transaction value and compete with other types of payment instruments.

\textsuperscript{33} Bourreau and Verdier (2010) and Rochet and Wright (2010) consider competition between merchant-specific private label and bank-issued general-purpose cards.

\textsuperscript{34} In Bolt and Chakravorti’s model, consumers only derive utility from consuming goods from the merchant they are matched to in the morning. Merchants differ on the types of payment instruments that they accept and type of consumption good they sell. Each merchant chooses which instruments to accept based on its production costs. Merchant heterogeneity is based on differences in production costs. They consider the merchants’ ability to pass on payment processing costs to consumers in the form of higher uniform and differentiated goods prices.

\textsuperscript{35} McAndrews and Wang (2008) also explicitly consider benefits and attach monetary values to them.
externality. The bank may also set the merchant fees to zero, but only if merchants are able to sufficiently pass on their payment fees to their consumers or if their payment fees are zero. Second, if the real resource cost of payment cards is sufficiently high, the social planner sets a higher merchant fee than the bank does, resulting in lower card acceptance and higher cash usage. Third, bank profit is higher when merchants are unable to pass on payment costs to consumers because the bank is better able to extract merchant surplus. Fourth, the relative cost of providing debit and credit cards determines whether the bank will provide both or only one type of payment card.

**Market Interventions**

Policymakers in different jurisdictions are encouraging the replacement of cash and checks with electronic substitutes, such as payment cards at the point of sale. In some U.S. municipalities, acceptance of payment cards for cab rides has been mandated. A primary reason cited is the safety of passengers and cab drivers (who are often the targets of muggings). However, forced acceptance of payment cards is not common. In this section, we discuss several market interventions in various jurisdictions.

**Removal of no-surcharge policies**

There are several jurisdictions where merchants are able to surcharge card transactions. Most of the academic research suggests that if merchants are allowed to surcharge, the level of the interchange fee would be neutral. If the interchange fee is

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36 Default rates and probability of theft will differ across countries. For Italy, Alvarez and Lippi (2009) estimate the probability of being pickpocketed at around 2 percent in 2004. For the United States, Scholtes (2009) reported that credit card default rates hit a record of more than 10 percent in June 2009.

37 Prager et al. (2009) review the U.S. payment card market and consider potential regulations.
neutral, regulating the interchange fee would have little impact. In this section, we explore whether merchants surcharge if they are allowed to do so.

The Australian authorities argued that consumers did not receive the proper price incentives to use debit cards, the less costly payment instrument. The Reserve Bank of Australia (RBA) reported that the average cost of the payment functionality of the credit card was AUS$0.35 higher than a debit card using a consistent AUS$50 transaction size. To encourage better price signals, the RBA removed no-surcharge restrictions in 2002.

While most Australian merchants do not impose surcharges for any type of payment card transaction today, the number of merchants surcharging credit card transactions continues to increase. At the end of 2007, around 23 percent of very large merchants and around ten percent of small and very small merchants imposed surcharges. The average surcharge for MasterCard and Visa transactions is around one percent, and that for American Express and Diners Club transactions is around two percent (Reserve Bank of Australia, 2008a). Using confidential data, the Reserve Bank of Australia (2008a) also found that if one network’s card was surcharged more than another networks’ cards, consumers dramatically reduced their use of the card with the surcharge. After analyzing consumer surveys, the Reserve Bank of Australia (2008a) noted that nearly 40 percent of credit card convenience users (that is, credit card users who do not need credit to make purchases) did not use a debit card during the time of the survey.

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38 Reserve Bank of Australia (2008a), 17.
suggesting that using credit cards is still preferred by many of those who do not need to borrow.\textsuperscript{39}

A Swedish survey showed that lifting the no-surcharge rule only had a marginal effect on merchant acceptance of credit cards (IMA Market Development, 2000). The vast majority of merchants connected to Visa and MasterCard would most likely have joined the card payment systems regardless of the ability to surcharge card transactions.

