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Essays on Alternative Finance

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Declaration of Originality

I hereby declare that this thesis consists of three independent research projects. Chapter 2 and 3 are self-authored; Chapter 4 is written jointly with three co-authors: Dirk Foremny, Associate Professor at the University of Barcelona; Clara Martínez-Toledano, Assistant Professor at Imperial College Business School; and Mariona Segú, Assistant Professor at THEMA and CY Cergy Paris Université.

I acknowledge that I have utilized ChatGPT, an AI language model developed by OpenAI, to assist in improving the wording and clarity of this thesis. All substantive content, analysis, and conclusions are the author's own original work.

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Abstract

This thesis investigates two areas of alternative finance - fintech and real estate investment - and examines how technological innovations in payment systems and frictions in real estate markets influence firm behaviours, household decisions, and broader economic outcomes.

Chapter 2 surveys the modern economics of payments, synthesises industrial organisation, new-monetarist and quantitative strands of the literature, highlighting open questions around two-sided pricing, merchant surcharging and consumer welfare.

Chapter 3, *Payment Wars in Retail*, develops a stylised model to understand the rapid adoption of Buy-Now-Pay-Later (BNPL) and how merchants choose among cash, credit cards and BNPL. BNPL combines vendor financing with fintech credit scoring, enabling merchants to practise third-degree price discrimination and serve liquidity-constrained, high-risk consumers that card networks cannot profitably reach. The model predicts (i) low-cost merchants are the first adopters of BNPL, (ii) equilibrium merchant pricing depends on the relative pass-through of card and BNPL fees, and (iii) BNPL diffusion can raise total surplus yet transfer rents from card networks to merchants and fintech lenders.

Chapter 4, *Golden Visas and Real-Estate Markets*, provides the first causal evaluation of Spain's 2013 golden visa programme. Using the universe of registrar transactions matched to buyer and seller nationality, a triple-difference design and shift-share instruments help to alleviate endogeneity concerns, we show that transactions just above the 500,000 Euro eligibility threshold rose by 0.24 percentage points for non-EU investors relative to EU buyers. Non-EU purchasers paid an average premium of about 10,000 Euro, and the programme generated positive spillovers, lifting municipality-level house prices by 0.45 percent.

Collectively, the essays demonstrate how fintech credit and policy-driven capital inflows reshape market outcomes, providing new evidence for regulators balancing innovation, financial inclusion and housing affordability.

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I have always been a fun-loving person, often uncertain about what I truly want to do and questioning whether I am good at anything. These doubts persisted throughout my PhD journey. However, I was fortunate to have great supervisors and wonderful companions who supported me, helping me persevere and complete this chapter of my life.

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During the Covid-19 pandemic, I moved to Wimbledon with my boyfriend, who is now my husband, Guitao. That move turned out to be one of the best decisions we ever made because it introduced us to a wonderful group of badminton friends – Yong, Zhen, Shawn, and Jess. I particularly cherish my partnership with Yong, whose kindness means so much to me. I will always treasure the joy, laughter, and countless meals we've shared together. It's truly been amazing to be friends with you all.

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Chapter 1

Introduction

The landscape of finance has undergone significant transformations over the past few decades, with alternative finance emerging as a crucial component of the global financial system. Traditionally, alternative finance has been predominantly associated with investment vehicles such as real estate and private equity. These asset classes have provided investors with opportunities to diversify their portfolios beyond traditional financial instruments such as stocks and bonds, offering potential for higher returns and risk mitigation.

Over time, however, the boundaries of alternative finance have expanded considerably. Technological innovations in financial services – collectively known as fintech – have led to new forms of credit provision, payment systems, and financial instruments that are reshaping both consumer behavior and institutional practices.

Among the most impactful changes in alternative finance is the rapid evolution of digital payment technologies. In recent years, an extensive array of electronic payment systems has emerged to complement, and in some cases supersede, traditional methods such as cash and credit cards. Mobile wallets, cryptocurrencies, blockchain-based solutions, and a variety of online credit platforms have not only improved transactional efficiency and accessibility but have also introduced novel business models. The proliferation of these payment modalities has intensified competition among payment service providers and forced merchants to reconsider their payment adoption and pricing strategies.

Chapter 3 of this thesis delves deeply into one particular innovation at the intersection of credit and payments: Buy Now, Pay Later (BNPL) services. BNPL solutions, which grant consumers short-term, zero-interest installment loans at the point of sale, have gained rapid adoption in the retail sector. They challenge traditional credit cards by adopting structured repayment plans rather than revolving credit with interest charges. Through a stylized model built on the logic of vendor financing (Brennan et al., 1988) adapted for unsecured retail credit, the chapter identifies two primary economic drivers behind BNPL’s rapid ascendance: price discrimination and adverse selection in credit markets.

From a price discrimination perspective, BNPL allows merchants and fintech firms to segment customers more finely based on their payment preferences and willingness to pay. By bundling zero-interest installments with the purchase price, merchants can cater differently to consumers who would otherwise be price-sensitive or credit-constrained. Adverse selection, on the other hand, arises because credit card companies struggle to write contracts that effectively separate borrowers of different credit risk profiles. BNPL’s structured repayment plans can help screen consumers more efficiently, thereby expanding access to credit and shaping the market composition of buyers.

The chapter then moves from these theoretical motivations to the equilibrium implications for merchants. As online and omnichannel retail grows, BNPL has become not just an alternative credit provider but a strategic instrument through which merchants can influence sales volumes, customer acquisition, and profitability. By examining which merchants adopt BNPL and how they set prices, the chapter offers insights into the competitive landscape of retail payments. It predicts who is most likely to specialize in BNPL relative to cash or credit cards and explores how payment service configurations affect consumer welfare, merchant profitability, and the distribution of surpluses across the value chain.

In parallel to these technological and market-driven innovations in credit and payment systems, governments around the world have also played an active role in shaping the landscape of alternative finance. Policymakers have introduced various schemes to stimulate investment flows, often in response to economic downturns and crises. One particularly noteworthy trend has

been the rise of “golden passport” and “golden visa” programs—arrangements whereby foreign investors gain citizenship or residence rights in exchange for substantial financial contributions. These policy instruments aim to attract foreign capital, foster real estate investment, and stimulate local economies.

Chapter 4 examines the introduction of such a golden visa program in Spain in 2013. Spain’s policy offers non-EU investors the opportunity to obtain residence rights by investing at least €500,000 in domestic real estate. Leveraging rich administrative microdata on the universe of real estate transactions, the chapter provides a rigorous empirical evaluation of the program’s effectiveness and impact on local housing markets. It asks three key questions: Did the policy actually increase foreign real estate investment? Did it generate a “golden visa premium” in property prices? And what were the broader spillover effects on local real estate dynamics?

By employing econometric techniques, including difference-in-differences and shift-share type instrumental variable approaches, the chapter isolates the causal effects of the policy on local housing markets. The results contribute to a growing literature on the determinants of real estate price fluctuations and the role of foreign capital inflows—providing new insights into how government-designed policies that explicitly link immigration and investment affect local economic conditions.

Collectively, the studies in this thesis deepen our understanding of how innovative payment technologies and policy interventions shape the contours of alternative finance. They shed light on the mechanisms through which digital payment solutions alter credit markets and merchant behavior, and how policy-driven foreign investment inflows transform local real estate markets. Ultimately, this research offers insights that may inform future policy design, regulatory strategies, and investment decisions in a rapidly evolving financial world.

Chapter 2

Literature Review on Payment Systems

2.1 Introduction

Over the past several decades, payment technology and infrastructure have undergone significant transformations. The methods by which we pay for products and services in our daily lives have evolved dramatically – from traditional paper cash and checks to electronic payment cards requiring digital processing, and more recently, to mobile payments and digital wallets. These advancements reflect not only technological innovation but also shifts in consumer behavior, financial markets, and regulatory environments.

Understanding these changes is crucial for comprehending the current state and future direction of payment systems. This paper surveys the literature on payments, encompassing both theoretical frameworks and empirical studies. Section 2.2 reviews the theoretical literature on payments from two major perspectives: the industrial organization of payment systems, focusing on their two-sided market characteristics and the pricing of payment services; and the modeling of economic frictions that necessitate payment arrangements. Section 2.3 surveys the relevant empirical works, analyzing how these theoretical concepts manifest in real-world scenarios and their implications for policy and practice.

Related Literature. Several studies provide comprehensive overviews of payment systems

and two-sided markets. [Rochet \(2003\)](#) provides a detailed summary of early contributions of theoretical literature on the determination of interchange fees by payment card associations. [Bolt and Chakravorti \(2008b\)](#) and [Verdier \(2011\)](#) examine the existing theoretical literature on payment systems and discuss the regulatory debate on interchange fees. [Rysman \(2009\)](#) surveys the literature on two-sided markets in general. Focusing on both theoretical and empirical perspectives, [Kahn and Roberds \(2009\)](#) presents basic models of payments and discusses relevant microeconomic and macroeconomic policy issues. [Rysman and Wright \(2014\)](#) specifically covers the literature on payment cards, emphasizing interchange fees, merchant internalization, and surcharging. [Sumit and Zhang \(2015\)](#) reviews the literature on credit card consumption. [Williamson and Wright \(2010\)](#) provides a survey of the models used in New Monetarist Economics to study payments. [Rocheteau and Nosal \(2017\)](#) provide an overview of the literature on the economics of payments using a unified New-Monetarist framework, especially on explaining economics with competing means of payments. Finally, [Jullien et al. \(2021\)](#) explores the theory of two-sided markets and related empirical work beyond payment systems.

2.2 Theoretical Work in Payments

The next two sections review theoretical studies of payment systems, with a primary focus on the industrial organization perspective. Section [2.2.1](#) provides a detailed overview of the industrial organization of payment systems by analyzing their two-sided market characteristics and primarily focuses on providing a positive and normative theory of pricing payment services. Section [2.2.2](#) takes a step back to understand those economic frictions that necessitate payment arrangements in the first place. In the Arrow-Debreu model with complete markets and full commitment, payment instruments or media of exchange – whether ancient currencies like shells, commodities like gold, real assets, fiat money, or even special items like cigarettes – become unnecessary. However, this frictionless scenario does not reflect real-world conditions, where payment systems play an essential role in facilitating economic transactions.

2.2.1 Industrial Organization of Card Payments

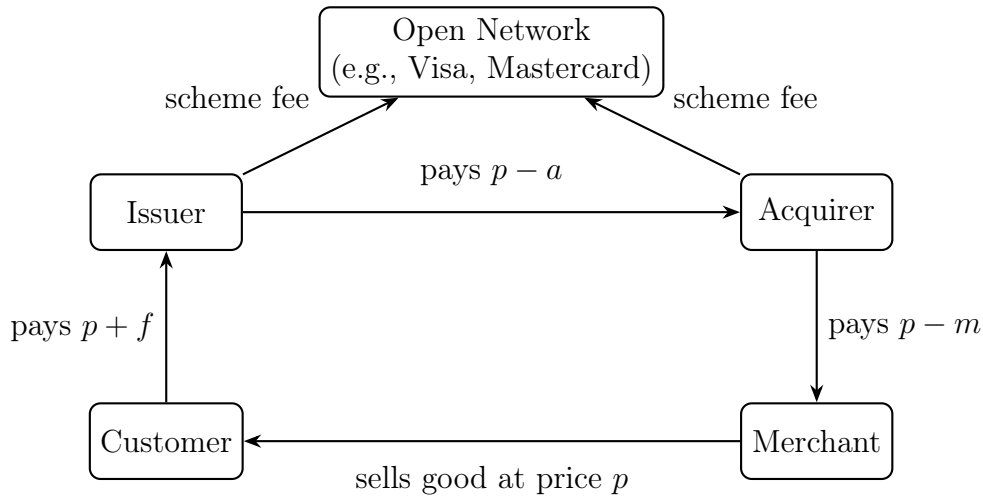
Card payment systems operate through either open or closed networks, as illustrated in Figure 2.1. Open networks, such as Visa and Mastercard (Figure 2.1a), separate clearing-house services from the tasks of managing relationships with consumers and merchants. These networks allow any bank or equivalent financial institution to join, with issuers and acquirers independently competing to attract cardholders and merchants by setting transaction fees and merchant discounts, respectively. The network owner charges a scheme fee¹ on both sides for processing card payments through its network and sets the interchange fee, paid by the acquiring bank to the issuing bank, to balance the incentives between these entities. Conversely, closed networks, such as American Express (Figure 2.1b), operate as an integrated systems where the payment network itself manages relationships with both consumers and merchants. Unlike open networks, closed networks do not use explicit interchange fees. Instead, they set fees directly on both sides (e.g., cardholder fees and merchant discount rates) to ensure balance. Nevertheless, the system implicitly incorporates interchange fee-like mechanisms to align incentives between the two sides.

A significant body of research has focused on analyzing and determining the optimal interchange fees for payment networks, as these fees play a critical role in balancing consumer adoption and merchant acceptance.

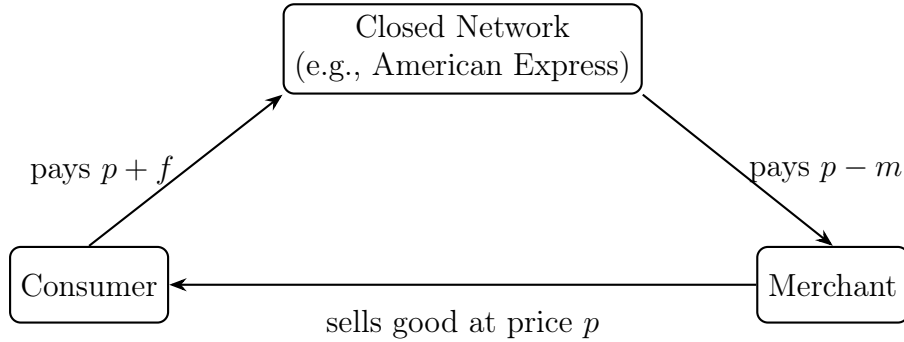
Baseline Model

Rochet and Tirole (2002) provide a useful framework to demonstrate Baxter (1983)'s justification for the existence of interchange fees in payment systems. Consider an economy where different payment methods are available, such as cash and card payments. Under the no-surcharge rule (NSR), merchants are prohibited from imposing a surcharging on goods purchased with

¹Also known as a network or assessment fee, scheme fees typically range from 0.01% to 1% or more per transaction. The fee varies depending on factors such as the card network (Visa, Mastercard), card type, merchant and cardholder location, transaction currency, and the acquirer's payment volume. Acquirers handling higher payment volumes often negotiate more favorable scheme fees with card networks. For further details, see [this resource](#).



(a) An Open Network System



(b) A Closed Network System

Figure 2.1: Payment Networks

cards compared to other payment methods such as cash, i.e., $p_{card} \leq p_{cash}$. Suppose all consumers (subscript B) purchase a fixed quantity of goods, normalized to one, from merchants (subscript S). Consumers derive a gross benefit of v from consuming the good, while each merchant incurs a cost of d to sell the good. In addition, a consumer derives a per-transaction net benefit b_B from paying by card instead of cash for a transaction with a merchant, and the merchant derives a per-transaction net benefit b_S from receiving payment by card rather than cash. The consumer pays a per-transaction fee f to the issuing bank², and the merchant pays a per-transaction merchant discount m to the acquiring bank. The per-transaction technological costs of processing a card transaction for the issuer and acquirer are c_I and c_A , respectively³.

²A negative fee will capture rebates offered to cardholders per transaction by issuers.

³For simplicity, costs and fees that arise per cardholder or per merchant are assumed away. We only consider per transaction costs and fees.

Figure 2.2 illustrates the flow of payments among the four parties.

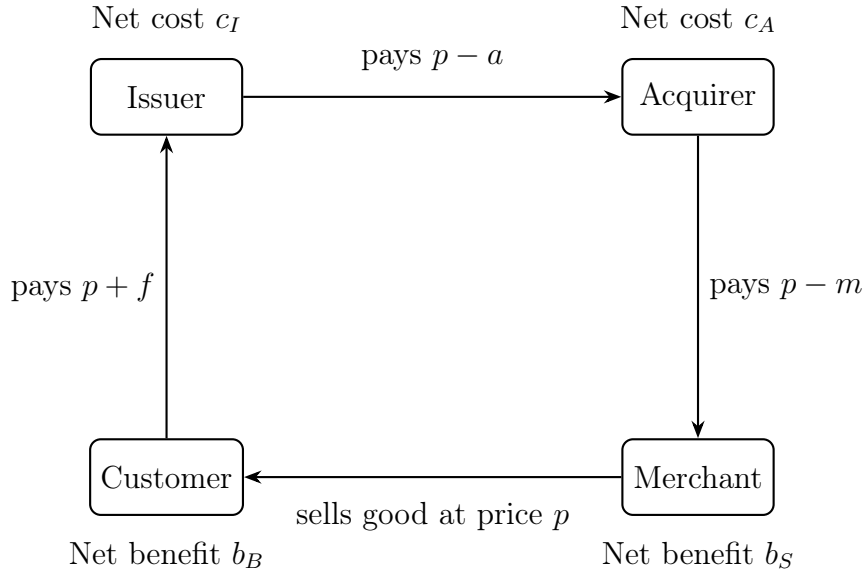


Figure 2.2: Flow of Funds in Card Transactions

Under perfect competition among banks in the issuing and acquiring businesses, fees are set equal to costs, so $f = c_I$ and $m = c_A$. If $b_B \geq f = c_I$ and $b_S \geq m = c_A$ (Region I in Figure 2.3), a card payment will take place. However, socially valuable card transactions are those satisfying $b_B + b_S \geq c_I + c_A \equiv c$ (Regions I, II, and III in Figure 2.3). Transactions in Regions II and III are socially desirable but are not realized under the current fee structure due to misaligned incentives.

Consider the scenario where the market fails to complete socially optimal transactions: $b_B < c_I$ and $b_S > c_A$, but $b_S + b_B \geq c_I + c_A$ (Region II in Figure 2.3). In this case, the consumer prefers to pay by cash (since $b_B < f = c_I$), while the merchant prefers to receive card payments (since $b_S > m = c_A$). However, the socially valuable card transaction is not realized due to a negative usage externality: the consumer's choice imposes a cost on the merchant.

This inefficiency can be corrected by introducing an interchange fee $a^o = b_S - c_A$ (Baxter fee) paid from the acquirer to the issuer⁴. With this interchange fee, the issuer's net cost

⁴The existence and appropriate level of interchange fees have long been a contentious issue in the payment card industry. Some researchers propose an alternative solution to correct market failures by removing the no-surcharge rule (NSR) for merchants. For instance, [Carlton and Frankel \(1995\)](#) argue that the market could

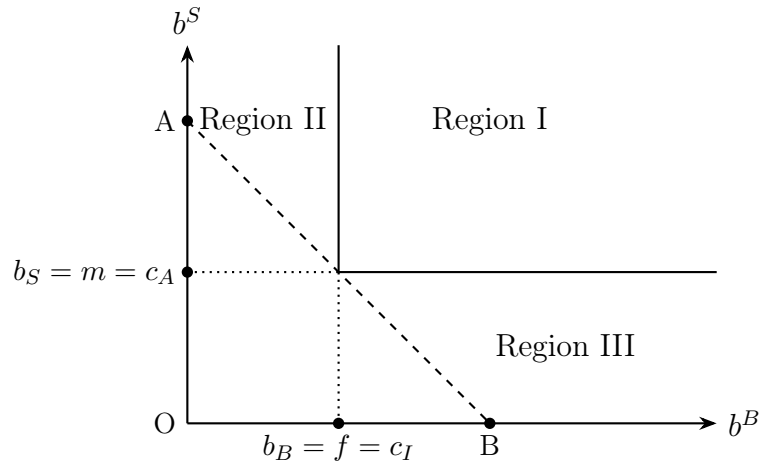


Figure 2.3: Diagram Illustrating Card Usage Efficiency

becomes $c_I - a^o = c_I - (b_S - c_A) = c_I + c_A - b_S$, and the net cost of the acquirer becomes $c_A + a^o = c_A + (b_S - c_A) = b_S$. Under perfect competition, the issuer will set the consumer fee equal to its net cost, so $f^o = c_I + c_A - b_S$. The consumer will choose to pay by card if $b_B \geq f^o = c_I + c_A - b_S$. Rearranging, we obtain: $b_S + b_B \geq c_I + c_A$, which is the same condition for socially optimal transactions. Thus, the interchange fee aligns private incentives with the social optimum, facilitating the socially valuable card transaction. Similarly, if we consider the case where $b_B > c_I$ but $b_S < c_A$ and $b_S + b_B \geq c_I + c_A$ (Region III in Figure 2.3), indicating that merchants prefer cash over card payments, the interchange fee can still correct the market failure by flowing from the issuer to the acquirer (i.e., the interchange fee is negative).

The above model relies on the following simplifying assumptions:

A1 No-surcharge rule (NSR) under which merchants cannot price discriminate between cash

achieve efficiency if the NSR is eliminated, allowing merchants to price discriminate based on customers' payment methods. In the context of Region II in Figure 2.2, merchants could reduce the price for card payments relative to cash payments by setting $p_{card} = p_{cash} - (b_S - m) = p_{cash} - (b_S - c_A)$, where $b_S - m = b_S - c_A$ represents the net benefit merchants receive from card payments. This pricing scheme incentivizes consumers to pay with card by ensuring that the surplus flows directly between end-users (merchants and customers) rather than through intermediaries (acquirers and issuers). Consequently, the interchange fee would no longer serve as a potential instrument for collusion, especially in cases where banks exert significant market power. This adjustment would theoretically ensure that all socially optimal transactions are completed. However, such pricing schemes are rarely observed in practice, likely due to high transaction costs or active discouragement by payment card networks, particularly credit card networks. If anything, merchants more commonly offer discounts for cash payments or surcharges for card use. The adoption of the NSR varies globally. Many countries, including the United Kingdom and the European Union, enforce the rule to protect consumers. Conversely, countries such as Australia (since 2003) and Canada (since 2017) have banned the NSR. In the United States, the legality of credit card surcharges depends on state-specific regulations, with most states permitting the practice under specific conditions.

and card payments.

A2 Homogeneous card usage benefits for consumers.

A3 Homogeneous card acceptance benefits for merchants.

A4 No strategic card acceptance decisions by merchants to attract more customers from rival merchants (Merchant Internalization).

A5 Fixed number of transactions normalized to one, implying that changes in retail prices induced by interchange fee do not affect demand for retail goods; thus, the interchange fee only affects the diffusion of payment cards.

A6 Competitive issuers make zero profit.

A7 Competitive acquirers make zero profit.

These assumptions are too restrictive to address questions such as the optimal level of the interchange fee⁵. Many papers attempt to relax them to gain a better understanding of the issue.

The sequence of events in a typical game is as follows:

S1 A payment system rule is established by a card network⁶ to determine whether merchants are allowed to surcharge card payments. Additionally, the interchange fee a is set to maximize member banks' total profit.

S2 Issuers set transaction fees f for cardholders, and acquirers set merchant discount m for merchants.

⁵For example, Assumptions **A6** and **A7** imply that issuers and acquirers and the owner of the card network are indifferent to the level of interchange fees.

⁶In an open card network, the network sets rules regarding surcharges and interchange fee a . In contrast, a closed card network directly sets the fees f and m .

S3 Customers and merchants decide simultaneously whether to join the payment card network⁷.

S4 Merchants set retail prices p_{card} and p_{cash} ⁸.

S5 Customers observe the retail prices and whether cards are accepted, and then choose a store and a payment method.

Strategic Merchants/Merchant Internalization

In [Rochet and Tirole \(2002\)](#), the authors relax Assumptions **A2**, **A4** and **A6** to study the determination of the interchange fee by a monopoly card network. **First**, consumers are assumed to differ in their card usage benefits, b_B , which are continuously distributed over an interval $[\underline{b}_B, \bar{b}_B]$ ⁹ according to the density function $h(b_B)$ and cumulative distribution function $H(b_B)$ ¹⁰. This heterogeneity determines consumers' demand for card payments $D_B(f) \equiv 1 - H(f)$. We define $\beta_B(f) = E[b_B | b_B \geq f]$ as the average transactional benefit for consumers who choose to use cards. **Second**, they utilize a symmetric Hotelling "linear city" model¹¹ to capture competition among merchants selling the same physical good, while accounting for both price and quality dimensions (Figure 2.4). **Third**, issuers are modeled as having some degree of market power over their customers, captured by the parametrized equilibrium price function $f = \phi(c_I - a, \tau)$, with $0 \leq \phi_1 \leq 1$ and $\phi_2 < 0$ ¹². Here, the lower indices denote partial derivatives, and the parameter τ reflects the level of competition among issuers.

⁷Some studies distinguish between card membership decisions by consumers and their subsequent card usage decisions, assuming that consumers make their membership decisions in stage **S3**. In such cases, as noted by [Wright \(2003\)](#), merchants recognize that their pricing has a negligible effect on customers' card membership decisions. Consequently, they set their optimal prices without accounting for the effect of their pricing on consumers' membership decisions. This is typically modeled by assuming that merchants determine their prices after cardholder membership decisions are made. When consumers face no cost to join the network, it is usually assumed that all consumers participate in the payment network.

⁸Under the NSR, same price for card and cash payments, $p = p_{card} = p_{cash}$.

⁹It is assumed that $\bar{b}_B + b_S > c_I + c_A$, indicating that card payments generate a positive social surplus.

¹⁰The monotone hazard function $h(b_B)/(1 - H(b_B))$ is assumed to be increasing in b_B to guarantee concavity of the optimization programs.

¹¹Specifically, consumers are uniformly distributed along a segment of length one and incur a transportation cost t per unit of distance, introducing product differentiation. Each merchant faces a manufacturing/marketing cost d , gross of the merchant discount and net of any transaction costs associated with cash payments.

¹² The equilibrium price function $\phi(x)$ is defined as a function of the net transaction cost x for the issuer. The issuer's per-transaction profit margin is therefore given by $\phi(x) - x$, where x reflects the net cost incurred.

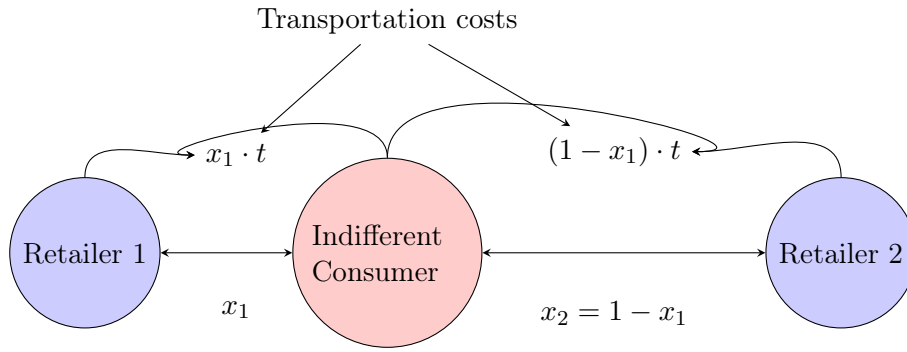


Figure 2.4: Hotelling Competition

They show that, **first**, under the NSR, an equilibrium exists where all merchants accept card payments if and only if $a \leq \bar{a}(\tau)$. The threshold $\bar{a}(\tau)$ is uniquely determined by the following equation, which equates the merchants' net cost to the average benefit received by cardholders:

$$\beta_B^n[\phi(c_I - \bar{a}(\tau), \tau)] = c_A + \bar{a}(\tau) - b_S, \quad (2.1)$$

where $\beta_B^n(f) \equiv E[b_B - f | b_B \geq f]$ represents the net surplus of an **average** cardholder¹³.