In the United States, merchants are allowed to offer cash discounts but may not be allowed to surcharge credit card transactions. In the 1980s, many U.S. gas stations explicitly posted cash and credit card prices. Barron, Staten, and Umbeck (1992) report that gas station operators imposed contingent-instrument pricing when their credit card processing costs were high but later abandoned this practice when acceptance costs decreased because of new technologies such as electronic terminals at the point of sale. Recently, some gas stations brought back price differentiation based on payment instrument type, citing the rapid rise in gas prices and declining profit margins.

In some instances, policymakers may prefer if merchants did not surcharge certain types of transactions. For the Netherlands, Bolt, Jonker, and van Renselaar (2010) find that a significant number of merchants surcharge debit transactions vis-à-vis cash. Debit card surcharges are widely assessed when purchases are below 10 euro, suggesting that merchants are unwilling to pay the fixed transaction fee below this threshold. They find that merchants may surcharge up to four times their fee. In addition, when these surcharges are removed, they argue that consumers start using their debit cards for these small payments, suggesting that merchant price incentives do affect consumer payment

\textsuperscript{39} Of course, even those credit card users who pay off their balances every month may benefit from short-term loans because of timing asymmetries between their incomes and purchases. Simon, Smith, and West (2010) find that the interest free period reduces the probability of debit card use by 19 percent.
choice. Interestingly, in an effort to promote a more efficient payment system, the Dutch central bank has supported a public campaign to encourage retailers to stop surcharging to encourage consumers to use their debit cards for small transactions. This strategy appears to be successful. In 2009, debit card payments below ten euro accounted for more than 50 percent of the total annual growth of almost 11 percent in debit card volume.

There are instances when card payments were discounted vis-à-vis cash payments. The Illinois Tollway charges motorists who use cash to pay tolls twice as much as those who use toll tags (called I-PASS), which may be loaded automatically with credit and debit cards when the level of remaining funds falls below a certain level (Amromin, Jankowski, and Porter, 2007). In addition to reducing cash handling costs, the widespread implementation of toll tags decreased not only congestions at toll booths but also pollution from idling vehicles waiting to pay tolls, since tolls could be collected as cars drove at highway speeds through certain points on the Illinois Tollway. In both of these cases, the benefits of using cards outweighed the costs for society in general. However, benefits from card acceptance vary considerably across merchants.

*Regulation of interchange fees*

There are several jurisdictions where interchange fees were directly regulated or significant pressure was exerted by the public authorities on networks to reduce their interchange fees.\(^{40}\) In this section, we will discuss the impact of interventions in four jurisdictions—Australia, Spain, the European Union, and the United States.

In 2002, the RBA imposed weighted-average MasterCard and Visa credit card interchange fee caps and later imposed per transaction targets for debit cards. As of April

\(^{40}\) For a summary of antitrust challenges in various jurisdictions, see Bradford and Hayashi (2008).
2008, the weighted-average credit card interchange fees in the MasterCard and Visa networks must not exceed 0.50 percent of the value of transactions. The Visa debit weighted-average interchange fee cap must not exceed 12 cents (Australian) per transaction. The EFTPOS (electronic funds transfer at point of sale) interchange fees for transactions that do not include a cash-out component must be between four cents (Australian) and five cents (Australian) per transaction.

The Reserve Bank of Australia (2008a) reports that the interchange fee regulation, coupled with the removal of the no-surcharge rule, improved the price signals that consumers face when deciding which payment instruments to use. Specifically, annual fees for credit cards increased and the value of the rewards decreased. The Reserve Bank of Australia (2008a) calculates that for an AUS$100 transaction, the cost to consumers increased from –AUS$1.30 to –AUS$1.10 for consumers who pay off their balances in full every month. A negative per transaction cost results when card benefits such as rewards and interest-free loans are greater than payment card fees.41

Those who oppose the Australian interchange fee regulation argue that consumers have been harmed by reduced rewards and higher fees and have not shared in the cost savings—in terms of lower prices for goods and services. However, measuring price effects over time of interchange fee regulation is difficult.42