Rearranging, the equation yields:

$$\bar{a}(\tau) = b_S - c_A + \beta_B^n[\phi(c_I - \bar{a}(\tau), \tau)] > a^o \equiv b_S - c_A, \quad (2.2)$$

which reflects the level of merchant resistance to card acceptance. Merchants are strategically willing to bear higher costs for card services in order to retain customers who prefer paying with cards. This strategic consideration reduces merchants' resistance to card acceptance, as accepting cards is perceived as an enhancement to service quality that differentiates them from competitors. By doing so, merchants can attract potential card-using customers from competitors who refuse to accept card payments. Consequently, merchants are willing to pay fees above the immediate transactional benefits they receive from card payments, up to the level of the average benefit enjoyed by card users. Importantly, the same card acceptance threshold holds under Cournot competition (Wright, 2010). as well as under perfect competition and Hotelling-Lerner-Salop competition (Rochet and Tirole, 2011). Chakravorti and To (2007)

¹³In Rochet and Tirole (2002)'s original model, a fixed annual fee for holding a card is assumed, rather than a per-transaction fee for using the card. Thus, the term $\beta_B^n(f)$ in Equation (2.1) is replace by $\beta_B(f)$.

extend this business-stealing effect induced by strategic consideration to an inter-temporal setting by explicitly considering the role of credit cards in providing liquidity to users. They highlight that credit cards guarantee sales today, helping merchants avoid losing customers to competitors in future periods.

Because the issuers' profit is increasing in a , the **privately optimal interchange fee**¹⁴ a^Π for issuers is the highest level consistent with merchants accepting cards, i.e., $a^\Pi = \bar{a}$. **Second**, as issuer competition intensifies (i.e. τ increases), the number of cardholders rises because the fees charged by issuers decrease, making card available to a larger population. This increase in cardholders lowers the average benefit to cardholders, thereby reducing merchants' inclination to accept cards. **Third**, under the NSR, the **socially optimal interchange fee** a^W is determined by maximizing total welfare subject to the constraint that all merchants must accept the card¹⁵. Formally, the social planner solves the following problem **P1**:

$$\begin{aligned} \max_a \quad & W(f) \\ \text{s.t.} \quad & f = \phi(c_I - a) \\ & a \leq \bar{a} \end{aligned} \tag{P1}$$

where the total welfare $W(f)$ is defined as $\int_f^{\bar{b}_B} (b_B + b_S - c_A - c_I) dH(b_B)$. If we ignore the constraint $a \leq \bar{a}$, the first order condition is:

$$W'(f) = -(f + b_S - c_A - c_I)h(f) = 0, \tag{2.3}$$

Solving this condition yields $f^W = c_I + c_A - b_S = c_I - a^o = f^o$. There are two cases:

- **If the constraint is non-binding (case i):** the socially optimal interchange fee $a^W < \bar{a}$, and is determined by the condition $f^W = \phi(c_I - a^W) = c_I + c_A - b_S$. This also implies that $\phi(c_I - a^W) > \phi(c_I - \bar{a})$, indicating an **over-provision** of payment card services by

¹⁴In the setting here, the volume maximizing interchange fee a^V is also equal to the maximum interchange fee that is compatible with merchant acceptance, i.e., $a^\Pi = a^V = \bar{a}$.

¹⁵The social planner maximizes the combined surplus of the network's end users – merchants and customers – without accounting for banks' profit.

issuers. Also, because $\phi(c_I - a^W) = c_I - a^o > c_I - a^W$, we have $\bar{a} > a^W > a^o \equiv b_S - c_A$.

- **If the constraint is binding (case ii):** the socially optimal interchange fee is simply $\bar{a} = a^W > a^o$.

Network Competition

Rochet and Tirole (2002) informally examine the case of two competing card networks ($i = 1, 2$), each offering perfectly substitutable card services to customers and merchants. The key modification lies in stage **S3**, where the two networks simultaneously set their interchange fees, a_1 and a_2 . Let f_i denote the transaction fees charged to consumers, and m_i the merchant discounts charged to merchants, with $i = 1, 2$ corresponding to the respective networks. They exclude the case where banks may be members of both card networks. With competitive acquirers and imperfectly competitive issuers within each network, the effects of system competition depend on the consumer behavior regarding multi-homing:

- **No consumer multi-homing:** In this scenario, consumers use only one card network. Both networks continue to set the maximum interchange fee that merchants are willing to accept: $a_1 = a_2 = \bar{a}$. This occurs because the interests of the networks and their cardholders are aligned, and the higher interchange fee benefits both the network and cardholders. As a result, system competition has no effect on merchants' resistance to accepting cards.
- **Some consumers multi-homing:** Here, some consumers hold cards from both networks, which introduces competition between the networks. In this case, $(\bar{a}, \bar{a})$ generally does not constitute an equilibrium because one network has an incentive to lower its interchange fee to gain a competitive edge. By reducing the interchange fee, a network can incentivize merchants to reject the competing network, as consumers may hold the card associated with the lower merchant discount. Consequently, system competition increases merchants' resistance to card acceptance, as merchants are less willing to accept both networks when competitive pressures push one network to lower its interchange fee.

Guthrie and Wright (2007) provide the first formal analysis of competition between two identical card networks. Building on the framework of Rochet and Tirole (2002), they incorporate heterogeneous customers and strategic merchants who cannot price discriminate. However, unlike Rochet and Tirole (2002), their model assumes competitive issuers and acquirers, with card networks maximizing the volume of transactions. In this setup, the cardholder fee is given by $f_i = c_I - a_i$, and the merchant fee is $m_i = c_A + a_i$ for each network $i = 1, 2$. They show that the equilibrium interchange fee a^C depends on the degree of multi-homing (using multiple card networks) by consumers and merchants: (1) Consumers always multi-home: $a^C = a^o$ (the socially optimal interchange fee); (2) Merchants always multi-home: $a^C = \bar{a}$ (the monopolistic interchange fee); (3) Both consumers and merchants multihome: $a^C \in [a^o, \bar{a}]$. A key finding is that competition between card networks leads to a "race to the top" in interchange fees. Card networks compete to attract consumers by offering higher rewards and benefits, which are funded by increased interchange fees. At the same time, merchants feel compelled to accept all major card networks to avoid losing customers to competitors who accept those cards. This dynamic is further exacerbated by contractual limitations—such as the No-Surcharge Rule or Honor-All-Cards Rule—which prevent merchants from steering consumers toward lower-cost payment methods. Compared to a monopoly card network, which can balance the interests of both consumers and merchants, competition results in higher fees and greater inefficiency.

Impact of Costless Surcharging

If merchants are allowed to surcharge costlessly, they will, at equilibrium, charge an additional amount of $m - b_S$ to customers paying card¹⁶, ensuring that the interchange fee is fully passed through to cardholders. Consequently, the total price of card services for customers becomes $\hat{f} \equiv f + m - b_S = \phi(c_I - a) + a + c_A - b_S$. The second equality follows from the assumption of competitive acquirers, who set the merchant discount fee as $m = c_A + a$. Crucially, $\hat{f}$ absorbs all effects of a : an increase in a raises the revenue received by issuers from acquirers, which in

¹⁶Under Hotelling competition, the equilibrium prices are determined by the marginal cost plus the differentiation parameter t . Specifically, with no NSR, the two prices satisfy $p_{card}^* > p^* > p_{cash}^*$, where $p^* = [d + D(\phi(c_I - a))(c_A + a - b_S)] + t$ represents the no-surcharge price, and $p_{card}^* = [d + (m - b_S)] + t = p_{cash}^* + m - b_S$.

turn allows issuers to reduce the fees (f) charged to cardholders or offer rewards to incentivize card usage. Thus, in equilibrium, the **total price of card services** $\hat{f}$, the demand for cards $D_B(\hat{f})$, and issuers' margins are all **independently** of the interchange fee a ¹⁷. Specifically, the demand for card services is given by:

$$D_B(\hat{f}) = \int_{\hat{f}}^{\bar{b}_B} dH(b_B),$$

The issuers' net margin under this framework can be expressed as:

$$\begin{aligned} f + a - c_I &= f + m - (c_I + c_A) \\ &= \hat{f} - (c_I + c_A - b_S) \\ &= \hat{f} - (c_I - a^o) \end{aligned}$$

By the definition of the function $\phi(\cdot)$ ¹⁸, the equilibrium total price charged to consumers by issuers is $\hat{f} = \phi(c_A - a^o)$. Since $\hat{f} = \phi(c_A - a^o) > f^W = c_A - a^o$, lifting the NSR systematically results in an **under-provision** of card services.

Now compare payment card diffusion and social welfare under the NSR versus no NSR:

- **Payment card diffusion:** If the net cost for an issuer is smaller under the NSR: $c_I - a \leq c_I + c_A - b_S$, or equivalently, $a \geq a^o = b_S - c_A$, the issuer can afford to reduce cardholder fees or offer rewards, thereby increasing card adoption. This condition is satisfied for both **case i** and **case ii** in problem **P1**. Thus, card surcharges inhibit the diffusion of payment cards.
- **Social welfare:** a social planner maximizes total welfare by solving the following problem

¹⁷Gans and King (2003) also show in general settings that, in the absence of the NSR, interchange fees have no real effects on payment system outcomes.

¹⁸Refer to footnote 12.

P2:

$$\begin{aligned}
& \max_a W(\hat{f}) \\
& s.t. \quad \hat{f} = \phi(c_I - a) + a + c_A - b_S \\
& \quad \quad a \leq \bar{a}
\end{aligned} \tag{P2}$$

where the total welfare is defined as $W(\hat{f}) = \int_{\hat{f}}^{\bar{b}_B} (b_B + b_S - c_A - c_I) dH(b_B)$.

1. In **case i** of problem **P1**, the effect of banning the NSR on welfare is ambiguous. As shown in Figure 2.5a, under the NSR, there is an **over-provision** of card services because the total price paid by cardholders is lower than the socially optimal level: $\phi(c_I - \bar{a}) < \phi(c_I - a^W) = c_I - a^o$. In contrast, lifting the NSR results in an **under-provision**, as the total price charged to cardholders exceeds the socially optimal level: $\phi(c_I - a^o) > \phi(c_I - a^W) = c_I - a^o$. Whether lifting the NSR results in higher total welfare (W) depends on two key factors: (a) **the degree of issuers' market power**, as captured by the equilibrium price function $\phi(\cdot)$, and (b) **the degree of merchants' resistance to card acceptance**, represented by the maximum interchange fee $\bar{a}$. Holding other factors constant:
 - Higher issuers' market power increases welfare under the NSR but decreases welfare when the NSR is lifted.
 - Higher merchant resistance (i.e., lower $\bar{a}$) only decreases welfare under the NSR.
2. In **case ii** of problem **P2**, lifting the NSR unambiguously reduces welfare. As shown in Figure 2.5b, social optimum coincides with private optimum under the NSR, lifting the NSR leads to an inefficient diffusion of cards causing reduced welfare.

Wright (2003) takes the framework in Rochet and Tirole (2002) and introduce two differences in the model: (a) consider two different extremes of merchant price – monopolistic pricing and Bertrand pricing; (b) distinguish membership decision (facing a membership fee) and usage decision (facing transaction fees or earning rewards) by customers to study the impact of the NSR on retail prices. Ignore the fixed membership fee and consider the following two pricing

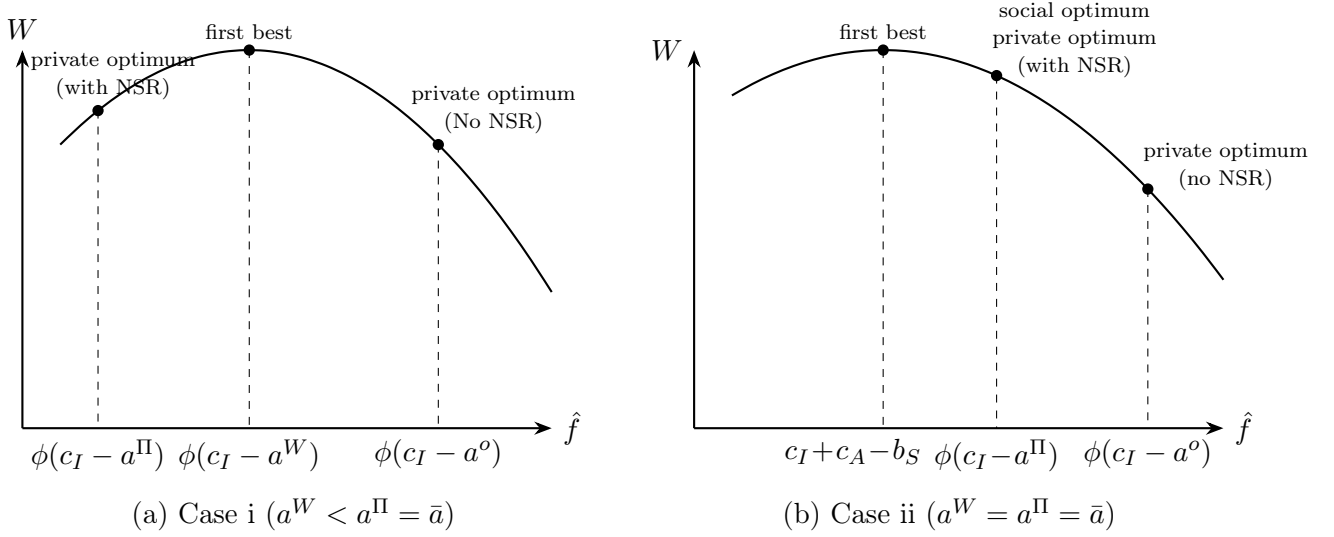


Figure 2.5: Comparison of Social Welfare under NSR and No NSR with Hotelling Merchants

Notes: This figure illustrates how social welfare varies with the total price charged to cardholders. Subfigure (a) depicts the ambiguous effect of banning the NSR on social welfare in case i of problem **P1**, where the privately optimal interchange fee exceeds the socially optimal fee ($a^\Pi > a^W$), resulting in an over-provision of card services under the NSR. In this scenario, lifting the NSR has an ambiguous impact on social welfare. Notice that $\phi(c_I - a^W) = c_I + c_A - b_S$. Subfigure (b), on the other hand, shows that lifting the NSR unambiguously reduces social welfare in case ii of problem **P1**. The first-best outcome is achieved when the total price charged to card users is $c_I + c_A - b_S$. However, this outcome is unattainable as the merchant acceptance constraint binds at $\bar{a}$. Consequently, the social and private optima coincide under the NSR ($a^W = a^\Pi = \bar{a}$).

schemes:

- **Monopolistic pricing:**

- **With the NSR:** Monopolistic merchants will charge a uniform price $p^* = v^{19}$ to avoid excluding cash customers. Merchants will accept cards if and only if $b_S \geq m = c_A + a$, or equivalently, $a \leq a^o$. In this case, the socially optimal and privately optimal interchange fees coincide, both equal to the Baxter fee $a^W = a^\Pi = a^o$, which represents the highest interchange fee consistent with merchants' acceptance of cards. Consumers will use cards if and only if $b_B \geq f = \phi(c_I - a^o)$, meaning the benefit of the marginal card user under the NSR is $b_B^{m,NSR} = \phi(c_I - a^o)$.
- **With costless surcharging:** Monopolistic merchants will set $p_{cash} = v$ for cash

¹⁹Under the condition that v is sufficiently large, merchants will not set $p^* > v$, as doing so would exclude cash consumers entirely.

users and adjust p_{card} for card users to maximize total profits:

$$\begin{aligned}\pi_M &= H(b_B^m)(v - d) + (1 - H(b_B^m))(p_{card} - d + b_S - m) \\ &= (v - d) + (1 - H(b_B^m))(b_B^m + b_S - m - f),\end{aligned}$$

where $b_B^m = f + p_{card} - p_{cash} = f + p_{card} - v$ defines the marginal card user. Solving for the equilibrium marginal card user $b_B^{m,NoNSR}$, we obtain:

$$\begin{aligned}b_B^{m,NoNSR} &= f + m - b_S + \frac{1 - H(b_B^{m,NoNSR})}{h(b_B^{m,NoNSR})} \\ &= f + a + c_A - b_S + \frac{1 - H(b_B^{m,NoNSR})}{h(b_B^{m,NoNSR})},\end{aligned}$$

where the second equality follows from the assumption of competitive acquirers, ensuring $m = a + c_A$. In this case, the interchange fee becomes neutral: the marginal card user $b_B^{m,NoNSR}$, the total price paid by cardholders $p_{card} + f$, and the issuers' net margin per transaction $f + a - c_I$ are all independent of a . This neutrality arises because all parties only care about the total amount $f + a$ charged by issuers. Evaluated at the Baxter fee a^o , we find that:

$$b_B^{m,NoNSR} = \phi(c_I - a^o) + \frac{1 - H}{h} > b_B^{m,NSR}.$$

Since $b_B^{m,NoNSR}$ depends on $c_I - a^o$, we denote it as $\psi(c_I - a^o)$. This result implies that, with costless surcharging, monopolistic merchants impose excessive surcharge on card payments. This leads to fewer card users and lower total surplus compared to the NSR scenario, as shown in Figure 2.6. These results differ from the ambiguous outcomes found in [Rochet and Tirole \(2002\)](#), as the monopoly power of merchants increases their resistance to card acceptance. Unlike in competitive settings, monopolistic merchants are not concerned about losing customers to competitors and therefore fail to internalize the transaction benefits that cardholders derive from using cards.

- **Bertrand pricing:** All merchants offer an identical product and compete on price according to the principles of Bertrand competition, which drives prices down to net costs.
 - **With the NSR:** If $b_S \leq m$, competitive merchants will specialize by either accepting only cash at a lower price, $p_{cash} = d$, or accepting only cards at a higher price, $p_{card} = d + m - b_S$. If $b_S > m$, competitive merchants will discount card purchases by setting $p_{cash} = d$ and $p_{card} = d + m - b_S$, with at least one merchant accepting cards. In both cases, the marginal cardholder have a level of b_B defined as:

$$\begin{aligned}
 b_B^{m,NSR} &= f + p_{card} - p_{cash} \\
 &= f + m - b_S \\
 &= f + a + c_A - b_S \\
 &= \phi(c_I - a^o),
 \end{aligned}$$

where the third line follows because of the assumption of competitive acquirers, such that $m = a + c_A$, and the last line reflects the fact that $b_B^{m,NSR}$ is independent of a and can, therefore, be evaluated at the Baxter fee a^o .

- **With costless surcharging:** At equilibrium, competitive merchants set $p_{cash} = d$ and $p_{card} = d + m - b_S$, with at least one merchant accepting cards. The marginal cardholder is similarly defined as $b_B^{m,NoNSR} = \phi(c_I - a^o)$.

By comparing prices and card usage under the NSR and no-NSR scenarios in a perfectly competitive merchant setting, the results are identical in both cases.

Balancing Both Sides

Schmalensee (2002) relax Assumptions **A2** and Assumptions **A3** to introduce heterogeneity in both consumers' and merchants' transaction benefits, thereby balancing the demand for card payments from both sides of the market. Specifically, the merchants' card acceptance benefit from a card transaction b_S is assumed to be distributed over the interval $[\underline{b}_S, \bar{b}_S]$ according

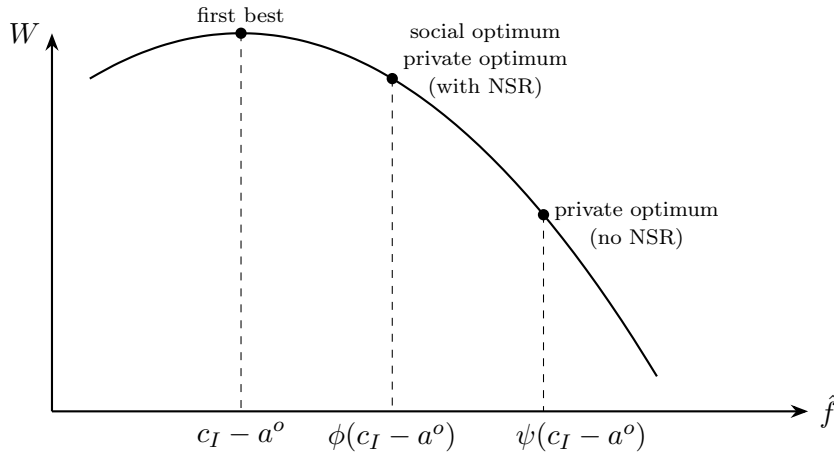


Figure 2.6: Comparison of Social Welfare under NSR and No NSR with Monopolistic Merchants

Notes: This figure illustrates how social welfare changes with the total price charged to cardholders and highlights the unambiguous effect of banning the NSR on social welfare. The first-best outcome is achieved when the total price charged to card users is $c_I - a^o$. However, this outcome is unattainable under a monopolistic merchant setting, as the merchant acceptance constraint binds at the Baxter fee a^o . Consequently, under the NSR, the socially optimal and privately optimal interchange fees coincide at the Baxter fee a^o . When costless surcharging is allowed, the total price charged to card users, denoted as $\psi(c_I - a^o)$, exceeds $\phi(c_I - a^o)$, reflecting the inefficiency introduced by excessive surcharging.

to a probability density function $g(b_S)$ and a cumulative distribution function $G(b_S)$. Consequently, the merchants' quasi-demand for card payments is defined as $D_S(m) = 1 - G(m)$. For consumers, using the same notation as before, the quasi-demand²⁰ function is defined as $D_B(f) = 1 - H(f)$. Assuming independence between b_B and b_S , the transaction volumes on the card network $Q(f, m)$ are the product of customers' and merchants' quasi-demand functions:

$$Q(f, m) = \Pr(b_B \geq f, b_S \geq m) = D_B(f) \cdot D_S(m).$$

Rochet and Tirole (2003) adopt the multiplicative formula for transaction volume introduced by Schmalensee (2002), thereby relaxing Assumption **A2** and **A3**. This extension allows for the examination of price structures in general two-sided markets where merchants and consumers interact on a monopoly platform. Specifically, within the context of a payment card network, the platform simultaneously assumes the roles of issuing and acquiring banks, charging a fee f to consumers and a fee m to merchants per transaction, incurring a marginal transaction cost

²⁰The term "quasi-demand" is used because, in a two-sided market such as payment card networks, actual demand depends on the decisions of both end-users: merchants and consumers. In earlier models with heterogeneous consumers but identical merchants, the card network would set the highest interchange fee that all merchants would accept, introducing asymmetry between merchants and consumers.

c^{21} . The privately optimal price structure is determined by maximizing total profit:

$$\Pi(f, m) = (f + m - c)D_B(f)D_S(m).$$

Assuming log-concavity of both demand functions, the profit function Π is jointly log concave in f and m . Its maximum is characterized by the first order conditions:

$$\begin{aligned}\frac{\partial \log \Pi}{\partial f} &= \frac{1}{f + m - c} + \frac{\partial D_B}{\partial f} \cdot \frac{1}{D_B} = 0, \\ \frac{\partial \log \Pi}{\partial m} &= \frac{1}{f + m - c} + \frac{\partial D_S}{\partial m} \cdot \frac{1}{D_S} = 0.\end{aligned}$$

Introducing the elasticities of quasi-demands:

$$\eta_B = -\frac{\partial D_B / \partial f}{D_B / f} = \frac{h(f)}{D_B / f}, \quad \eta_S = -\frac{\partial D_S / \partial m}{D_S / m} = \frac{g(m)}{D_S / m}, \quad (2.4)$$

the first order conditions yield the privately optimal price structure:

$$f + m - c = \frac{f}{\eta_B} = \frac{m}{\eta_S}. \quad (2.5)$$

A social planner maximizes welfare subject to budget constraints by solving the following optimization problem **P3**:

$$\begin{aligned}\max_a \quad & W(f, m) \\ \text{s.t.} \quad & f + m = c\end{aligned} \quad (\mathbf{P3})$$

²¹Previous models have explicit roles for issuers and acquirers, with respective marginal costs per transaction c_I and c_A , as illustrated in Figure 2.1a. In contrast, Rochet and Tirole consider a closed network, depicted in Figure 2.1b, where the interchange fee a is implicit and $c \equiv c_I + c_A$.

where the total surplus W is defined by:

$$W(f, m) = \int_f^{\bar{b}_B} \int_m^{\bar{b}_S} (b_B + b_S - c)g(b_S)h(b_B)db_Sdb_B$$

Differentiating the total surplus with respect to f and m , respectively, yields:

$$\begin{aligned} \frac{\partial W}{\partial f} &= - \int_m^{\bar{b}_S} (f + b_S - c)h(f)g(b_S)db_S \\ &= -(f + m + \beta_S^n(m) - c)h(f)D_S(m) \\ &= -\beta_S^n(m)h(f)D_S(m) \\ \frac{\partial W}{\partial m} &= - \int_f^{\bar{b}_B} (m + b_B - c)g(m)h(b_B)db_B \\ &= (f + m + \beta_B^n(f) - c)g(m)D_B(f) \\ &= -\beta_B^n(f)g(m)D_B(f) \end{aligned}$$

where $\beta_S^n(m) \equiv E[b_S - m | b_S \geq m]$ represents the net surplus of an average merchant. The socially optimal price structure is characterized by the first order condition $\frac{\partial W}{\partial f} = \frac{\partial W}{\partial m}$, which is equivalent to the following cost allocation condition:

$$\frac{f}{\eta_B} \beta_B^n = \frac{m}{\eta_S} \beta_S^n. \quad (2.6)$$

Both the monopoly platform and the social planner design their pricing structures to attract participants from both sides of the market—consumers and merchants. However, a comparison between Equation (2.5) and Equation (2.6) highlights a key difference in their approaches. The monopoly platform optimizes prices based solely on its private profits. In contrast, the social planner incorporates the average net surplus generated on one side of the market when setting prices to attract users from the other side. This allows the social planner to internalize cross-side externalities, ensuring that the benefits accrued by one group (e.g., consumers) are factored into the pricing decisions for the other group (e.g., merchants), thereby promoting overall social welfare.