Unlike in Australia, the antitrust authority, and not the central bank, intervened in payment card markets in Spain several times during the period 1999 to 2009. Part of the motivation was based on directives by the European Commission regarding fees that were set by networks that had significant market power. Over the period 1997–2007, the

41 For more discussion about card rewards, see Carbó Valverde and Liñares Zegarra (2009) and Ching and Hayashi (2010).
42 For more discussion, see Chang, Evans, and Garcia Swartz (2005) and Hayes (2007).
number of debit cards increased by 40.9 percent and the number of credit cards increased by 207.1 percent. During the same period, debit card transactions increased from 156 million to 863 million and credit card transactions increased from 138 million to 1.037 billion. Furthermore, the average number of POS transactions per card per year increased from 7.1 to 27.8 during the same period.

Carbó Valverde, Chakravorti, and Rodriguez Fernandez (2009) study the effects of interchange fee reductions in Spain from 1997 to 2007. To our knowledge, they are the first to use bank-level data to study the impact of several episodes of interchange fee reductions for debit and credit cards resulting from moral suasion and agreements between market participants intermediated by the government authorities. They demonstrate that merchants benefited from lower fees and consumers benefited from greater merchant acceptance. Surprisingly, they found that issuer revenues increased during the period when interchange fees decreased. While the effect of these reductions is positive on banks’ revenues, their effect on banks’ profits could not be determined because of data limitations. Furthermore, there may be a critical interchange fee below which issuer revenue decreases.

In December 2007, the European Commission (EC) ruled that the multilateral interchange fees for cross-border payments in the European Union applied by MasterCard Europe violated Council Regulation (EC) No. 1/2003. The EC argued that MasterCard’s fee structure restricted competition among acquiring banks and inflated the cost of card acceptance by retailers without leading to proven efficiencies.43 In response,

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43 On December 16, 2002, the Council of the European Union adopted Council Regulation (EC) No. 1/2003 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty Establishing the European Community (that is, the 1997 consolidated version of the Treaty of Rome). The
MasterCard reached an interim understanding with the European Commission on these interchange fees for cross-border consumer payments in the EU in April 2009. Effective July 1, 2009 MasterCard, Europe has established interchange fees for consumer card transactions that, on average, will not exceed 30 basis points for credit cards and 20 basis points for debit cards. With these fee changes, the EC will not further pursue MasterCard either for non-compliance with its December 2007 decision or for infringing the antitrust rules.

The EC conducted a separate antitrust investigation against Visa and will monitor the behavior of other market players as well to ensure that competition is effective in this market to the benefit of merchants and consumers. The EC and Visa have agreed to 20 basis point debit card interchange fees but have not agreed to the level of credit card interchange fees. The dialogue between Visa and MasterCard vis-a-vis the Commission has to date not led to an agreement concerning the application of the “merchant indifference methodology” based on the tourist test to consumer credit (and deferred debit) transactions—discussions on this issue continue.

As part of the Frank-Dodd Wall Street Reform and Consumer Protection Act signed into law on July 21, 2010, the Durbin Amendment grants the Federal Reserve Board the authority to set rules regarding the setting of debit card interchange fees that are “reasonable and proportional to cost.” Financial institutions with less than $10 billion in assets are exempt. Debit cards include payment cards that access accounts at financial institutions to make payment along with prepaid cards. Certain types of prepaid cards are

new regulation came into effect on May 1, 2004. For more discussion on the EC’s ruling on MasterCard, see Bolt (2008).
exempt such as those disbursing funds as a part of government-sponsored programs or geared towards the underbanked or lower-income households.

_Honor-all-cards rules_

A payment card network may require that merchants that accept one of its payment products to accept all of its products.\(^4^4\) Such a rule is a type of honor-all-cards rule. In other words, if a merchant accepts a network’s credit card, it must accept all debit and prepaid cards from that network. In the United States, around 5 million merchants sued the two major networks, MasterCard and Visa, over the required acceptance of the network’s signature-based debit card when accepting the same network’s credit card.\(^4^5\) The case was settled out of court. In addition to a monetary settlement, MasterCard and Visa agreed to decouple merchants’ acceptance of their debit and credit products. While few merchants have declined one type of card and accepted another type, the decoupling of debit and credit card acceptance may have increased bargaining power for merchants in negotiating fees.