[Wright \(2004\)](#) adopts the multiplicative demand specification introduced by [Schmalensee \(2002\)](#)

into the model of [Rochet and Tirole \(2002\)](#), further relaxing Assumptions A3 and A7 to account for merchant heterogeneity²² and acquirers' market power. Specifically, regarding merchant heterogeneity, the model assumes a continuum of industries where merchants in different industries receive varying benefits from accepting cards, denoted by b_S . These benefits are independently drawn from a common distribution $G(b_S)$ over the interval $[b_S, \bar{b}_S]$ for each industry. Furthermore, [Wright \(2004\)](#) focuses on interchange fee determination rather than the impact of NSR. For given fees f and m , $b_S^m(f, m)$ represents the merchant's card acceptance benefit at which merchants are indifferent between accepting or rejecting cards. The average transactional benefit for merchants who accept cards is defined as $\beta_S(b_S^m) = E[b_S | b_S \geq b_S^m]$. Similarly, for consumers, $b_B^m(f, m)$ denotes the card usage benefit at which consumers are indifferent between using a card or not. Under the NSR, consumers will use cards at merchants that accepts cards whenever $b_B \geq b_B^m$, and average transaction benefit for those consumers is $\beta_B(b_B^m) = E[b_B | b_B \geq b_B^m]$. He examines in detail three types of interchange fees, each serving different objectives:

- **Profit maximizing interchange fee (a^Π):** The owner of the card network aims to maximize the collective profit of its members by determining the optimal interchange fee. The total profit Π is given by:

$$\Pi(b_B^m, b_S^m) = (\pi_I + \pi_A) D_B(b_B^m) D_S(b_S^m),$$

where π_I and π_A represent the net margins of issuers and acquirers, respectively. Specifically, we have:

$$\pi_I(a) = \phi(c_I - a) + a - c_I$$

$$\pi_A(a) = \varphi(c_A + a) - c_A - a$$

²²Thus, there is no knife-edge case where all merchants accept or reject cards, as in [Rochet and Tirole \(2002\)](#).

The first order condition for profit maximization is:

$$\frac{d\Pi}{da} = (\pi_I + \pi_A) \underbrace{\left(D_S \frac{dD_B}{da} + D_B \frac{dD_S}{da} \right)}_{\text{Volume maximization}} + \underbrace{\left(\frac{d\pi_I}{da} + \frac{d\pi_A}{da} \right)}_{\text{Profit maximization per transaction}} D_B D_S = 0 \quad (2.7)$$

Rearranging the equation, the owner of the card network sets the profit-maximizing interchange fee a^Π such that

$$\eta_B = -\eta_S + \frac{d(f+m)/da}{\pi_I + \pi_A/a}, \quad (2.8)$$

where $\eta_B \equiv \frac{d \ln D_B}{d \ln a}$ and $\eta_S \equiv \frac{d \ln D_S}{d \ln a}$ represent the elasticity of cardholders' demand and merchants' demand to a , respectively. Define the pass-through rates of the issuer and the acquirer as $-\frac{df}{da}$ and $\frac{dm}{da}$, respectively. Because f decreases as a increases while m increases with a , if issuers are less competitive than acquirers – meaning that issuers pass through changes in interchange fees to their customers less effectively than acquirers pass through interchange fees to merchants – the total price $f + m$ will increase with a .

- **Volume maximizing interchange fee (a^V):** This fee seeks to maximize the total number of card transactions Q , defined as:

$$\begin{aligned} Q(b_B^m, b_S^m) &= \int_{b_B^m}^{\bar{b}_B} \int_{b_S^m}^{\bar{b}_S} dG(b_S) dH(b_B) \\ &= D_B(b_B^m) D_S(b_S^m) \end{aligned}$$

The first order condition for volume maximization is

$$\frac{dQ}{da} = D_S \frac{dD_B}{da} + D_B \frac{dD_S}{da} = 0. \quad (2.9)$$

Rearranging the equation, the owner of the card network sets the volume-maximizing interchange fee a^V such that

$$\eta_B = -\eta_S \quad (2.10)$$

- **Welfare maximizing interchange fee (a^W):** A social planner determines fees f and m to maximize total welfare W , defined as:

$$\begin{aligned} W(f, m) &= \int_{b_B^m}^{\bar{b}_B} \int_{b_S^m}^{\bar{b}_S} (b_B + b_S - c_I - c_A) dG(b_S) dH(b_B) \\ &= (\beta_B(b_B^m) + \beta_S(b_S^m) - c_I - c_A) D_B(b_B^m) D_S(b_S^m) \end{aligned}$$

The first order condition²³ for welfare maximization is:

$$\frac{dW}{da} = D_S \frac{dD_B}{da} (b_B^m + \beta_S(b_S^m) - c_I - c_A) + D_B \frac{dD_S}{da} (b_S^m + \beta_B(b_B^m) - c_I - c_A) = 0 \quad (2.11)$$

Discussion:

1. a^Π **versus** a^V : Comparing Equation (2.8) with Equation (2.10), the primary divergence between a^Π and a^V stems from differences in the pass-through rates of issuers and acquirers. If the pass-through rate is lower on the issuing side than on the acquiring side—that is, issuers are less effective at passing changes in interchange fees to cardholders—the network sets a higher interchange fee ($a^\Pi > a^V$). This is because the network prefers to increase revenue from the consumer side, even if it leads to a decrease in transaction volume due to higher total prices faced by cardholders.
2. a^V **versus** a^W : Comparing Equation (2.10) with Equation (2.11), a^V aligns with a^W if there is symmetry in the marginal and infra-marginal benefits of card users and merchants, i.e., $b_B^m + \beta_S(b_S^m) \neq b_S^m + \beta_B(b_B^m)$. When this condition does not hold, interchange fees can be used to raise welfare by restricting the volume of card transactions.
3. a^Π **versus** a^W : Comparing Equation (2.8) with Equation (2.11), in general, a^Π can be either higher or lower than a^W with more or fewer card transactions when compared to the welfare maximizing level. For example, when $a^\Pi > a^W$ and involves excessive card transactions (Figure 2.7a), this corresponds to:

²³To see this, $\frac{d\beta_B\beta_S D_S}{da} = D_B \frac{dD_S}{da} \beta_B + D_S \frac{d\beta_B D_B}{da}$, $\beta_B D_B = \int_{b_B^m}^{\bar{b}_B} b_B h(b_B) db_B$, and $\frac{dD_B}{db_B^m} = -h(b_B^m)$

- Issuers and acquirers pass through costs at the same rate, implying $a^V = a^\Pi$.
- At a^Π , the additional benefits of infra-marginal merchants over and above the marginal merchant accepting cards is less than the additional benefits of infra-marginal card users over and above the benefits of the marginal card user, i.e., $b_B^m + \beta_S(b_S^m) < b_S^m + \beta_B(b_B^m)$, implying $a^W < a^V = a^\Pi$.

Alternatively, $a^\Pi > a^W = a^V$ (Figure 2.7b) leads to too few card transactions compared to welfare maximizing level, this occurs when issuers are less competitive than acquirers.

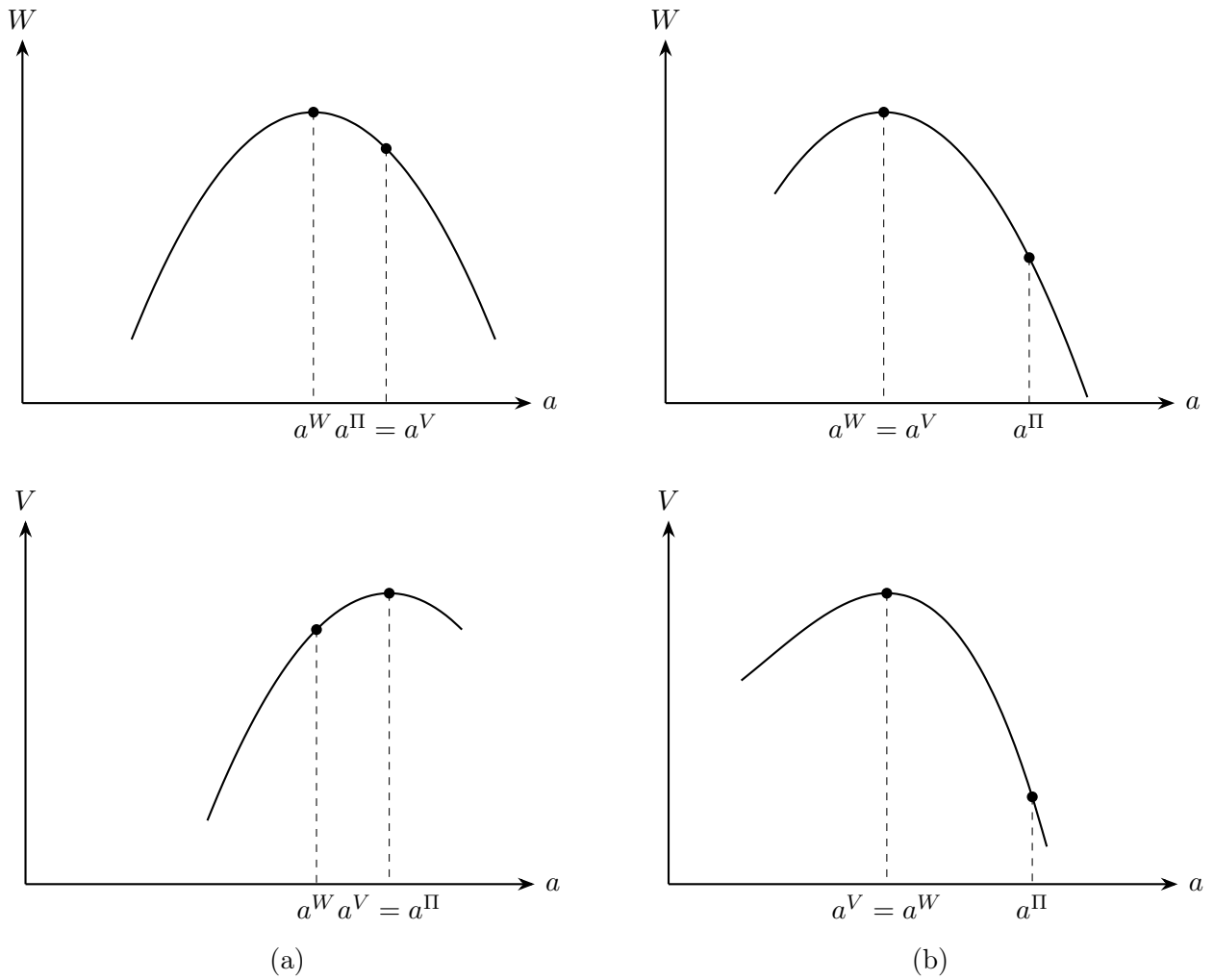


Figure 2.7: Comparison of Social Welfare and Transaction Volume across Different Cases

Issuers' Pricing Structure

Bedre-Defolie and Calvano (2013) provide an explanation for the inefficiently high profit-

maximizing interchange fee by distinguishing between two key decisions made by consumers: card membership and card usage, while assuming that merchants only make membership decisions. Their analysis is based on issuers employing a two-part tariff pricing structure, which includes a fixed annual fee, as in [Rochet and Tirole \(2002\)](#), and a per-transaction usage fee, as in [Wright \(2004\)](#). The introduction of a fixed membership fee creates an option value for cardholders, as it allows them to benefit from using the card whenever their transaction value exceeds the usage fee. Consequently, the profit-maximizing interchange fee (a^{Π}) over-subsidizes card usage by reducing per-transaction fees for consumers, while simultaneously imposing inefficiently high fees on merchants. This strategy not only increases the option value of holding a card to attract new cardholders but also incentivizes greater card usage among existing cardholders, thereby maximizing issuers' profits.

Ad Valorem Fees or Fixed Per-Transaction Fees?

There is also a debate over whether card networks should impose ad valorem (proportional) fees or fixed per-transaction fees. [Shy and Wang \(2011\)](#) analyze a model of a monopoly card network interacting with merchants competing à la Cournot and consumers facing constant-elasticity demand for card usage. Their findings suggest that ad valorem fees yield higher profits for the card network, higher consumer utility, and greater social welfare compared to fixed per-transaction fees, although merchants earn lower profits. The reduction in merchant profitability is attributed to the mitigation of the “double marginalization” problem. Double marginalization refers to the inefficiency arising when both the upstream platform (card network) and downstream merchants, each possessing market power, independently impose markups to maximize their individual profits. By adopting ad valorem fees, the card network aligns its incentives with merchants to increase transaction volumes, thereby reducing the compounded markups that occur under fixed fees. However, in the case of perfectly competitive merchant markets, where merchants have no market power to impose their own markups, this double marginalization problem is absent. Under such conditions, ad valorem fees and fixed per-transaction fees result in the same market outcomes, as merchants act as price takers, fully passing through the card network's fees to consumers. Thus, the specific choice of fee structure is less important

in perfectly competitive settings. [Wang and Wright \(2017\)](#) provide an alternative explanation for why profit-maximizing card networks may favor ad valorem fees. In their model, merchants are modeled as identical Bertrand competitors, and the value of a transaction to buyers is assumed to vary proportionally with the cost of the good traded. Ad valorem fees enable the card network to implement efficient price discrimination, as the fee scales with the value of the transaction, allowing the card network to extract more surplus from higher-value transactions. This ensures that the platform captures a share of the incremental value associated with larger purchases, which would not be possible under a fixed per-transaction fee structure. [Wang and Wright \(2018\)](#) further investigate the welfare implications of ad valorem fees versus fixed per-transaction fees. Their findings show that the use of ad valorem fees can generally improve welfare, particularly through the price discrimination channel. By aligning the card network's revenue with the value of transactions, ad valorem fees incentivize the network to increase transaction volumes and attract a broader base of consumers and merchants.

Credit Functionality

Unlike prior studies that primarily treat payment cards as debit cards, [Rochet and Wright \(2010\)](#) explicitly incorporate the credit functionality of payment cards to analyze the optimal interchange fee in a monopoly card network under the NSR. Their model assumes an exogenous fraction χ of consumers who hold credit cards and choose between cash, store credit, and credit cards when purchasing one unit of a retail good ("ordinary purchase"). A consumer derives a baseline utility of v from ordinary purchases and, with probability θ , gains an additional utility v^c from credit purchases. They assume a market with perfectly competitive acquirers and imperfectly competitive issuers²⁴. Under these conditions, the merchant fee m is given by $m(a) = c_A + a$, while the cardholder fee f is expressed as $f(a) = c_I - a + \pi$, where π represents a constant profit margin for issuers, simplifying the analysis. Merchant competition is modeled using the standard Hotelling framework, consistent with [Rochet and Tirole \(2002\)](#). A key distinction of this model is its approach to credit functionality. Instead of focusing on transaction

²⁴Following [Rochet and Tirole \(2002\)](#), these assumptions simplify the analysis by ensuring that a card network maximizing its members' profit also maximizes the volume of card transactions.

benefits associated with card payments, the authors introduce costs related to store credit provision. Specifically, c_B represents the transaction-specific cost incurred by consumers when using store credit, while c_S denotes the cost borne by merchants for providing store credit directly. The consumer cost c_B is drawn from a distribution H over the range $(\underline{c}_B, \bar{c}_B)$ ²⁵. The model demonstrates that interchange fees are set inefficiently high to maximize the card network's profit, leading to excessive use of credit cards. This inefficiency arises because cardholders fail to internalize the merchants' net avoided costs—the savings merchants realize by accepting credit cards instead of providing store credit themselves. To address this issue, the authors argue that regulators should cap interchange fees to reflect merchants' net avoided costs. Such a cap would reduce inefficiencies and increase consumer surplus by aligning the incentives of cardholders, merchants, and card networks. The above work primarily rely on reduced-form approaches to consider the costs and benefits of payment cards. In contrast, [Chakravorti and Emmons \(2003\)](#), [Chakravorti and To \(2007\)](#), and [Bolt and Chakravorti \(2008a\)](#) develop models that endogenously generate costs and benefits of credit card usage for consumers, merchants, and banks by explicitly modeling different roles of consumer credit. [Chakravorti and Emmons \(2003\)](#) focus on the liquidity provision role of credit cards. They model consumers as facing income shocks after making purchases, where some consumers (revolvers) must carry credit card debt and incur interest charges. They show that under the NSR, competitive merchants who accept credit cards increase their retail prices. To prevent liquidity-unconstrained customers from using cash, competitive card issuers need to subsidize them through side payments such as rewards. These subsidies are financed by the higher interest payments revolvers pay on their credit card debt. This creates a cross-subsidization mechanism within the card network, where liquidity-constrained consumers effectively bear the burden of providing liquidity benefits to others. [Chakravorti and To \(2007\)](#) considers a two-period dynamic model featuring a monopolist bank and monopolist merchants. Consumers in their framework face income and consumption uncertainties, while merchants charge exogenous retail prices. They show that merchants are willing to subsidize credit losses by paying merchant fees in exchange for

²⁵ $\underline{c}_B$ is sufficiently negative to ensure that cardholders sometimes prefer store credit over cash, while $\bar{c}_B$ is positive but not prohibitively high.

increased sales from credit card users in the current period. However, this behavior creates a negative externality over time, as higher current-period sales cannibalize future profits. The inter-temporal business-stealing effect arises because merchants, by accepting credit cards, shift future revenue into the present without expanding the overall market size. Bolt and Chakravorti (2008a) study how banks and merchants set prices for three payment instruments – cash, debit cards and credit cards – and examine how these pricing structures affect consumer choices and welfare. Their model incorporates three types of shocks that impact consumption: income shocks, which affect a consumer’s liquidity; cash theft, which creates uncertainty around holding cash; and merchant match uncertainty, which influences a consumer’s ability to find suitable merchants. Credit cards serve as an insurance mechanism in this setting by mitigating the negative effects of these shocks, providing liquidity during income disruptions, safeguarding against cash theft, and expanding purchasing opportunities even in less favorable merchant matches. They show that under the NSR, bank profits increase because merchants cannot steer consumers toward more efficient payment methods, such as cash or debit cards, by charging different prices based on the payment instrument used. Instead, merchants are forced to absorb the higher transaction fees associated with credit card usage, which they pass on to all consumers in the form of higher retail prices. This pricing structure encourages inefficiently high adoption and usage of credit cards, benefiting banks through increased merchant fees and fixed annual fees.

2.2.2 New Monetarist Approach to Payments

The New Monetarist Approach provides a useful framework for analyzing the economics of payments by modeling the exchange process explicitly and studying the endogenous emergence of institutions that facilitate trade. This perspective has proven fruitful in understanding why certain assets circulate as media of exchange, how intermediaries arise, and how payment systems evolve to mitigate frictions in decentralized trading environments.

Baseline Model

Lagos and Wright (2005) provide a tractable model for examining how a media of exchange emerges and functions within an economy. Their benchmark model considers an infinite-horizon, discrete-time environment in which each period is divided into two subperiods: day and night. As shown in Figure 2.8: During the day, trades occur in a decentralized market (DM), while during the night, all agents participate in a centralized market (CM). In the DM, trade is bilateral and occurs with probability σ . There are two types of agents: buyers, who wish to consume but cannot produce, and sellers, who can produce but have no desire to consume their own output during the day. This situation naturally gives rise to the classic double coincidence of wants problem—unless a buyer’s desired good matches exactly what a seller is willing to produce, and the seller simultaneously desires what the buyer can offer, trade may fail to occur. The result is a high degree of friction and potentially low trading efficiency, since finding a mutually acceptable barter arrangement is difficult. In contrast, the night market is a centralized and competitive (CM) environment where all agents can both produce and consume a “general good.” Unlike the DM’s bilateral matching, the CM allows for consumption and production to happen freely and symmetrically. Here, buyers and sellers adjust their holdings of assets and goods. We refer to the day-market good as the search good and the night-market good as the general good. A crucial assumption is that both the search good and the general good are non-storable. Because these goods cannot be carried over from one subperiod to the next, they cannot serve as a medium of exchange. In other words, without a storable, generally accepted object to bridge the timing and preference mismatches between agents, the DM remains plagued by the double coincidence problem. Buyers and sellers have preferences represented by discounted sums of period utilities: $\sum_t \beta^t U^b(q_t, x_t, y_t)$ and $\sum_t \beta^t U^s(q_t, x_t, y_t)$, where $\beta \in (0, 1)$ is the discount factor and the discount rate between the night and the next day is $r = \beta^{-1} - 1$, $q > 0$ is the quantity of the search good exchanged in the DM, $x > 0$ is the quantity of the general good consumed in the CM, and $y > 0$ is the amount of labor supplied in the CM. Utilities are assumed to be separable across subperiods and linear in hours worked, which simplifies the analysis by eliminating wealth effects. Let $u(q)$ denote the buyer’s utility from consuming the search good in the DM and $c(q)$ the seller’s disutility from producing it.

Similarly, let $v(x)$ capture the utility from consuming the general good in the CM. Thus, the buyers' and sellers' one-period utilities can be written as:

$$U^b(q, x, y) = u(q) + v(x) - y,$$

$$U^s(q, x, y) = -c(q) + v(x) - y.$$

The assumptions $u' > 0, u'' < 0, u(0) = c(0) = c'(0) = 0, c' > 0, c'' > 0$ ensure standard concavity, positivity, and diminishing returns in consumption and production utilities. The condition $u'(0) = +\infty$ ensures that buyers place very high marginal value on the first units of the search good, making trade desirable from their perspective. When a buyer and a seller are matched in the DM, they negotiate an amount q of the search good to be produced and consumed. The match surplus is $u(q) - c(q)$, and the efficient quantity q^* satisfies $u'(q) = c'(q)$.

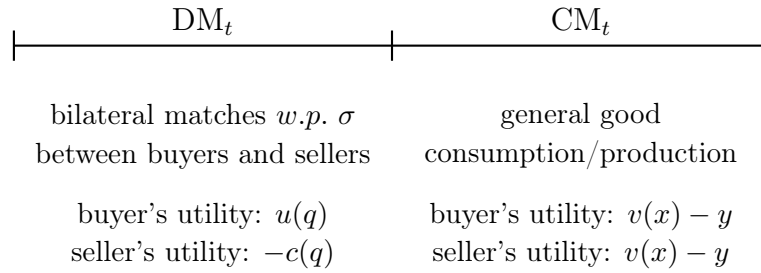


Figure 2.8: Timeline of Economic Activities

Despite identifying an efficient q^* , achieving it consistently in a barter economy is difficult due to the double coincidence problem. The model's frictional DM setting underlines why money – a storable and universally accepted asset – would be valuable: it allows buyers to separate the act of selling from the act of buying. Sellers accept money not because they directly value it in the DM, but because they know it can be used later in the CM (or in subsequent matches) to purchase the goods they desire.

2.3 Empirical Work in Payments

Empirical research on payments systems has expanded rapidly, moving beyond theoretical inquiries to examine how consumers, merchants, intermediaries, and payment networks actually behave. Section 2.3.1 provides an overview of studies on payment choice and usage, drawing insights from diverse datasets that shed light on key determinants and patterns in how individuals select and employ different payment methods. Section 2.3.2 then focuses on emerging evidence about the growing “Buy Now Pay Later” (BNPL) sector, reviewing recent research that evaluates the effects of this novel financial technology on both consumers and merchants.

2.3.1 Payment Choice and Usage

A substantial body of empirical research examines consumer payment choice and usage patterns. Early studies primarily utilize survey data to identify determinants of consumer payment choices, with particular attention to demographic characteristics and price-related variables. For instance, [Stavins \(2001\)](#) and [Klee \(2006\)](#), using survey data on U.S. households, find that younger, better educated consumers with higher incomes are more likely to adopt electronic payment methods. [Ching and Hayashi \(2010\)](#) use self-reported data on payment preferences to estimate multinomial logit models. They explain how demographics, payment method attributes (loyalty rewards programs) related to the likelihood of choosing specific payment instruments across different retail types. They show that loyalty programs can significantly influence consumers’ payment decisions at the extensive margin, although the elasticity of payment choice with respect to rewards remains elusive due to the limitations of survey data. Similarly, [Borzekowski et al. \(2008\)](#) use data from the 2004 Michigan Surveys of Consumers on point-of-sale payment to estimate probit models of debit card holding and usage in response to demographics, financial conditions, and transaction fees. They find that consumers respond strongly negatively to fees charged for debit card transactions; specifically, there is a 12% decline in debit card transaction in response to an average 1.8% fee. [Bolt et al. \(2010\)](#), using Dutch survey data, examine the effect of surcharging on consumer payment choice between

cash and debit cards. They estimate that the share of debit card transactions would increase by an average of 8% if retailers stop surcharging, potentially saving up to EUR 50 million in the long run. Focusing on substitution between debit and credit cards, [Zinman \(2009\)](#) estimates probit models using U.S. survey data and finds that over the 1995-2004 period, credit card revolvers are at least 21% more likely to use debit cards than convenience users, holding other factors constant. Other survey-based work has employed more sophisticated techniques. For example, [Schuh and Stavins \(2010\)](#) use a single-year survey data to apply a two-stage Heckman selection model to account for adoption and usage jointly, while [Koulayev et al. \(2016\)](#) develop a structural model to capture simultaneous adoption and usage decisions of multiple payment instruments. These more complex approaches allow researchers to simulate counterfactual scenarios, such as changes in interchange fee caps or the lifting of no-surcharge rules, to evaluate impacts on payment market outcomes.

More recently, studies have moved beyond survey data to exploit transaction-level datasets for greater precision. [Bounie and François \(2006\)](#), collecting daily payment records from French respondents, show that transaction size is a key determinant of payment method choice, with larger transactions more likely to be paid by check or card rather than cash. [Klee \(2008\)](#) and [Cohen and Rysman \(2013\)](#) utilize scanner data from grocery stores to provide insights into consumers' actual payment preferences and behaviors at the point of sale. [Wang and Wolman \(2014\)](#), using transaction-level data from a large retailer, and [Simon et al. \(2010\)](#), using similar data in Australia, find that price incentives, loyalty programs, and merchant acceptance policies significantly shift consumers toward credit card usage. The latter provides a precise estimate of the effect of price incentives on consumer payment choice. They find that an average consumer will increase the probability of credit card use by 23% in response to loyalty programs. [Arango et al. \(2015\)](#), also using transaction-level data, disentangle the influence of merchant card acceptance and credit card rewards, demonstrating that both supply-side and demand-side factors matter in shaping consumer payment choices. Finally, [Rysman \(2007\)](#) examines card usage externalities in payment networks, documenting how consumers' preferred payment methods and merchants' acceptance decisions interact. He finds strong evidence of positive feedback loops and shows that most consumers effectively "single-home," concentrating

almost all of their expenditures on a single payment network.

2.3.2 Buy Now Pay Later

The emergence of “Buy Now, Pay Later” (BNPL) fintechs has introduced a short-term, unsecured credit option at the point of sale, offered by merchants who integrate these services into their payment systems. While still a relatively new area of study, several recent empirical contributions shed light on this sector. [Guttman-Kenney et al. \(2023\)](#), using UK credit card transaction data, find that younger consumers and those in more deprived areas disproportionately use BNPL, often charging these purchases to their credit cards. In the U.S. context, [Di Maggio et al. \(2022\)](#) use transaction-level bank and credit card data to document that BNPL usage is most common among low-to-middle income individuals and leads to higher retail spending. Their findings challenge standard life-cycle models with liquidity constraints, instead suggesting a “liquidity flypaper effect” or mental accounting framework where additional liquidity immediately translates into more purchases of similar goods. Other U.S.-focused studies emphasize BNPL’s potential downsides. [deHaan et al. \(2024\)](#) document that BNPL adoption correlates with deteriorating financial health, as reflected in increased bank account overdraft charges, credit card interest payments, and late fees, consistent with BNPL facilitating overborrowing. In Australia, [Boshoff et al. \(2022\)](#) show that about 40% of BNPL users maintain multiple BNPL accounts, and that residents of lower socioeconomic areas are more likely to engage in this behavior. In contrast, [Bian et al. \(2023\)](#) examine the rise of digital wallets by analysing e-wallet transactions matched with both merchant and consumer on a super app in China. They find that BNPL expands credit access to consumers underserved by traditional banks, significantly boosting consumption. Notably, these consumers behave more cautiously, differing markedly from the overspending patterns observed in developed countries, emphasizing the financial inclusion role played by the new financial technology in developing countries.

From the merchant’s perspective, [Berg et al. \(2023\)](#), using transaction-level data from a German online furniture retailer, show that offering BNPL increases sales by 20%, particularly among less creditworthy consumers and for higher-markup products. This suggests a price-

discrimination mechanism through BNPL. Drawing on the same dataset, [Keil and Burg \(2023\)](#) find that BNPL also raises the likelihood of purchase completion for impulsive buyers by 13%. However, these impulsive users have higher default rates, raising concerns and calling for tighter regulation.

2.4 Quantitative Work in Payments

A growing quantitative literature employs structural and equilibrium models to assess how changes in payment system design and pricing affect welfare and distribution. [Schuh \(2010\)](#) examines the U.S. payments market and quantify transfers arising from credit card merchants fees and rewards programs, estimating that cash buyers pay about \$149 more and credit card buyers receiving about \$1,133 in transfers, as well as low-income households pay about \$21 more and high-income households receive about \$750 in transfers, highlighting the regressive nature of such systems. [Wang \(2023\)](#) develop a structural two-sided model that considers payment network pricing, consumer payment adoption, merchant acceptance, and merchant pricing decisions. He finds that intense competition among existing payment networks or from new fintech entrants incentivizes overuse of credit cards financed by higher merchant fees, ultimately reducing consumer and total welfare. His model suggests that such inefficiencies generate sizable welfare losses (\$7 billion in consumption and \$10 billion in total welfare annually), as merchants pass these costs back to consumers through higher retail prices.

Chapter 3

Payment Wars in Retail: Credit Cards, BNPL and Merchant Pricing Strategies

3.1 Introduction

In today's dynamic retail landscape, payment methods have undergone significant transformations, offering consumers a wide spectrum of options. These range from traditional cash to an extensive array of electronic payment systems, including debit cards, credit cards, and the relatively recent emergence of Buy Now Pay Later (BNPL) services. The key distinction among these payment methods lies in their credit functionalities. Historically, credit cards have served as the primary means for consumers to access credit when making purchases at the checkout. Consumers can use their cards at retailers that accept credit cards, allowing them to buy goods up to their credit limit without paying any price upfront. They can either repay their balance interest-free at the end of the grace period or incur interest charges on revolving credit card loans. In contrast, BNPL services adopt a different approach by avoiding interest charges beyond a predefined grace period, unlike credit card contracts. Instead, they implement structured payback schedules with zero interest charges to ensure borrowers adhere to their repayment commitments.

This shift in payment practices is especially significant against the backdrop of the rising preva-

lence of online retail. As e-commerce continues to expand, consumer payment preferences influence, and are influenced by, merchant strategies. The growth of BNPL, which inherently bundles a credit arrangement with a payment service, intensifies competition among payment providers and compels retailers to rethink how they structure their pricing, payment acceptance, and marketing strategies. Understanding the economic forces behind this trend—why BNPL emerged, how it differs from conventional credit products, and how it affects consumers and merchants—is crucial for both policy formulation and market participants.

This paper takes a theoretical approach to examine the fundamental economic rationale behind the existence and adoption of BNPL services. We begin by adapting the vendor financing model of [Brennan et al. \(1988\)](#) to an unsecured credit environment, thereby illuminating two key drivers of BNPL’s popularity: price discrimination and adverse selection in the credit market. First, BNPL schemes can help merchants price discriminate between consumer segments with different liquidity constraints and valuations, enabling them to extract surplus more effectively. Second, when adverse selection in credit markets prevents credit card companies from profitably serving certain segments of high-risk consumers, BNPL services can step in, leveraging alternative payment structures (i.e. charging fees on merchant side) to broaden credit access.

Having established why BNPL services arise naturally under certain conditions, we then build a model to analyze how merchants choose their payment acceptance and pricing strategies in the presence of multiple credit-providing payment options. Our results show that it is optimal for monopolistic merchants to partner with BNPL fintechs if they serve customer segments with lower reservation values for the underlying good. By offering zero-interest installment plans at the point of sale, merchants effectively bundle the cost of credit with the purchase price, thereby engaging in third-degree price discrimination and increasing their profitability. Moreover, when adverse selection makes it infeasible for credit card issuers to separate consumers by risk type, BNPL can facilitate transactions with previously excluded consumers, enhancing the merchant’s market reach.

Taken together, our theoretical model contributes to the literature on payment systems and

consumer credit. Prior research has largely focused on the financial contracting aspects of credit cards or on two-sided market models that emphasize interchange fees and platform competition (Rochet and Tirole, 2002, 2003; Wright, 2003, 2004). More recent empirical work on BNPL has documented user characteristics and spending patterns (Di Maggio et al., 2022; Guttman-Kenney et al., 2023; Bian et al., 2023; Berg et al., 2023; deHaan et al., 2024) but has not fully accounted for the strategic interaction among merchants, consumers, and competing payment providers¹. Our approach complements and extends these strands by introducing a richer equilibrium setting in which merchants of varying cost structures tailor their payment acceptance policies and prices, consumers choose payment methods and merchants, and BNPL fintechs design credit terms to tap underserved market segments.

The remainder of the paper is organized as follows. Section 3.2 provides institutional background and empirical context. Section 3.3 introduces the stylized theoretical framework to explain the underlying economic reasons for BNPL’s existence. In Section 3.4, we analyze how merchants specialize in payment adoption and pricing strategies when multiple payment methods, including BNPL, compete. Finally, we conclude with directions for future research.

3.2 Institutional Details About BNPL

3.2.1 History of BNPL

The Buy Now, Pay Later (BNPL) model, a significant innovation in consumer finance, was first introduced by Klarna in 2005 in Sweden. This model revolutionize e-commerce by offering instant, interest-free installment plans, which enhanced the shopping experience for consumers while expanding payment options for merchants. Klarna’s rapid growth-serving approximately 150 million active consumers, partnering with over 400,000 merchants across 45 countries, and processing an average of 2 million transactions daily-demonstrates the model’s efficacy². Klarna offers flexible payment plans tailored to different markets, such as ‘Pay in 3’ in the

¹See Chapter 2 for an overview of the literature on payments.

²See Klarna’s growth data at [Klarna About Us](#).

UK and the 'Pay in 4' in the US, allowing consumers to split their purchases into multiple interest-free installments. Under these plans, customers can distribute the cost of their purchase across several interest-free installments. Customers make an initial payment at checkout, with subsequent payments scheduled every 30 days. The convenience of deferring payment with late fees being capped at a reasonable \$7 has made BNPL attractive, with average purchase amounts around \$140, according to NerdWallet³.

The success of Klarna paved the way for other BNPL providers such as Affirm, Afterpay, Paypal, and more recently, ApplePay. Each of these providers offers distinct BNPL options tailored to different consumer needs. Affirm, for example, offers both "Pay in 4" interest-free payments made bi-weekly, as well as a Monthly Payments plan that functions similarly to a loan, with repayment periods ranging from 3 to 12 months at interest rates up to 30% APR. Affirm's maximum purchase limit is \$30,000, with the minimum at \$50.⁴ Customers are subject to soft credit checks, which do not impact credit scores, but late or missed payments can still negatively affect credit ratings.

Similarly, Afterpay allows customers to split purchases into four interest-free installments. Spending limits start around \$500 and can increase based on timely payments and shopping behavior, with a general cap of \$1,000. Afterpay charges late fees capped at the lesser of \$8 or 25% of the order value.⁵ Customers can have up to three active orders and up to \$2,000 in outstanding balances at any given time. Unlike traditional credit providers, Afterpay does not perform credit checks nor does it report repayment behavior to credit bureaus. Paypal and ApplePay have also entered the BNPL market, offering their own variants of installment

³For more information, see [NerdWallet on Klarna](#).

⁴For more information on Affirm's purchase limits, visit [Affirm Purchase Limit](#).

⁵See [Increasing Your Afterpay Limit](#) for details on Afterpay limits.

plans.^{6 7}

From a consumer perspective, BNPL services are widely praised for their convenience, simplicity, and accessibility. The Financial Lives Survey (FLS)⁸ conducted by the Financial Conduct Authority (FCA) in 2022 highlights that BNPL's appeal lies primarily in its lack of interest charges and minimal credit checks. The survey reports that BNPL's popularity experienced substantial growth, with usage increasing from 17% of UK adults (approximately 8.8 million individuals) in May 2022 to 27% (over 14.1 million adults) by January 2023. A significant driver of this growth is BNPL's interest-free payment structure, which nearly 46% of users cited as their primary reason for adopting the payment method. This feature positions BNPL as a more affordable alternative to traditional credit cards for many consumers. Furthermore, 40% of respondents highlighted BNPL's ability to help them purchase goods they could not otherwise afford in a single payment, showcasing the critical role of this payment method in managing household budgets. BNPL has become particularly attractive to younger generations, who often exhibit greater caution regarding traditional credit card debt. Notably, only 9% of 18-24-year-olds reported borrowing via a credit card, while 22% of adults aged 18-24 and 27% of adults aged 25-34 reported using BNPL within the 12 months leading to May 2022. Among existing users, a significant 60% of 25-34-year-olds indicated that they had increased their BNPL usage over time. In addition to younger consumers, specific demographic groups

⁶Details on PayPal's BNPL options can be found at [PayPal BNPL](#). Specifically, PayPal offers two adaptable BNPL options to cater to diverse customer needs. The first, 'Pay in 4', allows customers to divide purchases ranging from \$30 to \$1,500 into four interest-free, bi-weekly payments spread over five weeks, with no late fees incurred. This plan is particularly suited for smaller, more manageable purchases. The second option, 'Pay Monthly', presents a more flexible solution with 6, 12, or 24-month payment plans. This option requires no downpayment or sign-up fees and is available for purchases between \$199 and \$10,000. However, it does come with interest rates varying from 9.99% to 35.99%, depending on the specific terms of the purchase. Additionally, PayPal conducts soft credit checks to assess customer eligibility for its BNPL services. Importantly, these checks do not impact the customer's credit score, making PayPal's BNPL options accessible without the potential drawback of affecting credit ratings.

⁷Apple Pay Later, unveiled in June 2022, initially rolled out in early access for select iPhones and iPads in March 2023, before becoming widely available in October of the same year. This service offers a convenient BNPL option, allowing users to divide their purchases, ranging from \$75 to \$1,000, into four equal, interest-free payments over a span of six weeks. For more details on Apple Pay Later, visit [Apple Pay Later](#). A key feature of this plan is that all repayments must be made via debit cards. It's important to note that should a user's debit card account lack sufficient funds for a scheduled repayment, their bank may levy fees for the shortfall.

⁸The Financial Lives Survey (FLS) is an extensive research initiative led by the UK's Financial Conduct Authority (FCA), capturing a detailed snapshot of the financial behaviors, attitudes, and well-being of UK adults. Since 2017, it has been conducted periodically, with 19,145 respondents participating in the 2022 edition, which included specific questions on deferred payment credit (DPC), commonly referred to as Buy Now, Pay Later (BNPL), alongside traditional financial products

demonstrated higher usage rates during the same period. For example, 25% of Black adults, 25% of renters, and 19% of women reported using BNPL services. On average, users recalled engaging with deferred payment credit six times over the 12 months to May 2022, although some frequent users reported much higher usage: 14% had used it 10 or more times, and 5% had used it 25 or more times. This highlights a demographic shift toward BNPL as a flexible alternative to credit cards, particularly for individuals who value cost-effective, interest-free payment methods to manage cash flow challenges. BNPL's rise during a time of economic uncertainty further underscores its role in providing financial flexibility and cushioning against rising living costs.

From a merchant's standpoint, BNPL not only enhances the payment options available to consumers but also serves as a valuable digital marketing tool, driving customer acquisition and sales. By offering BNPL, merchants can boost conversion rates, attract new customers, and increase average transaction sizes.

BNPL's expansion has been driven by the rise in e-commerce and in-store Point of Sale (POS) integration. Juniper Research estimates that BNPL users numbered around 360 million in 2022, with this figure projected to exceed 900 million by 2027⁹. Deloitte reports that the global gross merchandise value (GMV) of BNPL transactions reached \$433 billion in 2022 and is expected to rise to \$960 billion by 2028¹⁰. Worldpay's 2023 Global Payments Report highlights that BNPL accounted for 5% of global e-commerce transactions in 2022, up from 3% in 2021 and just 1% in 2018. This growth is particularly evident among Millennials and Gen Z, with 75% of BNPL users falling into these age groups, who are shifting away from traditional credit cards.¹¹

This shift indicates a significant transformation in consumer financing preferences, with BNPL emerging as a popular alternative to credit cards. However, as BNPL providers face growing regulatory pressures and concerns over potential consumer overspending, they must adapt to evolving consumer needs and regulatory frameworks. Despite inflation and rising interest rates impacting company valuations, demand for BNPL services remains strong, supported by the

⁹For more details, see the Juniper Research report [BNPL User Projections](#).

¹⁰Deloitte's report on the future of BNPL is available [here](#).

¹¹Worldpay's report is accessible [here](#).

ongoing expansion of e-commerce.

Technological innovations, such as the introduction of virtual BNPL cards, have further fueled the sector's growth by allowing BNPL transactions in-store, in addition to online. These virtual cards, which can be used within digital wallets for contactless payments, remove the need for merchants to establish individual agreements with BNPL providers. As a result, BNPL is increasingly competing with credit cards, both online and at the point of sale. The entry of Big Tech (e.g., Apple Pay Later), traditional banks (e.g., Citibank, Chase), and card networks (e.g., Visa, Mastercard) into the BNPL market reflects the growing competition and further evolution of this dynamic sector.

3.2.2 Defaults and Debt collection

The rapid expansion of Buy Now, Pay Later (BNPL) services has brought with it concerns regarding consumer debt and defaults. According to an August 2021 survey conducted by Bain & Company, nearly one-third of BNPL users in the United Kingdom have missed at least one payment, and half of those missed payments more than once.

A separate survey involving 1,038 BNPL users by Credit Karma in December 2020 revealed that one in three BNPL users missed a payments, with many reporting a subsequent drop in their credit scores. Although BNPL products often market themselves as credit score-free, late payments can still have financial consequences. The survey revealed that younger consumers were particularly vulnerable, with over half of respondents under 30 missing at least one payment. While companies like Affirm do not charge late fees, missed or partial payments can negatively affect credit scores. In contrast, Klarna and Afterpay suspend accounts until payments are made and levy late fees. Afterpay charges the lesser of \$8 or 25% of the order value, while Klarna charges either 25% of the order value or \$7, whichever is lower. Klarna also contacts users to collect payment before imposing late fees. Klarna's default rates have shown a modest increase, with customer defaults rising from 0.56% of gross merchandise volume (GMV) in 2019 to 0.67% in 2021.

Research by the UK charity Citizens Advice in 2020 highlighted the growing issue of late fees and debt collection in the BNPL market. BNPL shoppers were charged a total of £39 million in late fees that year, with one in ten BNPL users reported being chased by debt collectors. Among those referred to debt collectors, 96% experienced negative consequences, including sleepless nights, ignoring communications about their debts, and even worsening mental health. Alarming, none of the BNPL checkouts on major retailers' websites warned consumers that missed payments could lead to debt collection, with such warnings often buried deep in the terms and conditions.

This issue of rising defaults and late payments has prompted regulators to take action. In the UK, Citizens Advice has pushed for stronger consumer protections, advocating for clearer warnings at checkout and stricter affordability checks. Regulatory scrutiny has increased in both the United States and the United Kingdom, with authorities working to impose rules that bring BNPL products closer in line with traditional credit regulations.

3.3 The Economics of BNPL

Building on [Brennan et al. \(1988\)](#), we develop a model of unsecured credit provision in a retail setting to understand why Buy Now, Pay Later (BNPL) services have become popular. In particular, we highlight how BNPL enables merchants to price discriminate among customers with different liquidity constraints and valuations. We start with a baseline model in which a monopolistic merchant can offer various forms of payment—cash, credit cards, and store credit—and then introduce a BNPL option. We show that BNPL arrangements can replicate or enhance the benefits of price discrimination inherent in store credit, often at lower cost to the merchant.

3.3.1 The Model

Consider a monopolistic merchant who sells consumption goods at an endogenous retail price P and faces a constant marginal cost γ . There are two groups of consumers: Rich and Poor¹². The mass of Rich consumers is μ and of Poor consumers is $1 - \mu$. Their valuations for the good are v_H (Rich) and v_L (Poor), with $v_H > v_L > \gamma$. Both types of consumers are risk neutral without discounting and have a unit demand of the consumption good. Rich consumers have the option to pay either in cash or through other credit-based payment methods such as credit cards. When using credit – whether via a credit card or other payment services – they are assumed to have zero probability of defaulting on the credit contracts they enter at the point of sale. Poor consumers, on the other hand, have no immediate cash, and must rely on credit to complete their purchases. However, they will default on their loans with a probability of $\delta \in (0, 1)$ if they borrow to make the purchase.

Cash Only

If the merchant only accepts cash at the checkout, she¹³ sells exclusively to Rich consumers, extracting their entire surplus by setting $P = v_H$. Her profit is:

$$\pi_m^{Cash} = \mu(v_H - \gamma), \quad (3.1)$$

and both Rich and Poor consumers earn zero surplus.

Credit Card

A credit card company operates two independent primary lines of business: consumer credit services and merchant payment processing.

¹²We are going to use “the Rich”, “Rich consumers”, and “Rich customers” interchangeably throughout the chapter. Similarly for “the Poor”.

¹³We will use “she” as a convention throughout.

On the consumer (credit) side, it provides open-ended lines of credit to consumers, characterized by credit limit L_i^{CC} , and interest rate r_i^{CC} , where $i \in \{R, P\}$ denotes the consumer type – Rich (R) or Poor (P) consumers. Assuming that competitive credit card companies face a perfectly elastic supply of funds at an exogenously determined interest rate of zero, because it is public information about a consumer's default probability, competition in the credit market will force credit card companies to charge zero interest rate ($r_R^{CC} = 0$) on their credit card loans to the Rich customers who never default and $r_P^{CC} = \frac{\delta}{1-\delta}$ to the Poor customers with δ probability of default because the break-even condition is

$$(1 - \delta)(1 + r^{CC})P = P. \quad (3.2)$$

Whenever credit card option is available at the checkout, we assume that Rich customers will prefer using credit cards over cash to take advantage of associated benefits, such as rewards programs and/or building credit history, without incurring any interest charges because of the assumption of zero default probability or the more realistic case in which they are able to repay their balances in full within grace period even when they are offered credit cards with a positive Annual Percentage Rate (APR) in the contract.

On the merchant (payment) side, we simplify the roles involved in the credit card network by consolidating both acquirers, issuers, and the network into a single entity. This allows us to focus solely on the merchant per-transaction¹⁴ fee m^{CC} charged to the merchant for accepting credit card payments. By reducing the complexity of the credit card network in this manner, we can more clearly analyze the economic interactions between merchants, credit card companies, and consumers.

If the merchant accepts credit card payments in addition to cash at the checkout, the expected

¹⁴Here, we assume that the merchant fee is charged on a per-transaction basis as merchants do pay the bulk of their payment service fees on a per-transaction basis, despite the fact there are many papers theoretically examine the different welfare implications of charging ad valorem fees vs per-transaction fee (see [Shy and Wang \(2011\)](#); [Wang and Wright \(2017, 2018\)](#)), but since this is not the focus of this paper and will not change the main results, we continue the analysis of per-transaction fee.

utility of the Poor customer will be:

$$\begin{aligned} u_P &= (1 - \delta)(v_L - (1 + r_P^{CC})P) + \delta v_L \\ &= v_L - P. \end{aligned} \tag{3.3}$$

Thus, the participation constraint for Poor customers to purchase is $P \leq v_L$. Similarly, Rich customers will purchase if and only if $P \leq v_H$.

Consider now the pricing strategy of a merchant. She will choose between two potential prices: a lower price $P = v_L$ and a higher price $P = v_H$. Setting $P = v_H$ will only attract Rich consumers, as the higher price is above Poor customers' reservation price v_L . In contrast, setting $P = v_L$ attracts both Rich and Poor consumers, as Poor customers can now afford the purchase using credit cards. Since Rich customers will also pay with credit cards, the profit of the merchant will be

$$\pi_m^{CC} = \begin{cases} \mu(v_H - m^{CC} - \gamma) & \text{if } P = v_H \\ v_L - m^{CC} - \gamma & \text{if } P = v_L \end{cases} \tag{3.4}$$

Comparing the profit function in Equation (3.4) with that in Equation (3.1), we will see that credit card companies will optimally set their merchant fee $m^{CC} = 0$ to induce the take-up rate of credit cards by merchants.

Suppose that the relative population of Rich versus Poor consumers and their respective reservation prices satisfy the condition $v_L - \gamma > \frac{\mu}{1-\mu}(v_H - v_L)$ so that it is optimal for the merchant to set $P = v_L$ and sell to both groups. Under the above condition, the merchant's profit will be:

$$\pi_m^{CC}(P = v_L) = v_L - \gamma. \tag{3.5}$$

The Rich now earn positive consumer surplus of $\mu(v_H - v_L)$ while the Poor's surplus remains zero.

Store Credit

Before understanding the economics of BNPL, we first consider how a merchant can implement price discrimination to extract consumer surplus as much as possible by offering in-house store credit to her customers at the point sale. Building on [Brennan et al. \(1988\)](#), which look at the secured credit market, we adapt their model into the unsecured credit market in a retail setting. The idea is that if Poor consumers with lower reservation value than Rich consumers, the merchant can use credit terms to price discriminate more effectively. Intuitively, she can charge a higher menu price P (tailored to the Rich) while offering subsidized credit terms (r^M) that lower the effective price for the Poor to their reservation level. Formally, for a merchant offering store credit, her profit depends on both the retail price P and the interest rate r^M offered, thus, assuming that it is optimal for her to sell to both groups, the profit optimization problem will be

$$\max_{P, r^M} \pi_m^{Store}(P, r^M) = \mu(P - \gamma) + (1 - \mu)((1 - \delta)(1 + r^M)P - \gamma) \quad (3.6)$$

$$s.t. \ P \leq v_H \quad (\text{PC of the Rich}) \quad (3.7)$$

$$r^M \geq 0 \quad (\text{IC of the Rich}) \quad (3.8)$$

$$(1 - \delta)(1 + r^M)P \leq v_L \quad (\text{PC of the Poor}) \quad (3.9)$$

Participation constraints (3.9) and (3.7) ensures both types purchase and an incentive constraint (3.8) prevents Rich consumers from exploiting the subsidized credit. Depending on whether the incentive constraint (IC) of the Rich is binding or not, the merchant will have different pricing strategies.

If the incentive constraint for the Rich is **binding**, which happens when $v_H > \frac{v_L}{1-\delta}$, that is, the reservation price of the Rich is high enough so that it is not possible to simultaneously sell to both groups without offering a negative interest rate. Therefore, the merchant will charge $P = \frac{v_L}{1-\delta}$ and $r^M = 0$. Under this pricing strategy, the merchant extracts full surplus from the

poor consumers only and her profit is

$$\pi_m^{Store} \left(P = \frac{v_L}{1-\delta}, r^M = 0 \right) = \mu \left(\frac{v_L}{1-\delta} - \gamma \right) + (1-\mu)(v_L - \gamma) \quad (3.10)$$

Notice that credit card companies are driven out of the payment market by store credit as the interest rate of the store credit is more favorable to the Poor than that of credit cards. If credit card companies offer credits to the Poor under such terms, they will incur a loss of δ for every credit card transaction processed through their network. Thus, the Poor will pay using store credit while the Rich will use credit card to make the purchase if the merchant accepts it¹⁵. In this case, the Rich has a consumer surplus of $\mu(v_H - \frac{v_L}{1-\delta})$ and the Poor has zero surplus.

If the incentive constraint of the Rich is **not binding**, that is, $v_H \leq \frac{v_L}{1-\delta}$. The merchant will charge $P = v_H$ while offering store credit at a rate of $r^M = \frac{v_L}{v_H(1-\delta)} - 1$ at the checkout. The Rich will make the purchase using cash (or credit card if the merchant accepts it), while the Poor can afford the purchase with the help of store credit and are happy to complete the purchase even if the menu price is above their reservation price because they will repay the store credit with a probability smaller than 1, which makes the effective price paid by the Poor matching the level of their reserved valuation. In this case, the profit of the merchant is given by

$$\pi_m^{Store} \left(P = v_H, r^M = \frac{v_L}{v_H(1-\delta)} - 1 \right) = \mu(v_H - \gamma) + (1-\mu)(v_L - \gamma). \quad (3.11)$$

Under this pricing strategy, the merchant is able to extract full surplus from both groups. Notice that although the merchant is offering store credit with a positive contractual interest rate, her expected rate of return on the store credit is $v_L/v_H - 1 < 0$. Therefore, similar to the binding IC constraint scenario, there is no incentive for the credit card company to compete with the store credit to offer the same rate to the Poor because the merchant is essentially

¹⁵Similar to our discussion in the credit card section, the competition among different payment methods (cash, credit cards, and store credit) will make credit card companies to set their per-transaction merchant fee m^{CC} equal to zero. Because of the potential benefits associated with credit card payments such as credit history building, the Rich will prefer using credit cards over other means of payment. Here, we are not considering the potential strategic consideration of credit cards acceptance by merchants to avoid losing customers to their rivals, which will lead to a positive merchant fee, as discussed extensively in [Rochet and Tirole \(2002\)](#); [Wright \(2004\)](#) and others.

offering subsidized credit so that she can price discriminate the Poor to extract fully their surplus, and at the same time, the positive rate is sufficient to prevent the Rich from using store credit. In this case, both the Rich and the Poor have zero consumer surplus.

In both scenarios, the merchant is offering subsidized store credit to the Poor who have a lower reservation price than the Rich so that the merchant can increase their sale, as this effectively price-discriminates between consumer types based on their liquidity constraints and valuations. Part of the profits from the surplus extracted from both groups are then used to cover the interest rate subsidy provided in the store credit. Moreover, by comparing the profit function of the merchant in Equation (3.10) and (3.11) against the case of credit card acceptance in Equation (3.5), we can see that store credit allows the merchant to improve upon the profit achieved with credit cards alone, whether the IC of the Rich is binding or not, which suggests a positive role for store credit.