As part of the payment system reforms in Australia, MasterCard and Visa were mandated to decouple merchants’ acceptance of their debit and credit cards as well. The Payments System Board (Reserve Bank of Australia, 2008b) is unaware of any merchant that continues to accept debit cards but does not accept credit cards from the same network.

\(^4^4\) For a theoretical model on honor-all-cards rules, see Rochet and Tirole (2010).
\(^4^5\) For a detailed account of the merchants’ position, see Constantine (2009).
Conclusion

Technological advances in mobile phone technology have the potential to replace many remaining paper-based transactions along with decreasing the number of face-to-face interactions. However, the rate at which these shifts will occur depends on the underlying benefits and costs to payment system participants. Most policymakers and economists agree that the digitization of payments is socially beneficial. But there is considerable debate regarding the optimal pricing of these payment services. Payment markets are complex with many participants engaging in a series of interrelated bilateral relations and transactions.

The determination of optimal prices is difficult for several reasons. First, there are significant scale and scope economies in payment processing because of large fixed costs to setup sophisticated secure networks to process, clear and settle payment transactions. Thus, established payment providers may generally enjoy some level of market power because these markets are generally not contestable.

Second, payment networks must convince two distinct sets of end users—consumers and merchants—to simultaneously participate. Networks often set asymmetric prices to get both sides on board. Such pricing is based on cost to serve end-users as well as their demand elasticities. It is extremely difficult for policymakers to disentangle optimal pricing strategies from excessive rent extraction.

Third, efficiency of payment systems is measured not only by the costs of resources used, but also by the social benefits generated by them. Measuring individual and social benefits is particularly difficult. The central question is whether the specific circumstances of payment markets are such that intervention by public authorities can be
expected to improve economic welfare.

The theoretical literature on payment cards continues to grow. However, there are a few areas of payment economics that deserve greater attention. First, what is the effect of the reduction of banks’ and networks’ surplus extraction on future innovation? Second, how should payment system participants pay for fraud containment and distribute the losses when fraud occurs? Third, should public entities step in and start providing payment services and if so, at what price?

Finally, empirical studies about payment system pricing using data from payment networks and providers are extremely scarce. Such analysis would be helpful in understanding how effective regulatory interventions were in meeting the stated objectives and studying any potential unintended consequences. We hope that recent regulatory changes in different parts of the world will generate rich sets of data that can be exploited by economists to test how well the theories fit the data.
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Table 1: Per Capita Card Transactions 1988 and 2008

<table>
<thead>
<tr>
<th>Country</th>
<th>1988</th>
<th>2008</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>6.23</td>
<td>87.1</td>
<td>1298</td>
</tr>
<tr>
<td>Canada</td>
<td>28.34</td>
<td>187.8</td>
<td>563</td>
</tr>
<tr>
<td>France</td>
<td>15.00</td>
<td>102.0</td>
<td>580</td>
</tr>
<tr>
<td>Germany</td>
<td>0.76</td>
<td>27.3</td>
<td>3492</td>
</tr>
<tr>
<td>Italy</td>
<td>0.33</td>
<td>23.5</td>
<td>7021</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.34</td>
<td>113.7</td>
<td>33341</td>
</tr>
<tr>
<td>Sweden</td>
<td>5.45</td>
<td>176.5</td>
<td>3139</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2.34</td>
<td>62.8</td>
<td>2583</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>10.47</td>
<td>123.7</td>
<td>1081</td>
</tr>
<tr>
<td>United States</td>
<td>36.67</td>
<td>191.1</td>
<td>421</td>
</tr>
</tbody>
</table>

Source: Committee on Payment and Settlement Systems (1993) and (2010).
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