Buy Now Pay Later

As demonstrated in the previous section, store credit creates value for the merchant by allowing her to effectively price discriminate customers with different liquidity constraints and valuations, thereby extracting more consumer surplus. This is achieved through in-house subsidized store credit tailored to specific customer groups. BNPL services replicate the benefits of store credit without requiring the merchant to bear the associated credit risk. Instead of managing credit in-house, the merchant partners with a BNPL fintech that offers zero-interest installment loans at the point of sale. In exchange, the merchant pays an ad valorem fee, m^{BNPL} , to the BNPL provider. This fee covers the costs incurred by the competitive BNPL fintech for screening, monitoring, and enforcing credit agreements, as well as the expected losses from consumer defaults.

Similar to credit card companies, BNPL fintechs operate with both a customer-facing and a merchant-facing department. However, unlike credit card companies, which separate these two functions, BNPL fintechs integrate them to achieve synergy. The fees collected from merchants are used to offset the credit losses incurred on customer loans, creating a streamlined revenue

model that supports the service's dual objectives.

The partnership between the merchant and her BNPL provider functions as a revenue-sharing model, wherein the merchant sets the retail price and receives revenue net of the ad valorem fee charged by the fintech. This structure has been extensively studied in the literature and is recognized for its ability to align incentives between two parties while enabling third-degree price discrimination (Wang and Wright, 2018).

Under BNPL, the merchant's problem mirrors that with store credit, but now the cost of subsidizing credit is transferred to the BNPL provider via the merchant fee. The BNPL fintech sets m^{BNPL} to break even, combining merchant revenue and borrower defaults. The merchant then chooses P to serve both groups taken as given the merchant fee m^{BNPL} :

$$\max_P \pi_m^{BNPL}(P) = \mu(P - \gamma) + (1 - \mu)((1 - m^{BNPL})P - \gamma) \quad (3.12)$$

$$s.t. P \leq v_H \quad (\text{PC of the Rich}) \quad (3.13)$$

$$(1 - \delta)(1 + r^B)P \leq v_L \quad (\text{PC of the Poor}) \quad (3.14)$$

The competitive BNPL fintech decides its merchant fee with a break-even condition on its combined profits from offering merchant payment processing and consumer credit services:

$$\pi_{bnpl} = (1 - \mu)m^{BNPL}P - P + (1 - \delta)(1 + r^B)P = 0 \quad (\text{Zero profit condition}) \quad (3.15)$$

$$s.t. r^B \geq 0 \quad (\text{IC of the Rich}) \quad (3.16)$$

Again, depending on whether the incentive constraint of the Rich is binding or not, the merchant will charge differently and the BNPL fintech will set a different fee and interest rate at the point of the sale.

If Equation (3.16) is **binding**, i.e., $v_H > \frac{v_L}{1-\delta}$, the merchant will charge $P = \frac{v_L}{1-\delta}$ and the BNPL fintech will charge a proportional fee $m^{BNPL} = \frac{\delta}{1-\mu}$ on the merchant and offer zero-interest installment loan at the point of sale. Under this pricing strategy and the partnership contract

with the BNPL fintech, the merchant restore the same result as the case of store credit:

$$\pi_m^{BNPL} \left(P = \frac{v_L}{1-\delta} \right) = \mu \left(\frac{v_L}{1-\delta} - \gamma \right) + (1-\mu)(v_L - \gamma) \quad (3.17)$$

If Equation (3.16) is **not binding**, that is, $v_H \leq \frac{v_L}{1-\delta}$. The merchant will charge $P = v_H$ and the BNPL partner will charge a merchant fee of $m^{BNPL} = \frac{v_H - v_L}{v_H(1-\mu)}$ while providing a point-of-sale loan with a positive interest rate $r^B = \frac{v_L}{v_H(1-\delta)} - 1$, which is still smaller than the break-even rate $r_P^{CC} = \frac{\delta}{1-\delta}$. In this case, the profit of the merchant is the same as the store credit results:

$$\pi_m^{BNPL} (P = v_H) = \mu(v_H - \gamma) + (1-\mu)(v_L - \gamma). \quad (3.18)$$

Thus, BNPL provides a market-based mechanism for merchants to implement price discrimination through subsidized credit, leveraging the fintech's expertise and risk management capabilities.

Note that in our current setting, which incorporates simplified features of BNPL services, there is no clear benefit for the Rich to use BNPL at the checkout compared to credit cards. Credit card companies typically perform hard credit checks, allowing consumers to build or maintain their credit ratings through responsible usage. In contrast, BNPL services primarily rely on soft credit checks, which do not impact credit scores. As a result, Rich consumers are unlikely to favor BNPL over credit cards, as they do not gain the same credit-building advantages.

3.4 Merchant Payment Specialization

Having explored the economic rationale for the emergence of BNPL services in retail markets, we now examine the competitive dynamics between BNPL fintechs and credit card companies, focusing on how merchants decide their payment acceptance and pricing strategies. Specifically, we investigate how merchants with different cost structures specialize in accepting specific payment methods: cash, credit cards, or BNPL.

Utilizing a modelling trick in Bolt and Chakravorti (2008a), we assume that each merchant i faces an exogenously determined production cost, γ_i , uniformly distributed over the interval $[0, 1]$. Although merchants face heterogeneity in costs, they charge the same price P in equilibrium. This assumption captures variation in merchant pricing power, arising from differences in markups or operational efficiencies.

Customers can purchase goods using either cash or credit. Credit-based payment options are provided by either a competitive credit card (CC) company or a BNPL fintech provider. Consumers fall into three distinct classes: Rich (R), Middle Class (M), and Poor (P). Each consumer's classification is publicly observable, simplifying the analysis of payment choices and default probabilities.

Rich consumers have sufficient liquidity to purchase goods outright with cash or, alternatively use credit-based payment method depending on the acceptance policy of the merchant they shop with. Importantly, there is zero probability that Rich consumers will default on any credit contract they enter into at the point of sale. In contrast, Middle Class and Poor consumers lack immediate cash and must use credit to make purchases. Middle Class consumers have default probability δ , while Poor consumers have a higher default probability of $\delta + \Delta$ with $\Delta > 0$. Consequently, Middle Class consumers repay fully with probability $1 - \delta$, and Poor consumers repay fully with probability $1 - \delta - \Delta$. We assume that Δ is sufficiently large to ensure that the CC company cannot break even on Poor consumers.¹⁶

The reservation prices for the good are denoted as v_H for Rich consumers, v_M for Middle Class consumers, and v_L for Poor consumers, with $v_H > v_M > v_L > 1$. The population shares of each consumer type are μ_R , μ_M , and μ_P , with $\mu_R + \mu_M + \mu_P = 1, 0 \leq \mu_R, \mu_M, \mu_P \leq 1$. When consumers opt to pay using credit cards, the CC company charges a per-transaction merchant fee m^{CC} , which is optimally set as zero due to the competition from cash payments as an outside option for the Rich, same reason we have discussed in section 3.3.1.

¹⁶This situation arises if the break-even interest rate for Poor consumers surpasses the usury limit, preventing the CC company from charging an interest rate that appropriately accounts for their higher risk.

3.4.1 Cash Only

If a merchant accepts only cash, they will exclusively target Rich consumers, who pay without credit. The merchant sets the price at $P_{cash} = v_H$ to extract the full surplus from the Rich consumer segment. The quantity sold will then be $Q_{cash} = \mu_R$. The corresponding profit for merchant i is:

$$\pi_{m,i}^{Cash} = \mu_R(P_{cash} - \gamma_i) = \mu_R(v_H - \gamma_i). \quad (3.19)$$

In this case, consumer surpluses for the Rich, Middle Class, and Poor are all zero, as only the Rich are served, and the merchant extracts their entire surplus.

3.4.2 Credit Card

The competitive credit card company operates under a perfectly elastic supply of funds at an exogenously determined interest rate, which we assume to be zero. Given that a consumer's wealth status (Rich, Middle Class, or Poor) is public information, competitive pressures force the credit card company to charge a zero interest rate on loans extended to Rich consumers, who have a zero probability of defaulting. For Middle Class consumers, the credit card company aims to break even on their loans. Let r_M^P denote the interest rate charged to Middle Class consumers. The break-even condition can be expressed as:

$$(1 - \delta)(1 + r^{CC})P = P \rightarrow r^P = \frac{\delta}{1 - \delta}. \quad (3.20)$$

The expected utility for a Middle Class consumer is given by:

$$u_M = (1 - \delta)(v_M - (1 + r^{CC})P) + \delta(v_M - D), \quad (3.21)$$

where default penalty D represents the utility loss from defaulting such as damaged credit score, fees, etc.

Substituting Equation (3.20) into the expected utility function, the necessary and sufficient condition for Middle Class consumers to purchase is $P \leq v_M - \delta D$. For simplicity, assuming $D = 0$, the condition simplifies to $P \leq v_M$. Similarly, Rich consumers will purchase the good if and only if $P \leq v_H$. For In contrast, Poor consumers are excluded from the credit market, making it impossible for them to make a purchase regardless of the price.

If the merchant also accepts credit cards in addition to cash payments, they can expand their target market to include both Rich and Middle Class consumers. Suppose the relative proportions of Rich and Middle Class consumers and their respective valuations make it optimal for the merchant to set the price at $P_{cc} = v_M$, allowing sales to both groups. Rich consumers will choose to pay using credit cards rather than cash¹⁷. Under these conditions, the merchant sells $Q_{cc} = \mu_R + \mu_M$ units of good. The profit of merchant i becomes:

$$\begin{aligned}\pi_{m,i}^{CC} &= (\mu_R + \mu_M)(v_M - m^{CC} - \gamma_i) \\ &= (\mu_R + \mu_M)(v_M - \gamma_i),\end{aligned}\tag{3.22}$$

because the CC company will charge zero merchant fee to incentive merchant acceptance of credit cards.

The difference in profit between accepting credit cards and accepting only cash is:

$$\Delta\pi_{m,i} = \pi_{m,i}^{CC} - \pi_{m,i}^{Cash}.\tag{3.23}$$

Substituting the respective profit expressions yields:

$$\Delta\pi_{m,i} = (\mu_R + \mu_M)v_M - \mu_R v_H - \mu_M \gamma_i\tag{3.24}$$

Merchants will accept credit cards if and only if $\Delta\pi_{m,i} \geq 0$. This condition defines a threshold cost γ^{CC} , below which merchants will find it profitable to accept credit cards as a payment

¹⁷Same reason as before, there are many benefits comes with using credit cards since Rich consumers will not face any interest charges, such as credit history building, rewards, etc.

method. The threshold is given by¹⁸:

$$\gamma^{CC} = v_M - \frac{\mu_R}{\mu_M}(v_H - v_M). \quad (3.25)$$

If $\gamma^{CC} \geq 0$, which is equivalent to

$$v_H \leq \frac{\mu_R + \mu_M}{\mu_R} v_M, \quad (3.26)$$

merchants with costs $\gamma_i \leq \gamma^{CC}$ will accept credit cards, while higher-cost merchants remain cash-only. In this scenario, both Rich consumers and Middle Class consumers pay using credit cards when shopping with merchants accepting credit cards, and the Rich gains a positive consumer surplus of $\mu_R(v_H - v_M)$, while the Middle Class and Poor earn zero surplus.

3.4.3 BNPL

Now consider the case that a BNPL fintech competes with the CC company by offering zero-interest credit to consumers at the checkout of its partnered merchant. Merchants accepting BNPL payment option will need to pay ad valorem fee m^{BNPL} for every BNPL transaction, which reflects the credit cost bear by BNPL fintech from lending money to consumers with high default probability at the point of sale. If a merchant i accepts BNPL option in addition to cash, taken the fee m^{BNPL} charged by BNPL fintech as given, he can set the price P such that all consumers are willing to buy the good

$$\max_P \pi_{m,i}^{BNPL}(P) \quad (3.27)$$

$$s.t. \quad P \leq v_H \quad (\text{P.C. of Rich consumers}) \quad (3.28)$$

$$P(1 - \delta) \leq v_M \quad (\text{P.C. of Middle Class consumers}) \quad (3.29)$$

$$P(1 - \delta - \Delta) \leq v_L \quad (\text{P.C. of Poor consumers}) \quad (3.30)$$

¹⁸Suppose v_M , v_H , μ_R , and μ_M are such that $v_M - \frac{\mu_R}{\mu_M}(v_H - v_M)$ is positive.

where $\pi_{m,i}^{BNPL} = P(1 - m^{BNPL}) - \gamma_i$.

Suppose $v_H(1 - \delta) \leq v_M$ and $v_H(1 - \delta - \Delta) \leq v_L$, the participation constraint of the Rich customer (3.28) is binding. The merchant therefore sets a price equal to $P_{bnpl} = v_H$ and makes equilibrium profits of

$$\pi_{m,i}^{BNPL} = v_H(1 - m^{BNPL}) - \gamma_i \quad (3.31)$$

The difference in profit between accepting BNPL and accepting credit cards for a merchant i is:

$$\Delta\pi_{m,i} = (1 - m^{BNPL})v_H - \gamma_i - (\mu_R + \mu_M)(v_M - \gamma_i). \quad (3.32)$$

He will offer BNPL if and only if $\Delta\pi_{m,i} \geq 0$. This condition defines a threshold cost γ^{BNPL} , below which merchants will find it profitable to accept BNPL as a means of payment in addition to cash. The threshold is given by:

$$\gamma^{BNPL} = (1 - m^{BNPL})v_H + \frac{\mu_R + \mu_M}{\mu_P}((1 - m^{BNPL})v_H - v_M) \quad (3.33)$$

BNPL fintech is competitive so that they will charge a proportion fee m^{BNPL} to compensate for the credit losses from financing the purchases of the Middle Class and the Poor. Zero profit condition of BNPL fintech is

$$\pi_{bnpl} = m^{BNPL}P - \mu_M P\delta - \mu_R P(\delta + \Delta) = 0 \quad (3.34)$$

Therefore, it will charge a merchant fee m^{BNPL} given by

$$m^{BNPL} = \delta\mu_M + (\delta + \Delta)\mu_P. \quad (3.35)$$

Substitute the optimal fee charged by BNPL fintech into Equation (3.33), we have

$$\gamma^{BNPL} = \frac{\mu_R + \mu_M(1 - \delta) + \mu_P(1 - \delta - \Delta)}{\mu_P} v_H - \frac{\mu_R + \mu_M}{\mu_P} v_M. \quad (3.36)$$

If $\gamma^{BNPL} \geq 0$, which is equivalent to the condition

$$v_H \geq \frac{\mu_M + \mu_R}{\mu_R + \mu_M(1 - \delta) + \mu_P(1 - \delta - \Delta)} v_M, \quad (3.37)$$

together with the following two conditions

$$v_H \leq \frac{v_M}{1 - \delta} \quad (3.38)$$

$$v_H \leq \frac{v_L}{1 - \delta - \Delta} \quad (3.39)$$

then merchants with costs $\gamma_i \leq \gamma^{BNPL}$ will accept BNPL over cash.

Comparing the two thresholds γ^{BNPL} with γ^{CC} , we have

$$\begin{aligned} \gamma^{BNPL} - \gamma^{CC} &= \frac{(\mu_R + \mu_M(1 - \delta) + \mu_P(1 - \delta - \Delta))\mu_M + \mu_R\mu_P}{\mu_P\mu_M} v_H \\ &\quad - \frac{(\mu_M + \mu_R)(\mu_M + \mu_P)}{\mu_P\mu_M} v_M \end{aligned} \quad (3.40)$$

If the following condition holds:

$$v_H \leq \frac{\mu_M + \mu_R}{\mu_R + \mu_M(1 - \delta) - \frac{\Delta}{\frac{1}{\mu_M} + \frac{1}{\mu_P}}} v_M, \quad (3.41)$$

together with conditions (3.37), (3.38), (3.39), and (3.26), γ^{BNPL} will be smaller than γ^{CC} , which means merchants with varying product costs across the distribution tend to specialize in different payment options. Specifically, small merchants with $\gamma \geq \gamma^{CC}$ will accept cash, intermediate merchants $\gamma \in [\gamma^{BNPL}, \gamma^{CC}]$ will accept credit cards, and large merchants with $\gamma \leq \gamma^{BNPL}$ will accept BNPL. Note that $\mu_P\mu_M(1 - \delta - \Delta) + \mu_M^2(1 - \delta) > 0$, thus if Equation (3.41) holds, Equation (3.26) will always hold.

These results show that BNPL enables merchants to serve high-risk consumers (Middle Class and Poor) who are excluded from traditional credit markets, allowing merchants to capture greater market share and profits compared to cash or credit cards alone.

3.5 Conclusion

This paper provides a theoretical framework to understand the emergence and widespread adoption of Buy Now, Pay Later (BNPL) services in retail markets, as well as their interaction with more traditional credit instruments like credit cards. Our analysis shows that BNPL services can replicate the value-creating role of store credit—allowing merchants to price discriminate across customers with varying liquidity constraints and valuations—without requiring merchants to assume direct credit risk. By outsourcing credit provision and monitoring to specialized fintech providers, merchants benefit from lower operational burdens and greater market reach.

In particular, we show that when merchants operate in an environment with heterogeneous costs and serve a population of consumers with different degrees of default risk, distinct payment acceptance patterns emerge. High-cost merchants find it optimal to accept only cash, extracting full surplus from the most affluent consumers. Intermediate-cost merchants incorporate credit cards, expanding their customer base to include consumers with moderate default risk. Finally, low-cost merchants have an incentive to partner with BNPL fintechs, thereby broadening their appeal to even riskier consumers who remain excluded from traditional credit markets.

From a policy perspective, our findings suggest that BNPL may improve access to credit for previously underserved customers, though it also raises questions about consumer protection and financial stability. The next step of this project is to further refine the model to consider dynamic interactions, richer pricing structures, and the role of regulation, as well as explore the welfare implications of these payment innovations more comprehensively.

Chapter 4

Golden Visas and Real Estate Markets¹

4.1 Introduction

With the onset of the global financial crisis, many countries around the world decided to introduce policies aimed at stimulating their economies and increasing investment flows. In particular, many national governments implemented investor citizenship and residence schemes, more commonly known as “golden passport” and “golden visa” programmes. These schemes allow individuals to buy citizenship or residence in the host country for a substantial financial contribution. The usual qualifying investments are investment in a company, in an investment fund or structure, in government bonds, in real estate, deposits in a bank, and financial contributions to public projects. Globally, more than 60 countries currently operate golden passport or visa programmes, which see hundreds of thousands of people leveraging their purchasing power to gain a grade of membership in a polity each year. In the European Union alone, more than 130,000 people have acquired citizenship or residence in this way, with half of the EU member states running some form of these schemes (Surak, 2023). Despite their global prevalence, the causal impact of these investor-based citizenship and residence policies on local economies has remained an open question.

¹This is joint work with Dirk Foremny, Associate Professor at the University of Barcelona; Clara Martínez-Toledano, Assistant Professor at Imperial College Business School; and Mariona Segú, Assistant Professor at THEMA and CY Cergy Paris Université.

This project aims to fill this gap by causally evaluating the introduction of the golden visa programme in 2013 in Spain. According to national government reports, the majority of applicants park their funds in real estate. Hence, the focus of this project is on assessing the impact of investments in real estate through the programme on local real estate markets. Spain is an ideal laboratory for two main reasons. First, the country has one of the most generous golden visa programmes in the world, as non-EU investors can obtain a visa or authorization with full residence rights by just investing at least 500,000 Euro in real estate. Second, it also has rich administrative micro-level data on the universe of real estate transactions from national real estate property registrars, with detailed transaction-level information (including the location of the properties, the nationality of buyers and sellers, as well as financing information) both before and after the introduction of the programme.

We provide three main results. First, we study whether the programme was effective, that is, whether there has been a significant increase in real estate investment by non-EU investors after its introduction. We first provide descriptive evidence documenting that non-EU investors bunch at the 500,000 Euro threshold and that the growth in real estate-transactions by non-EU investors has been 3.42% higher than the growth for EU investors after the introduction of the programme. We then estimate the effectiveness of the programme more formally using difference-in-differences techniques and comparing the number of real estate transactions above the 500,000 Euro threshold by non-EU relative to EU investors across municipalities before and after the introduction of the programme. We find that the number of real estate transactions above the threshold increased by 0.24% more for non-EU relative to EU and investors after the introduction of the programme. These transactions are concentrated in coastal areas and across the top 10 largest non-EU nationalities in terms of golden visa investments.

Second, we assess whether there are any price distortions between non-EU investors and all other investors as a consequence of the programme. We do so by relying on a difference-in-differences design where we compare real estate transaction prices of non-EU relative to EU and Spanish investors before and after the programme, controlling for as many transaction characteristics as possible (i.e., property quality, property size, type of buyer, etc.) and including number of squared meters and interacted zip-code and year fixed effects. We find that non-EU investors

buy real estate properties around the threshold that are on average 9,228 Euro more expensive than those bought by EU and Spaniards after the introduction of the programme. These findings go in line with those found by [Cvijanović and Spaenjers \(2021\)](#), [Davids \(2020\)](#), [Li \(2021\)](#) and [Pereira dos Santos and Strohmaier \(2024\)](#) in other settings. In particular, [Pereira dos Santos and Strohmaier \(2024\)](#) uncover a golden visa premium where transaction prices exceed fiscal values by an average of around 38,000 Euro at the investment threshold in Portugal. We do not find any other premium in other parts of the real estate price distribution.

Third, we study whether the golden visa programme may have had any spillover effects on real estate prices in Spain. For that, we exploit variation in the exposure to the programme across zip codes, that is, we rely on differences in the ex-ante exposure to high-end real estate transactions by non-EU investors across zip codes. Despite controlling for municipality-level characteristics and interacting the golden visa share with a post-reform dummy, the estimation by ordinary least squares (OLS) may still suffer an endogeneity bias. The reason is that golden visa investors do not randomly select the zip codes in which they invest, which makes identification challenging. In order to overcome the potential endogeneity problem, we construct a shift-share instrument following the approach commonly used in the literature, where we interact the share of golden visa transactions in year 2012 in every zip code with the average share of non-EU transactions across all zip codes excluding the zip code of interest in every year. This instrument is an adaptation of the network instrument developed by [Card \(2001\)](#), that has already been used in the context of housing markets by [Saiz \(2007\)](#), [Ottaviano and Peri \(2012\)](#) and [Badarinza and Ramadorai \(2018\)](#). We find that the programme had spillover effects on the real estate market increasing overall real estate transaction prices on average by 0.45% after the introduction of the scheme. In line with the effect on quantities, we also find that the spillover effects have been concentrated in coastal areas.

This paper contributes to the literature analyzing the determinants of real estate price fluctuations. Scholars have highlighted, among others, the importance of credit supply and credit conditions (e.g., [Akin et al. \(2014\)](#); [Favara and Imbs \(2015\)](#), [Favilukis et al. \(2017\)](#), [Jordà et al. \(2015\)](#), [Justiniano et al. \(2019\)](#); [Mian and Sufi \(2009\)](#), [Mian and Sufi \(2022\)](#)); housing supply (e.g., [Glaeser et al. \(2005\)](#), [Gyourko et al. \(2013\)](#), [Saiz \(2010\)](#)); house purchase restrictions

(e.g., [Deng et al. \(2022\)](#)); agglomeration effects (e.g., [Combes et al. \(2019\)](#)); shifts in beliefs (e.g., [Adelino et al. \(2016\)](#), [Burnside et al. \(2016\)](#), [Kaplan et al. \(2020\)](#), [Mian and Sufi \(2022\)](#)); inflation and money illusion (e.g., [Brunnermeier and Julliard \(2008\)](#)); seasonality (e.g., [Ngai and Tenreyro \(2014\)](#)); and demographic changes (e.g., [Mankiw and Weil \(1989\)](#)).

Our paper is closely related to the substrand of this literature emphasizing the role of foreign capital flows in explaining real estate price fluctuations. Early research primarily relied on cross-country data and panel regressions to examine the effect of foreign capital inflows on housing markets (e.g., [Aizenman and Jinjark \(2009\)](#), [Sá et al. \(2014\)](#), [Cesa-Bianchi et al. \(2015\)](#), [Favilukis et al. \(2013\)](#), [Artola et al. \(2021\)](#)). More recent studies have used granular micro-level datasets and reduced-form techniques to study the causal link between foreign capital and house prices, as well as the underlying mechanisms. Scholars have highlighted the role of immigration and ethnic networks (e.g., [Cvijanović and Spaenjers \(2021\)](#), [Gonzalez and Ortega \(2013\)](#), [Li et al. \(2024\)](#), [Sá \(2015\)](#), [Sanchis-Guarner \(2023\)](#)); economic and political risk (e.g., [Badarinza and Ramadorai \(2018\)](#), [Sá \(2016\)](#)); exchange rate depreciation (e.g., [Davids \(2020\)](#)); flight route openings (e.g., [Sakong \(2021\)](#)); and international tax policy (e.g., [Gorback and Keys \(2020\)](#)) as important drivers of foreign demand of real estate and real estate price increases.

We show that golden visa or investor by citizenship programmes can be an important force increasing foreign demand of real estate and real estate prices. The other few studies examining the economic impact of these programmes are either descriptive or qualitative in nature (e.g., [Džankic \(2019\)](#), [Surak and Tsuzuki \(2021\)](#), [Surak \(2021\)](#), [Surak \(2022\)](#); [Surak \(2024\)](#), [Xu et al. \(2015\)](#)). As mentioned earlier, [Pereira dos Santos and Strohmaier \(2024\)](#) uncover a golden visa premium around the minimum investment threshold in Portugal, but they do not assess the real effects of the programme. This paper is thus the first to quantify the impact of golden visa programmes on local real estate markets.

The rest of the chapter is organized as follows. Section [4.2](#) describes the institutional setting of the Spanish golden visa programme, providing an overview of its key features and its evolution since its introduction in 2013. Section [4.3](#) provides details about the data sources used in this

study, including information on real estate transactions and control variables used in the analysis. 4.4 presents descriptive evidence, illustrating trends in real estate investments by non-EU investors, the geographic distribution of golden visa transactions, and initial patterns of price changes around the 500,000 Euro threshold. Section 4.5 evaluates the programme's effectiveness by estimating the impact of the golden visa policy on the quantity of real estate transactions by non-EU investors, employing difference-in-differences techniques. Section 4.6 examines price effects, assessing the existence of a golden visa premium and spillover effects on local real estate markets using both difference-in-differences and instrumental variable approaches. Finally, Section 4.7 summarizes our findings and future research.

4.2 Institutional Setting: The Spanish *Golden Visa* Programme

Following the outbreak of the 2008 financial crisis, Spain introduced a residency programme for foreigners with the aim of stimulating its economy. This scheme has been in force since September 28, 2013 (Law 14/2013 of September 27) and grants visas and authorizations with full residence rights—including access to the Schengen Area and other European Union countries—to foreign investors who make a significant capital investment.² The minimum qualified investments are: 500,000 Euro in real estate; 1,000,000 Euro in shares of Spanish companies, or investment or venture capital funds established in Spain, or bank deposits in Spanish financial entities; 2,000,000 Euro in Spanish public debt securities; or any business investment with high socioeconomic impact (for example, job creation, scientific innovation, etc.). In the case of investments in real estate, at least 500,000 Euro of the value must not be mortgaged and the investment can be made in multiple properties as long as the total investment amounts to at least 500,000 Euro.

There is no requirement for the investor to reside in Spain, but he must be of legal age, have

²The programme also grants visas and authorizations to entrepreneurs, highly qualified professionals, researchers and workers who move within the same company or group of companies.

no criminal record during the last five years and have public or private health insurance from an entity authorized to operate in Spain.³ The investor obtains a visa with a duration of one year if he is outside of Spanish territory, while if the investor is legally in Spain he can directly obtain a residence authorization with a validity of three years (two years until 20th December 2022, Law 28/2022). If the investor with a visa wishes to maintain residence for more than one year, he can apply for a residence permit valid for three years at any time before the visa expires (under the condition of maintaining the investment and visiting the country at least once during the period). The authorization can be renewed indefinitely for subsequent five-year periods if the investor continues to comply with the requirements. Spouses, partners, children and ascendants of the investor can also obtain the visa. Investments can be made directly by individuals or through a corporation.

Since the entry into force of the program in late 2013 until the end of 2023, a total of 13,285 initial visas and/or authorizations have been granted to primary visa applicants for investments in Spain. Out of this total amount of visas and/or authorizations, 94.14% (12,507) have been granted for the acquisition of real estate, and 5.86% (778) for other investments (i.e., financial assets and businesses).⁴ This motivates why, in the remainder of the paper, we restrict the evaluation of the programme to the acquisitions of real estate.

Figure 4.1a documents that in 2014 the take-up of the programme was quite low—only 153 initial golden visas were granted for investments in real estate—due likely to the fact that investors took some time to learn about the programme, invest, and apply for the visa. However, the number of golden visas steadily grew thereafter reaching 1,401 in 2019. In 2020, the number of golden visas declined to 778 due to the COVID-19 outbreak, but it further increased thereafter reaching 3,111 in 2023.

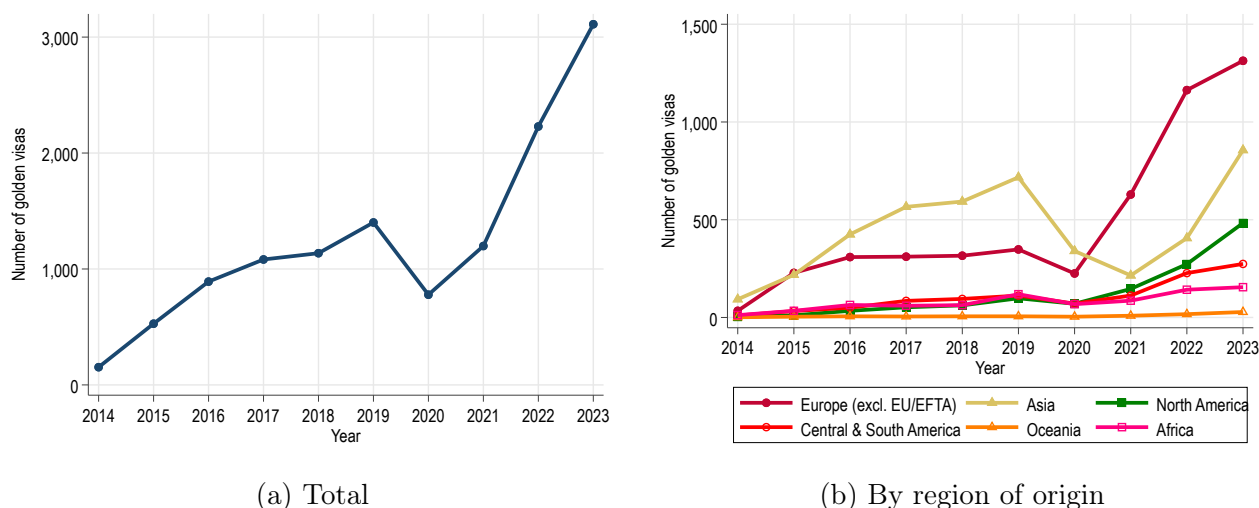
The take-up of the scheme is highly concentrated among investors coming from certain regions, as shown in Figure 4.1b. The two regions with the largest amount of visas and/or authorizations

³We will use *he* throughout as a convention.

⁴An additional 10,350 visas— 9,923 for real estate, 427 for other investments—have been granted to these primary visa investors due to renewals or changes of visa type between 2014 and 2023. Furthermore, 39,693 additional visas or authorizations (including initials, renewals and modifications) have been granted to dependents of these investors between 2014 and 2023.

granted between 2014 and 2023 were Europe (4,876) and Asia (4,429). According to [Boletín Oficial de las Cortes Generales \(2020\)](#), this is mainly due to Russian and Chinese investors, which represent approximately three quarters of the total number of visas granted to investors. The number of visas or authorizations granted to Europeans substantially increased in 2021, due likely to the rise in golden visa applications by UK investors after Brexit.

Figure 4.1: Golden visas initially granted via real estate investments, 2014-2023



Notes: This figure presents the annual evolution of golden visas or authorizations initially granted to primary applicants via real estate investments in Spain from 2014 to 2023. Panel (a) depicts the total amount of initial visas or authorizations granted every year to primary visa applicants for investments in real estate. Panel (b) decomposes the total amount of initial visas or authorizations granted every year to primary visa applicants for investments in real estate by region of origin of the applicant. The continents included are Europe (excluding EU/EFTA and including Russia), Asia, North America, Central and South America, Oceania, and Africa. The data is sourced from [Observatorio Permanente de la Inmigración \(OPI\)](#).

Figure 4.2 shows that the take-up of programme is concentrated in only a few Spanish provinces. In particular, there are only four provinces with more than 1,000 acquisitions of real estate by golden visa investors between 2014 and 2023 (i.e., Barcelona (4,052), Málaga (2,297), Madrid (2,206), Alicante (1,313)), followed by only six provinces with more than 100 but less than 1,000 acquisitions (i.e., Balearic Islands (754), Girona (524), Valencia (467), Tenerife (339), Cádiz (140), and Tarragona (119)). The rest of provinces have less than 100 golden visa acquisitions, out of which ten of them do not have a single acquisition over the 2014-2023 period, as shown in Figure 4.2. These are mainly non-coastal poorer and less densely populated provinces.⁵

⁵Appendix Figure A.1 shows that the take-up of programme is also disproportionately more concentrated among middle-aged male investors.

Figure 4.2: Golden visas granted via real estate investments across Spanish provinces, 2014-2023



Notes: This figure shows the total amount of golden visas initially granted to primary applicants between 2014 and 2023 across Spanish provinces. The data is sourced from *Observatorio Permanente de la Inmigración (OPI)*.

On April 8, 2024, the Spanish government announced that they were going to start the procedure to eliminate the golden visa programme as part of a broader move to address concerns over rising housing prices and the impact of foreign investment on local communities. Spain had already suspended its golden visa programme for Russian citizens in response to the Russian invasion of Ukraine, which began in February 2022. The suspension was part of broader sanctions and measures taken by the European Union to limit economic ties and put pressure on Russia following the conflict. The golden visa ceased to operate on April 3, 2025.

4.3 Data

4.3.1 Real Estate Transactions

The primary data source we use is the universe of real estate transaction records from the Spanish registrars, which provides very detailed information on all real estate purchases that have been officially registered across Spain from 2003 to 2022. Most real estate transactions

are registered by the registrars, as they provide legal security to the buyer for a relatively low cost.

For each transaction, the dataset includes the transaction price, transaction date, number of squared meters, property type (i.e., urban or rural, free or public) and subtype (i.e., apartment, terraced house, detached houses, commercial properties, offices, garage, land, etc.), municipality, zip code, street, property title (i.e., sale, barter, inheritance, donation), and financing information (i.e., mortgage value, interest rate, and mortgage duration). Most importantly, the dataset contains information on both buyers and sellers, in particular, their nationality as well as whether they are an individual, a corporation or a public institution.

We limit our analysis to the period from 2008 to 2019. We exclude years 2003 to 2007, since they do not contain full information on nationality, which is the key variable we need to evaluate the programme. We also exclude the period from 2020 onward to avoid the confounding effects caused by the significant decline in real estate transactions during the COVID-19 pandemic and Brexit. In addition, we restrict our analysis to urban and free real estate properties, which include either apartments, terraced or detached houses, commercial properties and offices. We thus exclude rural, public or state subsidized properties, as well as any other type of property such as land, garages or industrial warehouses. We also focus on transactions arising from sales and carried by either individual or corporate buyers, thereby also excluding transactions taken place due to barter, inheritances or donations, as well as those properties bought by public institutions. We address outliers by trimming 1% from both the lower and upper tails of the value of the transaction and size of the property. This step ensures that the combination of value and size and price per square meter falls within reasonable ranges. Finally, we also drop transactions that miss zip code and street information. As a result, our cleaned final sample comprises 3,878,873 observations, representing approximately 13% of the original raw registrars sample. [Appendix A](#) outlines the data cleaning procedure in more detail, documents the number of observations removed at each stage, and presents the annual number of observations we have in the final cleaned dataset we use in the analyses.

Despite its richness, the Spanish registrars database does not provide an indicator for whether

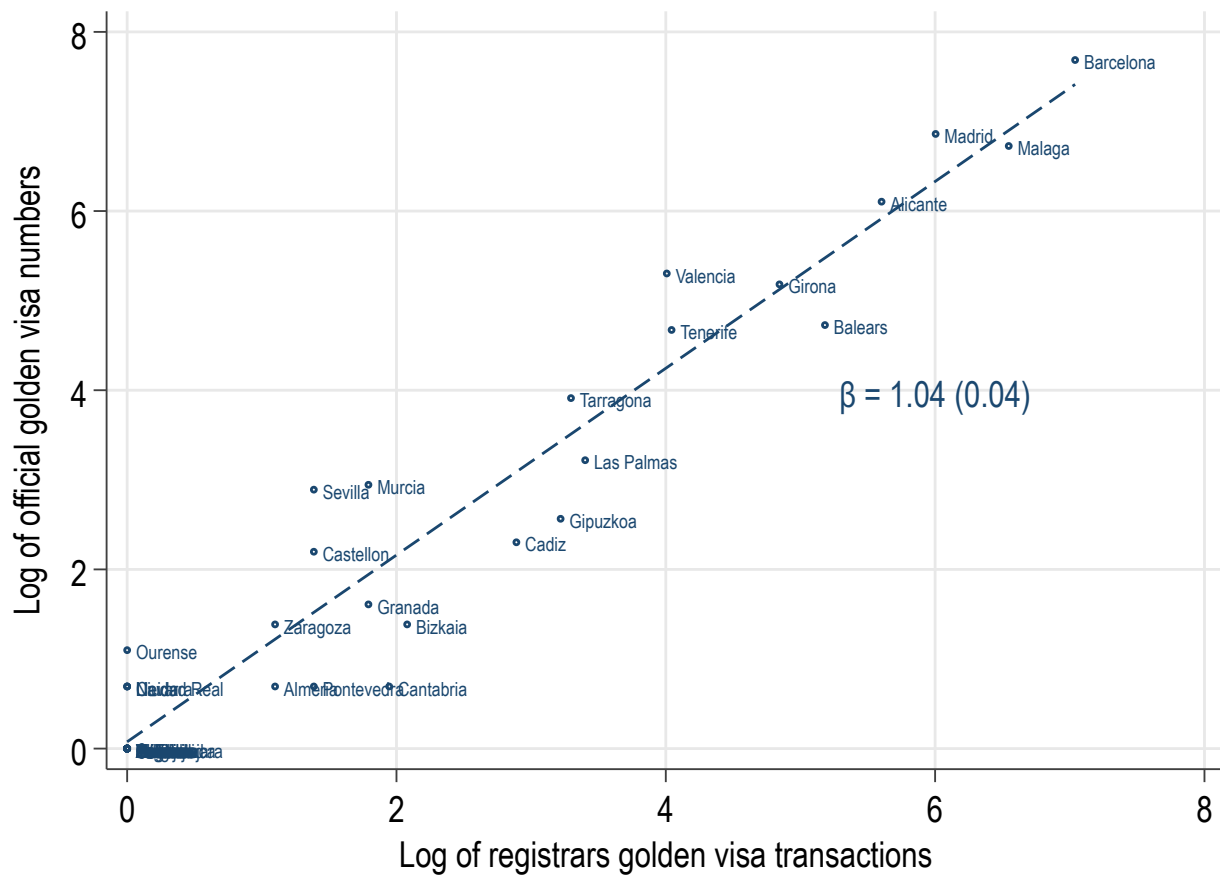
the real estate transaction granted the buyer a golden visa or not. Hence, we need to find a proxy indicator for golden visa transactions with the available information included in the dataset. We create a golden visa dummy variable indicator and set it equal to 1 if the transaction satisfies the following two conditions: (1) the *cash value* (transaction value minus the mortgage) is equal or above 500,000 Euro, and (2) the transaction was made by a non-EU buyer on or after September 28, 2013; 0 otherwise. This proxy may be subject to measurement error for two main reasons. On the one hand, we may be overestimating the number of golden visas with this measure if there are non-EU buyers who are purchasing properties whose cash value is equal or above 500,000 Euro, but they do not apply for a golden visa. On the other hand, we may be underestimating this measure if there are non-EU buyers who are applying for a golden visa, but they are purchasing multiple properties below 500,000 Euro instead of just one above the threshold.

We assess the validity of our indicator at correctly identifying golden visa transactions by comparing it with the aggregate official statistics on golden visas granted for investments in real estate sourced from [Observatorio Permanente de la Inmigración \(OPI\)](#). Figure 4.3 reports the relationship between the total official number of initial visas and residence authorizations granted to primary visa applicants for investments in real estate and the number of golden visa transactions based on the golden visa indicator we create using the Spanish registrars database across Spanish provinces. The coefficient for regressing the official number on our registrars measure using logs is 1.04 and significant at the 1% level, suggesting that our indicator captures the overall distribution of golden visas across Spanish provinces very well.

4.3.2 Other variables

We rely on several data sources to construct our municipality-level control variables, including population and foreign population size, local property tax rate, and unemployed rates relative to the population size. We obtain population data from the Padrón Continuo microdata provided by the Instituto Nacional de Estadística (INE). This dataset offers detailed information on the number of residents by nationality for each municipality from 1996 and annually from 1998 to

Figure 4.3: Relationship between official golden visa numbers and registrars golden visa transactions



Notes: This figure presents the relationship between the official number of golden visas and residence authorizations granted for real estate investments through the Spanish Golden Visa programme and the number of golden visa transactions recorded by the Spanish registrars across provinces. The comparison includes all visas initially granted to primary applicants and transactions recorded between 2014-2019. The coefficient and standard error reported are derived from regressing the official visa numbers on the registrars' transactions, both in log form. The official statistics are sourced from [Observatorio Permanente de la Inmigración \(OPI\)](#), while transaction data is obtained from the Spanish registrars.

2022. Municipal property tax (IBI) data for urban properties spans the period from 2000 to 2020, covering an average of 7,546 municipalities over our sample period (2008 to 2019), representing 92.8% of Spain. Monthly data on registered unemployment contracts at the municipal level in Spain, spanning the period 2005 to 2023, is sourced from Servicio Público de Empleo Estatal (SEPE). This dataset provides granular information on individuals officially registered as unemployed and actively seeking work through public employment services. To ensure data privacy and confidentiality, SEPE replaces the exact count with the notation “<5” when the number of unemployed individuals in a particular category is fewer than five. Fortunately, such cases are predominantly found in the 2022 and 2023 records, which fall outside our sample period, minimizing any potential impact on our analysis. We also incorporate various geospatial datasets: (1) Geolocation data for Spanish municipalities is obtained from Opendatasoft⁶. (2) We use data from Eurostat to identify coastal cities in Spain. These are defined as municipalities (LAU2) that either border the coastline or have at least 50% of their surface area within 10 km of the coast⁷. (3) Historical postal codes for each municipality in Spain are sourced from the Callejero del Censo Electoral, managed by INE⁸. (4) We obtain 2023 geospatial data on zip codes in Spain from INE, enabling us to determine neighboring zip codes for each postal code.

4.4 Descriptive Evidence

As initial visual evidence, we compare the evolution of golden visa real estate transactions (i.e., those above 500,000 Euro excluding mortgages) between non-EU and EU investors. EU investors should not be responding to the golden visa programme, as they have the right to reside and move freely within the European Union. Figure 4.4a shows that non-EU investors experienced on average 3.42% more growth in the number of these high-end real estate transactions than EU investors between 2013 and 2019. Note that most of the growth happened post-2014, since the programme was first introduced in September 28, 2013. This differential

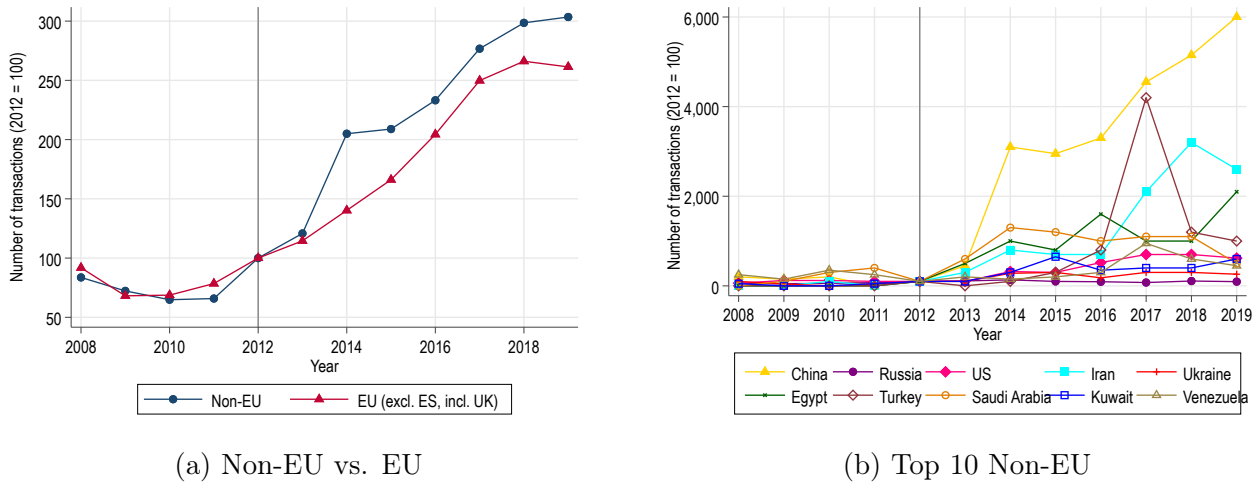
⁶Opendatasoft database is [here](#).

⁷Details are available from Eurostat [here](#).

⁸The dataset is available in CSV format and can be accessed [here](#).

growth in the number of transactions between non-EU and EU investors appears to be driven by the programme, since the two groups of investors had a very similar evolution in the number of real estate transactions prior to the introduction of the scheme.

Figure 4.4: Real estate transactions above 500,000 Euro excluding mortgages in Spain



Notes: This figure presents the evolution of real estate transactions above 500,000 Euro excluding mortgages over the period 2008-2019 in Spain. Panel (a) compares the evolution of transactions between non-EU and EU investors. The EU investors group excludes transactions made by Spaniards, but includes all transactions made by UK nationals, as the latter still part of the EU during that period of time. Panel (b) shows the evolution of these high-end real estate transactions for the top 10 nationalities of non-EU investors. The top 10 nationalities are obtained based on the counts of golden visas investments in real estate from the Spanish registrars dataset since the introduction of the programme on 28 September 2013 up to 31 December 2019. All series are normalized to 100 in 2012.

The take-up of the programme appears to be heterogeneous across top non-EU investors, with Chinese, Saudi Arabians, Egyptians and Iranians experiencing the fastest growth in transactions in the post-reform relative to the pre-reform period, as shown in Figure 4.4b. Note that even though Russians are the second largest nationality in terms of golden visas granted according to official statistics ([Boletín Oficial de las Cortes Generales \(2020\)](#)), they do not appear to experience as fast growth as other nationalities after the introduction of the scheme. The reason is that they were already buying a similar amount of high-end properties before the introduction of the programme.

Figure 4.5 shows that the take-up of the programme also seems to be heterogeneous across Spanish regions. The municipalities with the largest number of acquisitions of real estate by golden visa investors belong to the provinces of Barcelona, Madrid, Canary Islands and the Mediterranean coast, in particular, Málaga, Alicante, the Balearic Islands, Girona and Valencia.

This evidence goes in line with the official statistics on golden visas published by [Observatorio Permanente de la Inmigración \(OPI\)](#) and already presented in Section 4.2.

Figure 4.5: Distribution of real estate transactions acquired through the Spanish Golden Visa programme across Spanish municipalities



Notes: This figure depicts the distribution of real estate investments made by golden visa investors between September 28, 2013 and December 31, 2019 across Spanish municipalities. The map has been built based on the Spanish Registrars real estate transactions database. Our proxy for golden visas in the registrars is any transaction above 500,000 Euro excluding mortgage made by a non-EU investor. The black borders delineate the different Spanish provinces.

We also examine the distribution of real estate transactions before and after the introduction of the golden visa programme around the 500,000 Euro threshold. Since non-EU investors can obtain a golden visa as long as they buy a property above 500,000 Euro excluding mortgages, the programme incentivizes non-EU investors to purchase properties as close as possible to, but above the 500,000 Euro threshold. Figure 4.6a documents that there is a rightward shift in the distribution of real estate transactions for non-EU investors in the post-reform period relative to the pre-reform period, but Figure 4.6b shows that this is not the case for EU investors. Furthermore, Figure 4.6a also documents that non-EU investors buy disproportionately more properties around the 500,000 Euro threshold in the post-reform relative to the pre-reform period, but this is not the case for EU investors, as shown in Figure 4.6b. Hence, this evidence reveals that non-EU investors do bunch around the 500,000 Euro threshold as a response to

the programme.

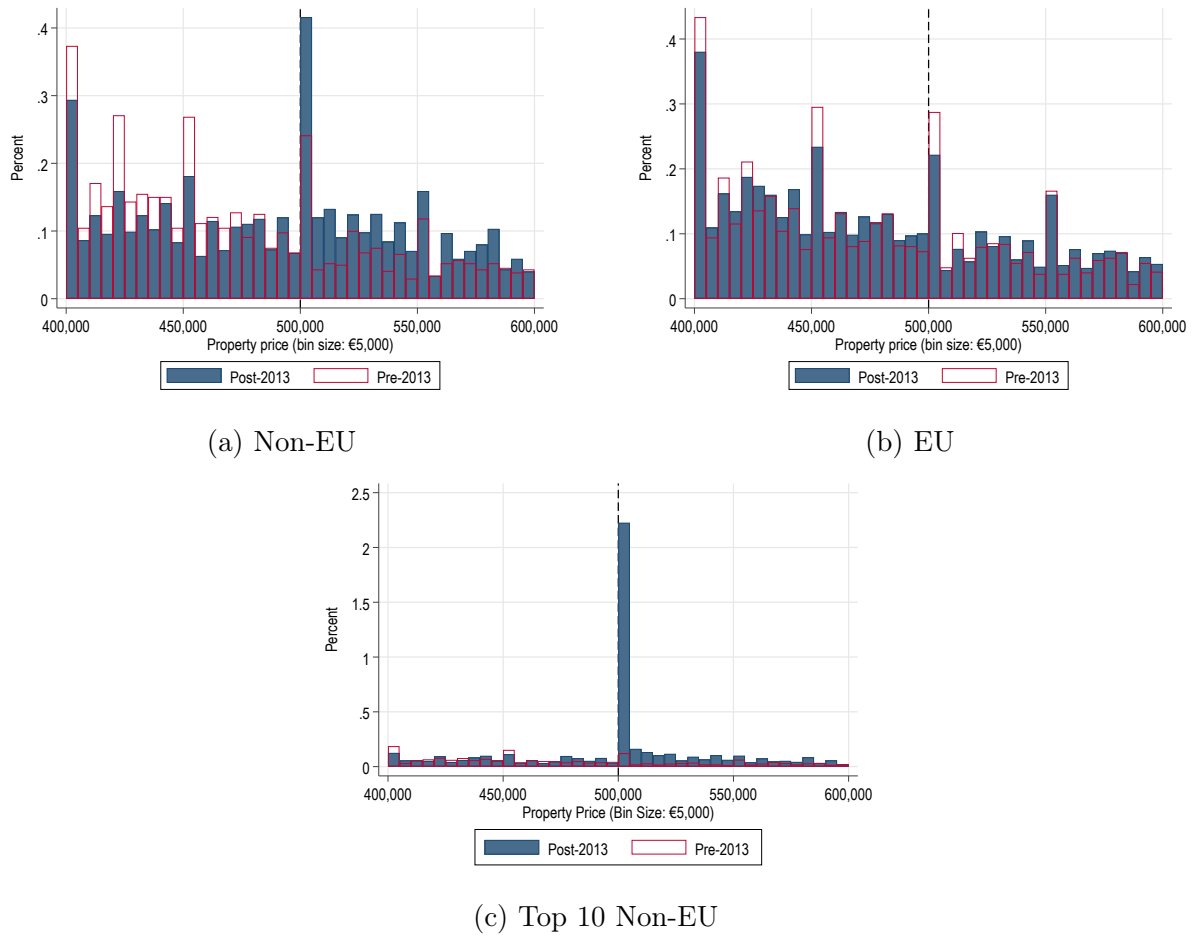


Figure 4.6: Distribution of real estate transactions in Spain pre- and post-reform for non-EU and EU investors

Notes: This figure depicts the distribution of real estate transactions in Spain before (1 January, 2008 up to 27 September, 2013) and after the introduction of the programme (28 September, 2013 up to 31 December, 2019) for non-EU and EU investors. The EU investors group excludes transactions made by Spaniards, but includes all transactions made by UK nationals, as the UK was still part of the EU during that period of time. Panels (a) and (b) present the zoomed-in distributions for real estate transactions around the 500,000 Euro threshold (between 400,000 and 600,000 Euro) before and after the introduction of the programme for non-EU and EU investors, respectively. Panel (c) presents the zoomed-in distribution of real estate transactions for top 10 non-EU nationalities around the threshold (between 400,000 and 600,000 Euro) before and after the introduction of the programme. The top 10 nationalities are obtained based on the counts of golden visas investments in real estate from the Spanish registrars dataset since the introduction of the programme on 28 September 2013 up to 31 December 2019. The bin size used is 5,000 Euro.

Figure 4.6c shows the distribution of real estate transactions before and after the introduction of the golden visa programme for top non-EU golden visa investors. The rightward shift in the distribution of real estate transactions for non-EU investors in the post-reform period relative to the pre-reform period seems to be largely driven by the top non-EU investors, as shown in Figure 4.6c. Indeed, Figure 4.6c shows that these top non-EU investors buy disproportionately

more properties around the 500,000 Euro threshold. Hence, this evidence is reassuring in that the bunchers around the 500,000 Euro threshold are precisely the top golden visa investors.

4.5 Effects on Quantities

This section estimates the causal effect of the Spanish golden visa program on the total number of real estate transactions. To conduct the analysis, we first aggregate transaction-level data into cell-level observations defined by municipality, buyer group (non-EU vs. EU), value range (above vs. below the eligibility threshold), and year. We include all municipalities that have at least one recorded transaction (of any value) during the sample period; cells without transactions are assigned zeros. For the baseline specification, we thus consider 723 municipalities, two buyer groups, two property value ranges, and 12 years, which leads to a total of 34,704 observations. We then use our cell-level data to estimate the following triple-difference model:

$$Q_{i,g,r,t} = \beta_0 + \sum_{t=2008}^{2019} \beta_t \times \text{Year}_{t \neq 2012} \cdot [\text{BuyerGroup}_g \cdot \mathbf{1}[\text{Value} \geq 500,000]] \quad (4.1) \\ + \theta_t + \gamma_g + \gamma_r + \eta_{g,t} + \lambda_{g,r} + \zeta_{r,t} + \epsilon_{i,t},$$

where $Q_{i,g,r,t}$ is the number of real estate transactions in municipality i , for buyer group g , purchasing in range r , and year t . The parameters of interest are thus the annual coefficients on the triple interaction of the year dummies for the period 2008 to 2019 (with 2012 as the baseline), the non-EU buyer group indicator (BuyerGroup_g), which equals 1 for non-EU investors and 0 for EU investors, and $\mathbf{1}[\text{Value} \geq 500,000]$, which equals 1 for property values equal or above 500,000 Euro, 0 for properties above 350,000 Euro and below 500,000 Euro. We also include year, buyer group, and range fixed effects, as well as interactions of buyer group with year, buyer group with range, and range with year fixed effects. We restrict our analysis to municipalities with at least one transaction by one buyer group over time, as otherwise all cells would be zero and collinear with the fixed effects.

We then modify this specification to estimate range-specific effects in a cumulative way by

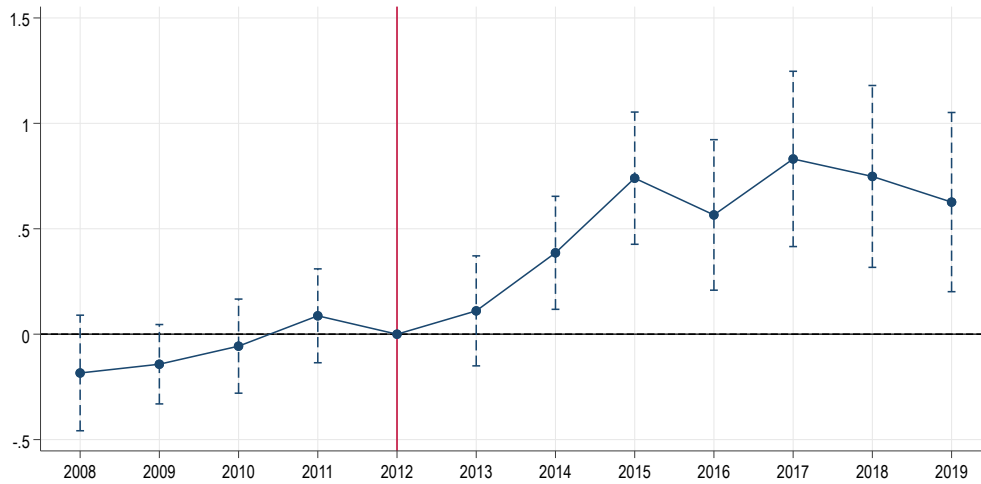
restricting the value of transactions included in the calculation of cells and estimate aggregated post-treatment effect for the years after 2012, relative to the average of the pre-treatment period, by substituting the year dummies with a treatment-period indicator which equals 1 for 2013-2019 and 0 for 2008-2012.

Figure 4.7 presents the annual estimates of Equation (4.1). The number of golden visa transactions steadily increases relative to the comparison group (i.e., real estate transactions above 500,000 Euro made by EU investors) starting in 2013 and becomes relatively stable from 2017 onwards. The average effect over the entire post-reform period (20013-2019) is 0.63 transactions, corresponding to a 0.24% increase over the 2012 baseline of 260 golden visa transactions. We find no significant differences in pre-trends, consistent with the number of real estate transactions below and above the threshold evolving similarly for EU and non-EU investors prior to the introduction of the Spanish golden visa programme. In line with the descriptive evidence shown in Sections 4.2 and 4.4, the first year of introduction of the scheme is not significant, as the programme was introduced late in 2013 and the official number of golden visas granted for investments in real estate in that year was just 2. Figure 4.8 shows how these estimates vary when we cumulatively adjust the upper bound of the treatment range above 500,000 Euro (Panel a) and the lower bound of the comparison range below 500,000 Euro (Panel b). When using smaller treatment ranges [500,000–650,000], the estimated average treatment effect is larger (0.91 transactions, 0.55% of the baseline) than when using broader ranges [500,000–950,000], where it is 0.63 transactions, 0.24% of the baseline. Similarly, adjusting the control range yields average effects of 2.73, 3.50, 2.86, and 1.62 transactions for control price ranges [0–500,000], [50,000–500,000], [150,000–500,000], and [250,000–500,000], respectively. These translate into proportional increases of 1.05%, 1.35%, 1.10%, and 0.62% in the baseline number of transactions within the [500,000–1,000,000] range.

Figure 4.9 depicts the annual estimates by nationality. Panel (a) focuses on Chinese investors. Similar to the full sample, we observe a stable and significant post-2013 increase, with an average effect of 0.49 transactions, corresponding to a 12.25% increase relative to the 2012 baseline number of golden visa transactions made by Chinese investors. Panel (b) focuses on the top 10 non-EU investor nationalities combined. Here, the average effect is 0.61 transactions,

equivalent to a 0.41% increase over the baseline number in 2012. Figure 4.10 splits the sample into coastal and non-coastal areas. The pattern in coastal municipalities mirrors the results of full sample, with stable and significant increase in the number of golden visa transactions after 2013. In contrast, no significant increase occurs in non-coastal areas. The average effect in coastal municipalities is 0.92 transactions, corresponding to a 0.40% increase relative to their 2012 baseline.

Figure 4.7: Triple Difference Model - Changes in Quantities above Threshold



(a) Above 500,000 Euro vs. Between 350,000 and 500,000 Euro

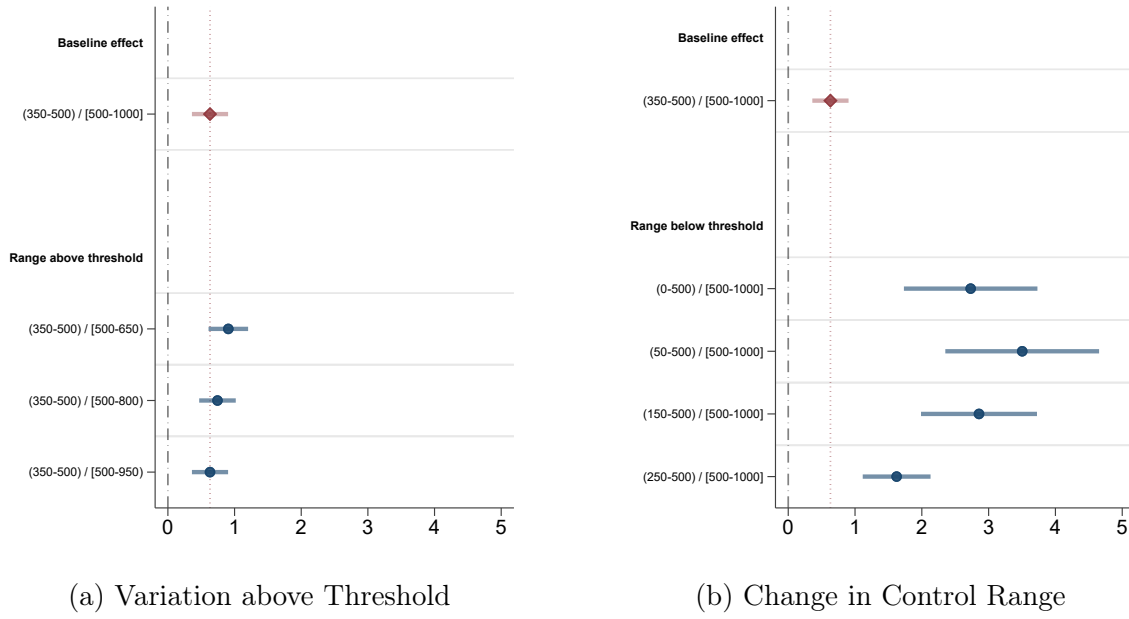
Notes: This figure depicts the annual estimates of Equation (4.1) and shows the effects based on the aggregated treatment $\mathbf{1}[\text{Value} \geq 500,000]$. Standard errors are clustered at the municipality level and 95% confidence intervals are plotted.

4.6 Effects on Prices

4.6.1 Golden visa premium

To determine whether the Spanish golden visa programme has had any impact on real estate prices, we start by assessing whether golden visa buyers paid a different price for their properties relative to other investors. For that, we use a difference-in-differences approach, comparing the evolution of real estate prices paid by non-EU against those paid by EU and Spanish investors, before and after the introduction of the Spanish golden visa scheme. As a robustness check, we

Figure 4.8: Triple Difference Model - Heterogeneity by Price Range



Notes: This figure shows point estimates from a simplified model comparing the post-treatment to the pre-treatment period. Panel (a) varies the range of transaction values above the threshold in a cumulative way, and Panel (b) shows robustness by varying the control range below the threshold. 95% confidence bands estimated with clustered standard errors at the municipality level around point estimates.

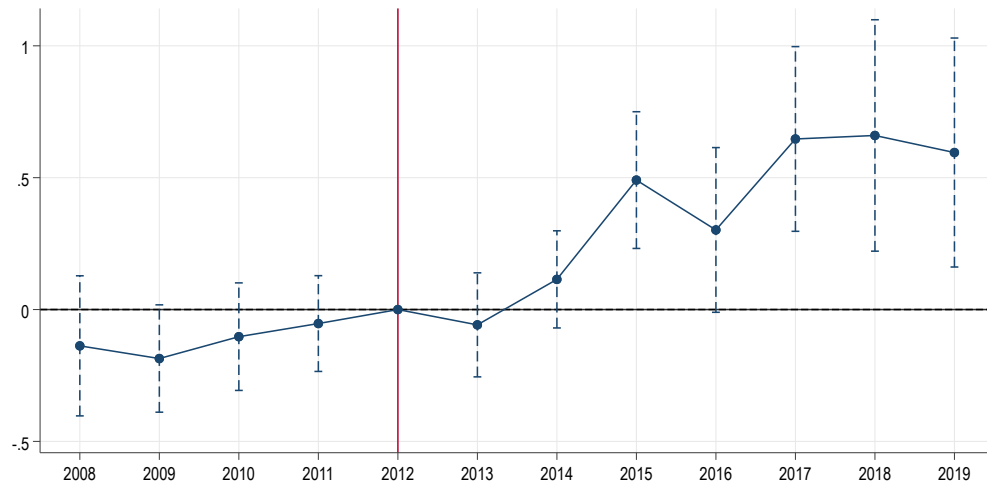
refine the analysis by using only EU investors as control group. The regression specification we use is as follows:

$$\ln P_{i,g,z,t} = \beta_0 + \sum_{t=2008}^{2019} \beta_k \times \text{Year}_{t \neq 2012} \cdot \text{BuyerGroup}_g + X'_{i,t} \quad (4.2)$$

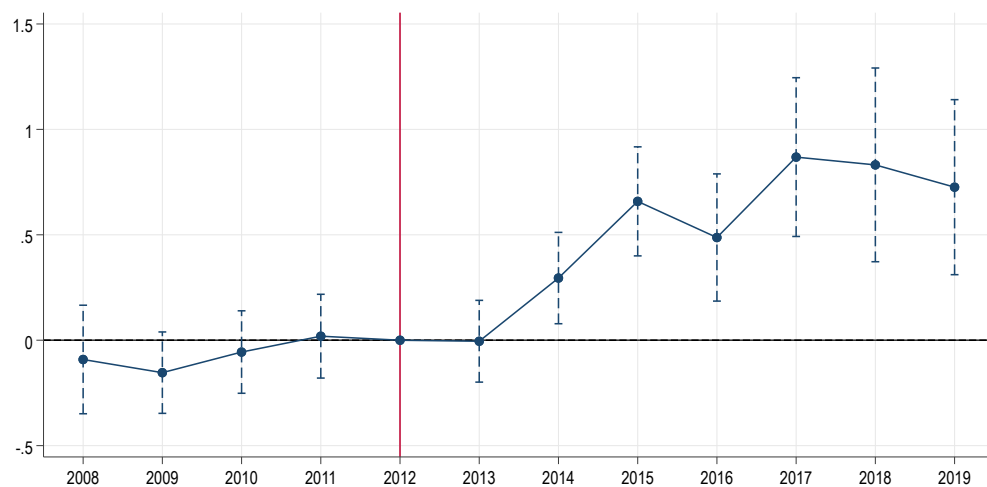
$$+ \gamma_s + \alpha_z + \mu_m + \theta_t + \zeta_{z,t} + \lambda_{m,t} + \epsilon_{i,t},$$

where $\ln P_{i,g,z,t}$ is the logarithm of the transaction price for property i , purchased by buyer group g , in zip code z , in year t . The parameters of interest are thus the annual coefficients of the interaction between BuyerGroup_g , which equals 1 for non-EU investors and 0 for EU and Spaniard investors (or EU investors only in the robustness check), and the year dummies for the period 2008 to 2019, using 2012 as the baseline year. We include number of squared meters s , zip code z , month m , year t , as well as interacted zip code and year and month and year fixed effects. Additionally, we control for a wide variety of transaction-level characteristics,

Figure 4.9: Triple Difference Model - Heterogeneity by Nationality



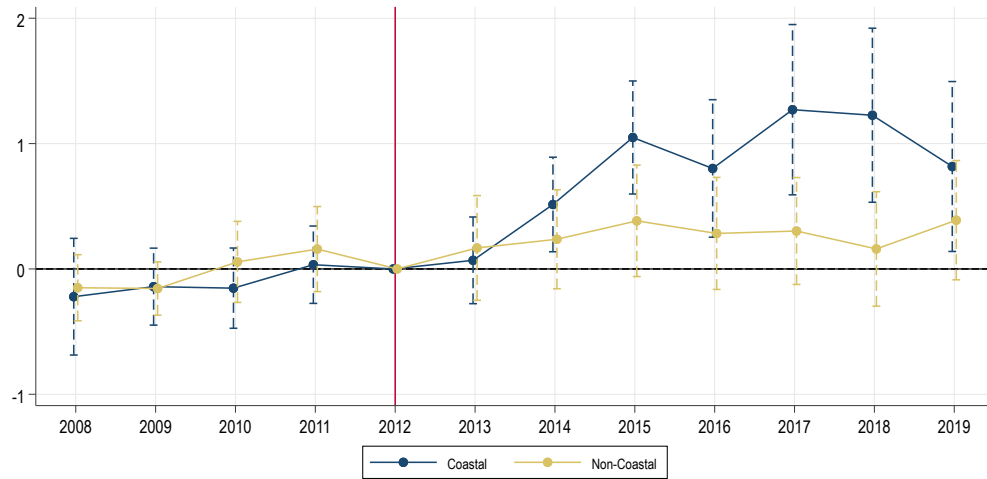
(a) Chinese



(b) Top 10 Non-EU

Notes: This figure depicts the annual estimates of Equation (4.1) with range-specific effects for Chinese in Panel (a) and top 10 non-EU nationalities in Panel (b). Standard errors are clustered at the municipality level and 95% confidence intervals are plotted.

Figure 4.10: Triple Difference Model - Coastal vs. Interior Municipalities



(a) Above 500,000 Euro vs. Between 350,000 and 500,000 Euro

Notes: This figure depicts the annual estimates of Equation (4.1) and shows the effects based on the aggregated treatment $\mathbf{1}[\text{Value} \geq 500,000]$ for coastal and non-coastal areas. Standard errors are clustered at the municipality level and 95% confidence intervals are plotted.

in particular, the loan-to-value ratio associated with the property mortgage, and dummies for property subtype (i.e., apartment, terraced house, detached houses, commercial properties, offices, garage, land, etc.), property quality (i.e., new or old), buyer type (i.e., individual or corporation) and seller type (i.e., individual, corporation or public institution). We also include a dummy indicator for whether the buyer and seller are from the same country.

The analysis is conducted across three distinct price ranges – [250,000-400,000], [400,000-550,000] and [550,000-700,000] – to capture potential heterogeneity in the program’s impact across different market segments. Standard errors are clustered at the zip-code level to address potential spatial correlations in price changes, ensuring robust inference about the effects of the policy intervention.

Table 4.1 displays in column (1) the aggregated post-reform effect across the three different price ranges for the years 2013-2019, relative to the average of the pre-reform 2008-2012 period using both EU and Spanish investors as control group. To estimate that, we modify the regression in equation 4.2 by substituting the year dummies with a treatment-period indicator which equals 1 for 2013-2019 and 0 for 2008-2012. The results indicate a significant premium

only for the 400,000-550,000 Euro price range. In particular, non-EU investors paid, on average, 2.02% ($= \exp(0.02) - 1$) more than EU and Spanish investors for properties in this range during the post-reform period relative to the pre-reform period. This translates into a premium of approximately 9,228 Euro relative on the baseline average price of 456,826 Euro paid by non-EU investors in 2012.

The existence with a golden visa premium only around the 500,000 Euro threshold is consistent with the fact that only when the property value could potentially be below the 500,000 Euro required threshold to obtain the visa, non-EU investors are willing to pay a higher price for the property. To ensure that these findings are not driven by market segmentation, columns (2-4) of Table 4.1 show these findings are robust to the inclusion of street and interacted street and year fixed effects. Table 4.2 also shows the results are robust to the use of just EU investors as control group.

Figure 4.11 depicts the annual estimates of Equation 4.2 for properties in the 400,000-550,000 Euro price range. We find no significant differences in pre-trends for the 400,000-550,000 Euro price range, indicating that non-EU and other investors paid similar prices for properties prior to the programme's introduction. The first year of introduction of the scheme is not significant for this price range either, as the programme was introduced late in 2013 and the official number of golden visas granted for investments in real estate in that year was just 2. This evidence further supports the existence of a golden visa premium just around the 500,000 Euro threshold.

4.6.2 Spillovers

This section studies whether the programme has had any additional effect on real estate prices beyond the golden visa premium we document in the previous subsection. For that, we rely on a two-step approach. First, we compute a price index for each year and foreign buyer group (i.e., non-EU, EU). More specifically, we run an hedonic regression model by regressing the logarithm of transaction prices $\ln P_{i,z,t}$ on different property-level attributes, as shown in Equation (4.3). The attributes we include in the model are: surface area, surface area squared, the loan-to-value ratio associated with the property mortgage, and dummies for property subtype

Table 4.1: Non-EU vs EU + Spaniards

	(1)	(2)	(3)	(4)
[250,000 - 400,000]				
Non-EU	0.004* (0.002)	0.002 (0.002)	-0.002	-0.002
Non-EU × Post	-0.004 (0.003)	-0.003 (0.003)	-0.002	-0.002
# of Observations	370,168	320,979	240,765	240,765
# of Municipalities	1,801	1,510	1,502	1,502
# of Zipcodes	2,952	2,535	2,509	2,509
R-squared	0.21	0.42	0.52	0.52
[400,000 - 550,000]				
Non-EU	0.002 (0.003)	-0.003 (0.004)	-0.001 (0.004)	-0.001 (0.004)
Non-EU × Post	0.020*** (0.003)	0.025*** (0.004)	0.024*** (0.005)	0.024*** (0.005)
# of Observations	94,788	76,330	55,352	55,352
# of Municipalities	871	664	661	661
# of Zipcodes	1,614	1,258	1,252	1,252
R-squared	0.18	0.37	0.47	0.47
[550,000 - 700,000]				
Non-EU	0.003 (0.004)	0.001 (0.005)	0.002 (0.006)	0.002 (0.007)
Non-EU × Post	-0.005 (0.004)	-0.004 (0.005)	0.000 (0.007)	0.000 (0.007)
# of Observations	33,539	25,475	17,500	17,500
# of Municipalities	486	332	330	330
# of Zipcodes	927	662	652	652
R-squared	0.19	0.38	0.47	0.47
Baseline FE	Yes	Yes	Yes	Yes
Street FE	No	Yes	No	Yes
Street × Year FE	No	No	Yes	Yes

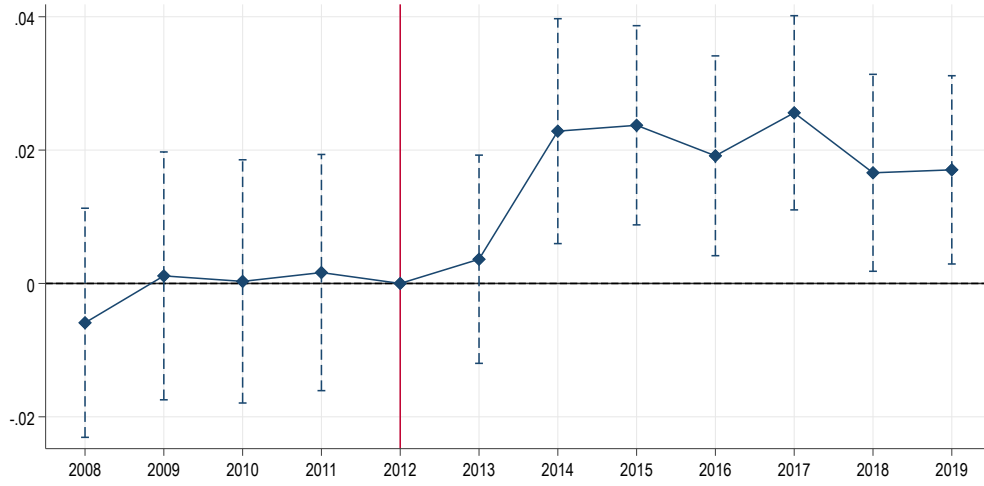
*Notes: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. For price range [250,000-400,000], the robust standard errors in Column (3) and (4) are omitted here because of insufficient observations to do the calculation.*

Table 4.2: Non-EU vs EU

	(1)	(2)	(3)	(4)
[250,000 - 400,000]				
Non-EU	0.003 (0.003)	0.005* (0.003)	-0.002	-0.002
Non-EU × Post	-0.009*** (0.003)	-0.014*** (0.004)	-0.009	-0.009
# of Observations	370,168	320,979	240,765	240,765
# of Municipalities	1,801	1,510	1,502	1,502
# of Zipcodes	2,952	2,535	2,509	2,509
R-squared	0.21	0.42	0.52	0.52
[400,000 - 550,000]				
Non-EU	-0.000 (0.003)	-0.002 (0.004)	0.002 (0.005)	0.002 (0.005)
Non-EU × Post	0.020*** (0.004)	0.020*** (0.005)	0.016*** (0.006)	0.016*** (0.006)
# of Observations	94,788	76,330	55,352	55,352
# of Municipalities	871	664	661	661
# of Zipcodes	1,614	1,258	1,252	1,252
R-squared	0.18	0.37	0.47	0.47
[550,000 - 700,000]				
Non-EU	0.001 (0.004)	-0.005 (0.006)	-0.005 (0.007)	-0.005 (0.008)
Non-EU × Post	-0.004 (0.005)	0.003 (0.006)	0.009 (0.008)	0.009 (0.009)
# of Observations	33,539	25,475	17,500	17,500
# of Municipalities	486	332	330	330
# of Zipcodes	927	662	652	652
R-squared	0.19	0.38	0.47	0.47
Baseline FE	Yes	Yes	Yes	Yes
Street FE	No	Yes	No	Yes
Street × Year FE	No	No	Yes	Yes

*Notes: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. For price range [250,000-400,000], the robust standard errors in Column (3) and (4) are omitted here because of insufficient observations to do the calculation.*

Figure 4.11: Golden Visa Premium



(a) [400,000 - 550,000]

Notes: This figure depicts the annual estimates of Equation (4.2) for the price range 400,000-550,000 Euro. Standard errors are clustered at the zip-code level and 95% confidence intervals are plotted.

(i.e., apartment, terraced house, detached houses, commercial properties, offices, garage, land, etc.), property quality (i.e., new or old), buyer type (i.e., individual or corporation) and seller type (i.e., individual, corporation or public institution). We also include a dummy indicator for whether the buyer and seller are from the same country, as well as year (θ_t) and zip-code fixed effects (μ_z). In addition, we also include month fixed effects to adjust for any seasonal fluctuations in prices. This allows us to construct a price index net of property characteristics by adding the constant, fixed effects for time and location, and the residual from the regression model. We then average these price indices at the zip code and year level to construct $PriceIdx_{z,t}$. We generate two versions of this index, one for the overall number of transacted properties in every zip code and year and a similar one but excluding golden visa transactions. This will help us to determine whether the programme has had any spillover effects on real estate markets beyond the localized golden visa premium around the 500,000 Euro threshold or not.

$$\ln P_{i,t,z} = \beta_0 + X'_{i,t} + \theta_t + \mu_z + \epsilon_{i,t} \quad (4.3)$$

Second, we rely on a difference-in-differences approach with treatment intensity where we compare the evolution of real estate prices before and after the introduction of the programme across zip codes with different exposure to the golden visa programme. In particular, we run the following specification:

$$\ln PriceIdx_{z,t} = \beta_0 + \beta_1 GVShare_{z,t} \times Post_t + X'_{z,t} + \theta_t + \mu_z + \epsilon_{z,t}, \quad (4.4)$$

where $PriceIdx_{z,t}$ is the real estate price index in zip code z in year t , $GVShare_{z,t}$ is the share of non-EU golden visa transactions (i.e., transactions above 500,000 Euro) in zip code z and year t , and $Post_t$ is an indicator variable which equals 1 for years between 2013 and 2019 and 0 for years 2008 to 2012. The coefficient β_1 thus measures whether there is any differential effect on real estate prices effects before and after the programme across zip codes with different exposure to the programme. We include two sets of controls in $X_{i,z,t}$. At the zip-code level, we control for the total number of non-EU transactions, the total number of EU transactions, and the logarithm of the average property surface area within the zip code. At the municipality-level, we control for property taxes on urban properties, the unemployment share relative to the total population, total population size and the foreign population size. In addition, we include year fixed effects (θ_t) to control for macro-level shocks common to all zip codes in a given year, and zip-code fixed effects (μ_z) to capture unobserved, time-invariant characteristics specific to each zip code that could influence real estate prices. Standard errors are clustered at the zip-code level to correct for spatial correlation in price trends.

The variable $GVShare_{z,t}$ may be endogenous for the following two main reasons. First, it may suffer from reverse causality, as higher real estate price growth in certain zip codes could attract more non-EU investors. Second, it may also suffer from omitted variable bias, as there may exist unobserved time-varying factors at the zip-code level, such as changes in local amenities (e.g., new schools, parks, or commercial developments), housing supply dynamics (e.g., new infrastructure projects or zoning changes), or proximity to desirable locations that could simultaneously influence real estate prices and the attractiveness of these areas for golden visa investors. To address these concerns, we construct a shift-share instrument ($SS_{z,t}$) following

the approach commonly used in the literature. We create one instrument per year as follows:

$$SS_{z,t} = share_z^{2012} \times shift_{-z,t}, \quad (4.5)$$

where $share_z^{2012}$ represents the share of golden visa transactions in year 2012 for a given zip code z . This captures the historical propensity of a zip code to attract non-EU golden visa transactions based on predetermined characteristics. $shift_{-z,t}$ represents the average share of non-EU transactions across all zip codes excluding zip code z for a given year t . This accounts for time-varying factors that affect the overall attractiveness of Spain to non-EU investors, but that are exogenous to any specific zip code. By combining a time-invariant local share ($share_z^{2012}$) with a time-varying aggregate shift ($shift_{-z,t}$), the instrument isolates exogenous variation in $GVShare_{z,t}$ that is uncorrelated to specific local shocks.

Table 4.3 summarizes the results of the difference-in-differences analysis at the zip code level. Panel A reports estimates where the dependent variable is the price index based on all transactions, while panel B excludes transactions by golden visa investors (i.e., non-EU investors purchasing properties above 500,000 Euro). Column (1) displays the OLS results, while columns (2)-(4) present the 2SLS results using robust, municipality and zip-code-level clustered standard errors, respectively. The instrument is strong across all specifications, according to both the Cragg-Donald Wald F statistic, as well as the rk Wald F statistic.

The average golden visa share at the zip-code level in the post-reform period is 0.045%. Hence, according to our baseline estimate in column (4) panel A of Table 4.3, this means that the Spanish golden visa scheme led on average to an increase of 0.45% in real estate prices. This corresponds to an increase of 74 Euro relative to the average price index of 16,382 Euro in 2012. The effect is quite similar (0.49%) when looking at the average price effect excluding golden visa transactions in panel B, namely an increase of 80 Euro relative to the average price index of 16,390 Euro in 2012. Figure 4.12 shows that prior to the introduction of the programme there was not a different evolution in real estate prices across zip codes with different ex-ante exposure to golden visa investors. It is only after the introduction of the scheme when real estate prices start to differ across zip codes with different ex-ante exposure to golden visa

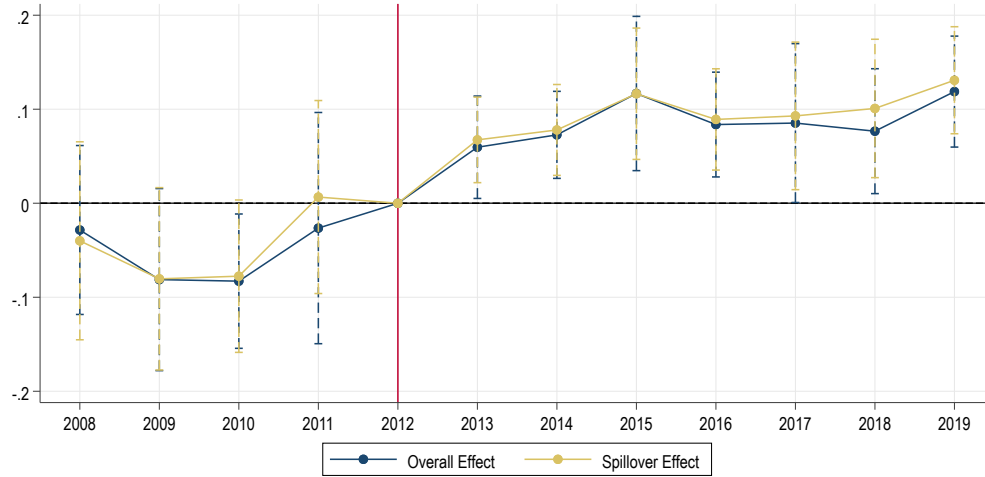
Table 4.3: Average Price Effect of Golden Visa Programme

	OLS (1)	2SLS (2)	2SLS (3)	2SLS (4)
Panel A: Overall Effect				
GVshare	0.003 (0.002)	0.005 (0.010)	0.005 (0.013)	0.005 (0.008)
GVshare $\times$ Post	0.012*** (0.003)	0.100*** (0.014)	0.100*** (0.026)	0.100*** (0.019)
# of Observations	79,463	79,463	79,463	79,463
# of Zipcode	9,163	9,163	9,163	9,163
Mean of Dep. Var.	9.28	9.28	9.28	9.28
Adj. R-squared	0.734	-0.051	0.070	0.070
Cragg-Donald Wald F statistic		46.80	52.90	52.90
rk Wald F statistic		4.92	100.65	14.33
Panel B: Spillover Effect				
GVshare	-0.005** (0.002)	-0.010 (0.008)	-0.010 (0.010)	-0.010 (0.007)
GVshare $\times$ Post	0.012** (0.006)	0.108*** (0.014)	0.108*** (0.027)	0.108*** (0.019)
# of Observations	79,461	79,461	79,461	79,461
# of Zipcode	9,163	9,163	9,163	9,163
Mean of Dep. Var.	9.28	9.28	9.28	9.28
Adj. R-squared	0.733	-0.040	0.080	0.080
Cragg-Donald Wald F statistic		105.14	118.85	118.85
rk Wald F statistic		4.66	108.39	13.87
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Zip-code FE	Yes	Yes	Yes	Yes
Cluster	Robust	Robust	Municipality	Zip-Code

Notes: This table depicts the coefficients of interest from estimating Equation (4.4). Panel A reports the estimates for full set of transactions, while panel B reports the same estimates excluding golden visa transactions. Column (1) presents the OLS results, while Columns (2) to (4) displays the estimates from estimating the same Equation (4.4), but instrumenting the golden visa share ($GVShare_{z,t}$) by the shift-share instrument ($SS_{z,t}$). Robust standard errors are reported in Columns (1) and (2) and municipality and zip-code level standard error clustering are applied in Columns (3) and (4), respectively. Standard errors are reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

investors. The effect is quite stable throughout the entire post-reform period. This evidence indicates that the Spanish golden visa programme has had a spillover effect on the real estate market in Spain.

Figure 4.12: Event Study on the Average Price Effect of Golden Visa Programme



Notes: This figure depicts the annual estimates from estimating Equation (4.4) instrumenting the golden visa share in 2012 ($GVShare_{z,t}$) by the shift-share instrument ($SS_{z,t}$). Standard errors are clustered at the zip-code level and 95% confidence intervals are plotted.

Table 4.4 compares the overall average price effect of the golden visa programme in coastal and non-coastal areas. In coastal areas, the coefficient of interest is significant, while it is not in non-coastal areas. Specifically, the coefficient of 0.081 translates to a 1.17% increase in the price index in coastal areas if exposure to non-EU golden visa transactions rises from 0% to the post-period average of 0.14%. This corresponds to an increase of 278 Euro, from the 2012 average price index of 23,735 Euro. The spillover effects on real estate prices of the golden visa programme have thus been concentrated in coastal areas.

4.7 Conclusion

This paper provides the first causal analysis of the economic effects of the golden visa programme on local real estate markets in Spain. Using rich administrative micro-level data on the universe of real estate transactions before and after the introduction of the Spanish golden visa scheme

Table 4.4: Average Price Effect of Golden Visa Programme

	OLS (1)	2SLS (2)	2SLS (3)	2SLS (4)
Panel A: Coastal Areas				
GVshare	0.000 (0.003)	−0.000 (0.011)	−0.000 (0.015)	−0.000 (0.010)
GVshare × Post	0.013*** (0.004)	0.081*** (0.013)	0.081*** (0.015)	0.081*** (0.015)
# of Observations	18,215	18,215	18,215	18,215
# of Zipcode	1,781	1,781	1,781	1,781
Mean of Dep. Var.	9.84	9.84	9.84	9.84
Adj. R-squared	0.691	0.018	0.114	0.114
Cragg-Donald Wald F statistic		19.97	22.14	22.14
rk Wald F statistic		4.47	140.31	17.24
Panel B: Non-Coastal Areas				
GVshare	0.006** (0.003)	0.011 (0.011)	0.011 (0.010)	0.011 (0.009)
GVshare × Post	0.008* (0.005)	0.243 (0.364)	0.243 (0.524)	0.243 (0.368)
# of Observations	61,248	61,248	61,248	61,248
# of Zipcode	7,382	7,382	7,382	7,382
Mean of Dep. Var.	9.11	9.11	9.11	9.11
Adj. R-squared	0.687	−0.114	0.021	0.021
Cragg-Donald Wald F statistic		0.04	0.05	0.05
rk Wald F statistic		0.95	1.89	0.70
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Zip-code FE	Yes	Yes	Yes	Yes
Cluster	Robust	Robust	Municipality	Zip-Code

*Notes: This table depicts the coefficients of interest from estimating Equation (4.4). Panel A reports the estimates for coastal areas, while Panel B reports the same estimates for non-coastal areas. Column (1) presents the OLS results, while Columns (2) to (4) displays the estimates from estimating the same Equation (4.4), but instrumenting the golden visa share ($GVShare_{z,t}$) by the shift-share instrument ($SS_{z,t}$). Robust standard errors are reported in columns (1) and (2) and municipality and zip-code level standard error clustering are applied in Columns (3) and (4), respectively. Standard errors are reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.*

in 2013, we show that the program effectively stimulated foreign real estate investment by non-EU investors. Our results indicate a significant increase in the volume of high-value real estate purchases by non-EU investors, with a stable and sizeable effect emerging a few years after the introduction of the programme. Moreover, these effects are stronger in coastal areas, which appear especially attractive to foreign real estate buyers.

We also find evidence of a "golden visa premium" around the 500,000 Euro investment threshold. Specifically, non-EU investors consistently pay higher prices for properties just above this threshold, relative to EU and Spanish investors, after controlling for property characteristics and location-specific factors. This premium likely reflects the willingness of non-EU buyers to outbid local purchasers in order to secure the residency benefits tied to qualifying real estate investments.

Beyond demonstrating the effectiveness of the Spanish golden visa program in boosting foreign real estate demand, we examine potential spillover effects on broader housing market outcomes. Our instrument variable strategy, leveraging non-EU investors' historical purchasing patterns of high value properties, suggests that rising foreign investment translates into moderate increases in local real estate prices – even when golden visa transactions are excluded. These spillover effects, however, are geographically concentrated and most pronounced in coastal municipalities.

From a policy perspective, these findings underscore the potential of investor visa schemes to attract foreign capital and stimulate real estate markets, particularly during economic downturns. However, the extent to which these programmes generate broader economic benefits, such as employment growth or rental market expansions, remains an open question. Our next step is to explore these dimensions to provide a more comprehensive assessment of the economic implications of golden visa programmes.

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Appendix A

Data cleaning procedure of the Spanish Registrars database

This section provides a detailed description of the data cleaning procedure we follow to arrive to the final sample of the Spanish Registrars database we use in the analyses. This database contains the universe of all real estate transactions that have been officially registered in Spain from 2003 until 2022. Most real estate transactions are registered by the Registrars, as they provide legal security to the buyer for a relatively low cost.

Our data cleaning procedure consists of the following steps:

1. We exclude real estate transactions that have missing data for the property’s surface area, transaction value, or contain nonsensical transaction dates.
2. We restrict our analysis to six types of urban real estate properties¹: specifically, apart-

¹Our dataset comprises properties classified into three main categories: (1) rural properties, which include dryland farming (agricultural land reliant on rainfall), irrigated land (agricultural land with artificial irrigation systems), rural housing (residential properties located in rural areas), rural agricultural buildings (structures used for agricultural purposes in rural areas), properties dedicated to agricultural production activities, and miscellaneous rural properties not classified above; (2) urban properties, which include apartments with additional spaces such as storage rooms or parking spaces, standalone apartments without additional attached spaces, terraced houses that share common walls with neighboring properties, detached houses, commercial properties used for activities like shops or restaurants, garages, offices, storage rooms, unbuilt land, industrial warehouses, other buildings, and urban development rights; and (3) other natures, including rights granted by government entities to use public property, buildings constructed for residential purposes, and properties that do not fit into the rural or urban categories.

ments with or without annexes, terraced houses, detached houses, commercial properties, and offices. We exclude public and state subsidized housing, keeping only properties sold at market prices without government-imposed price controls or subsidies. Additionally, we focus solely on transactions made by individual or corporate buyers, thereby excluding properties bought by various types of legal entities such as the national government, regional governments, provincial administrative bodies, island councils, associations of municipalities, municipal governments, and smaller local administrative units within municipalities. We also keep transactions involving purchase and sale agreements between parties, excluding those arising from barter, inheritances, or donations. We remove duplicate transactions—those recorded multiple times with the same location, price, house type, etc.—and retain only unique transactions in our sample. Since buyer nationality is crucial to our analysis, we retain only transactions where this information is available.

3. We exclude transactions containing inaccurate information regarding the municipality location.
4. We address outliers by trimming 1% from both the lower and upper tails of the following two main variables: value of the transaction and size of the property. This step ensures that the combination of value, size and price per square meter falls within reasonable ranges.
5. We also clean the zip code variable, as our empirical analysis in Section 4.6 requires zip code-level fixed effects. This was achieved through a multi-step process:
 - First, we remove transactions that either lack a meaningful street name or have missing zip codes.
 - Second, using a dataset that links municipalities to zip codes, we retain transactions with accurate municipality-zip code pairs and correct those in small municipalities with only one zip code.
 - Third, we web-scraped information on street names and corresponding zip codes for

every municipality and province in Spain from a website². We used this dataset to correct transactions with incorrect zip codes, provided the municipality and street name perfectly matched the scraped data.

- Fourth, for the remaining transactions, we applied fuzzy matching on street names against the web-scraped data to correct invalid zip codes. We retained matches with a similarity score higher than 0.7³ and, for cases with multiple matches, selected the one with the highest score for each municipality-street name combination.
- Finally, using transactions with verified municipality-street name-zip code combinations, we corrected the zip codes for the remaining transactions by matching them based on municipality and street names.

6. Finally, to study the spillover effects of the programme, we calculate the number of Golden Visa transactions for all neighboring zip codes of each zip code. Using both the geospatial file for zip codes in Spain and the zip code-municipality matching data, we achieve this task. It is important to note that zip code and municipality boundaries do not always align perfectly. A single zip code may span multiple municipalities, meaning its geographic coverage can cross municipal boundaries. First, we determine the relationship between zip codes and municipalities, checking whether a zip code is strictly contained within a municipality. If not, we calculate the intersection area between a zip code and a municipality. This process is applied to the zip code-municipality geo-matched dataset to verify which pairs are correctly or incorrectly matched. For zip codes with missing municipality information after the initial matching step, we perform a spatial join to attach the nearest municipality to each zip code. For those remaining zip codes that do not have a correct municipality pair, we determine their nearest municipality using calculated spatial distance. Once the zip code-municipality pairs are established, we can

²<https://codigo-postal.info/>

³When selecting the threshold for the similarity score, there is always a trade-off. A higher threshold results in fewer matched observations but a lower false positive rate, while a lower threshold increases the number of matched observations at the cost of a higher false positive rate. In Table A.3, we report the number of fuzzy-matched pairs between street names from the Registrars dataset and the web-scraped dataset, using thresholds ranging from 0.5 to 0.9. From these fuzzy-matched pairs, we randomly retain 1% of the sample for manual validation to assess the false positive rate, with the results documented accordingly. To strike a balance between maximizing matched pairs and minimizing the false positive rate, we select a similarity score threshold of 0.7

then identify all neighboring zip codes for each pair.

7. We limit our analysis to the period from 2008 to 2019. We exclude years 2003 to 2007, since they do not contain full information on nationality, which is the key variable we need to evaluate the programme. We also exclude the period from 2020 onward to avoid the confounding effects caused by the significant decline in real estate transactions during the COVID-19 pandemic.

As a result, our cleaned final sample, consisting of transactions with correct zip codes, comprises 3,878,873 observations, representing 13.17% of the original raw Registrars sample. Table [A.1](#) summarizes the data cleaning process. Table [A.2](#) describes the final number of observations we use every single year, the total number of municipalities covered, as well as the overall population share they represent.

Table A.1: Registrars data cleaning procedure

Steps	Observations	Share
Raw data	29,448,422	100.00%
Keep properties with non-missing transaction values	29,420,357	99.90%
Keep properties with positive surface area	28,541,171	96.92%
Keep properties with valid transaction dates	27,713,578	94.11%
Keep urban housing properties	14,572,968	49.49%
Keep free housing transactions	11,944,125	40.56%
Keep transactions involving individuals or corporate buyers	11,928,027	40.50%
Keep purchase and sale transactions	9,228,489	31.34%
Keep unique transactions	8,963,141	30.44%
Keep transactions with known buyer nationality	6,537,356	22.20%
Keep transactions with accurate municipality information	6,536,726	22.20%
Trim property values at the 1st and 99th percentiles	6,406,125	21.75%
Trim property sizes at the 1st and 99th percentiles	6,278,019	21.32%
Keep transactions with nonzero zip codes and non-missing street names	6,233,068	21.17%
Keep transactions with corrected zip codes	6,160,184	20.92%
Keep transactions from the years 2008 to 2019	3,878,873	13.17%
Final data	3,878,873	13.17%

Notes: This table outlines the different steps taken to clean the Spanish Registrars database, detailing the number of remaining observations at each stage and the corresponding percentage of the initial raw sample retained.

Table A.2: Annual Real Estate Transactions

Year	Total	Municipality	Population
		Covered	Share
2008	389,035	5,610	98.49%
2009	317,965	5,312	98.28%
2010	348,394	5,453	98.46%
2011	238,495	5,173	98.04%
2012	259,855	5,028	97.97%
2013	214,900	4,898	97.76%
2014	261,692	5,153	98.14%
2015	288,122	5,231	98.32%
2016	331,197	5,396	98.47%
2017	394,172	5,570	98.67%
2018	433,496	5,693	98.83%
2019	401,550	5,639	98.82%
Total	3,878,873		

Notes: This table presents the total number of annual real estate transactions (column 1) and the corresponding number of municipalities covered each year in the dataset (column 2). Column 3 reports the percentage of the population covered for each year.

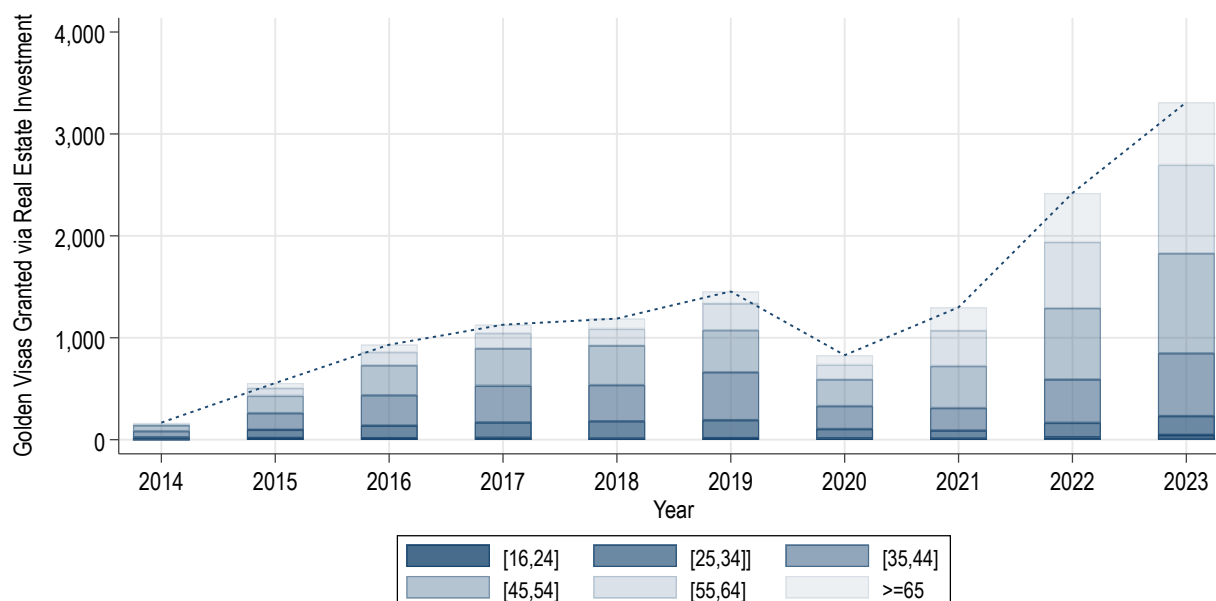
Table A.3: Registrars street name fuzzy matching threshold comparison

Similarity Score Threshold	Observations	1% Random Sample	False Positive Rate (%)
0.5	35,591	356	27.0
0.6	27,927	279	16.8
0.7	19,888	199	9.5
0.8	11,660	117	4.3
0.9	3,820	38	0

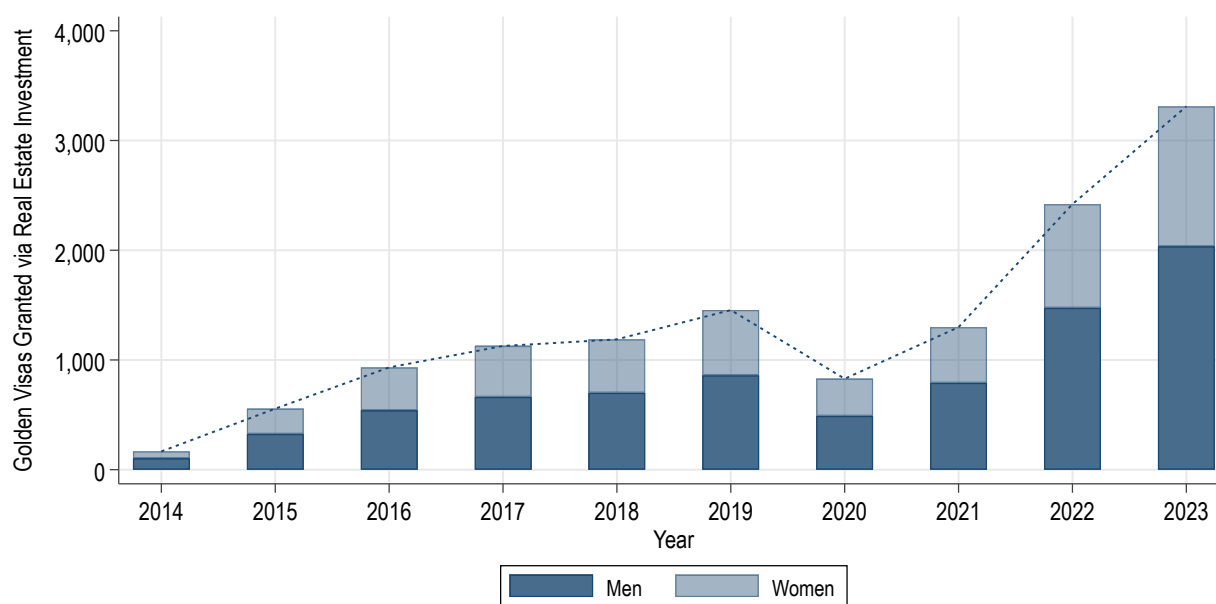
Table A.4: Summary Statistics, 2012

Variables	N	Mean	Std.Dev	Min	Max
Panel A: Transaction-level characteristics					
Whole Sample:					
Value	259,855	139,865	106,913	6,800	925,000
Surface	259,855	98	50	29	363
Price per sqm	259,855	1,519	994	19	20,087
Loan-to-value(%)	259,855	23	38	0	150
Non-EU Countries:					
Value	9,550	150,706	128,131	6,808	910,000
Surface	9,550	95	50	30	362
Price per sqm	9,550	1,590	1,051	40	11,401
Loan-to-value(%)	9,550	25	38	0	150
EU Countries:					
Value	18,027	162,037	131,103	7,200	925,000
Surface	18,027	97	54	29	362
Price per sqm	18,027	1,708	1,039	57	16,051
Loan-to-value(%)	18,027	10	27	0	150
Spain:					
Value	232,278	137,698	103,590	6,800	925,000
Surface	232,278	98	50	29	363
Price per sqm	232,278	1,502	987	19	20,087
Loan-to-value(%)	232,278	24	39	0	150
Panel B: Municipality-level characteristics					
Whole Sample:					
Number of Municipalities	5,028				
Population Covered(%)	5,028	98	0	98	98
Income pca	2,810	6,276	2,401	1,155	23,608
Property tax rate(%)	4,667	61	16	10	123
Non-EU Countries:					
Number of Municipalities	811				
Population Covered(%)	811	68	0	68	68
Income pca	709	7,138	2,608	1,734	23,608
Property tax rate(%)	766	67	19	29	123
EU Countries:					
Number of Municipalities	922				
Population Covered(%)	922	68	0	68	68
Income pca	805	6,936	2,670	1,973	23,608
Property tax rate(%)	878	66	18	29	123
Spain:					
Number of Municipalities	4,990				
Population Covered(%)	4,990	98	0	98	98
Income pca	2,798	6,285	2,398	1,155	23,608
Property tax rate(%)	4,631	61	16	10	123

Figure A.1: Golden visas granted via real estate investments



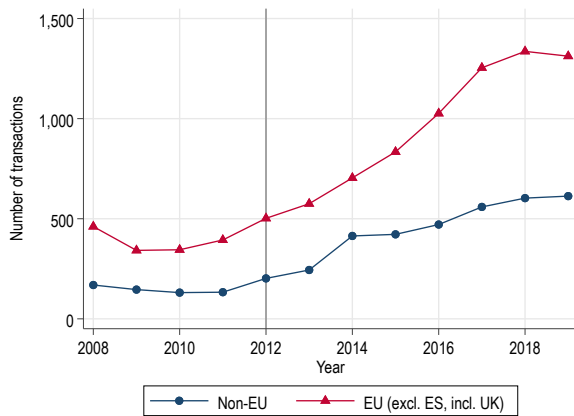
(a) By age group



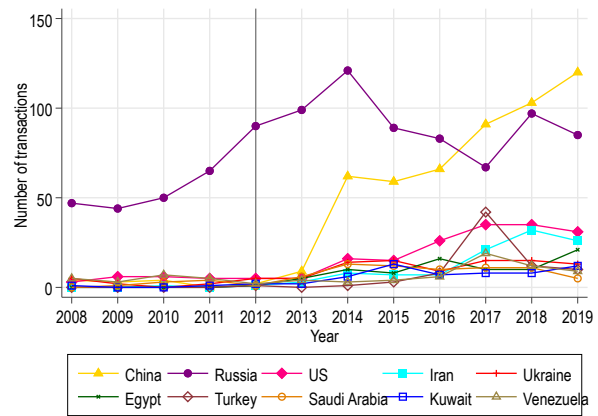
(b) By gender

Notes: This figure depicts the annual evolution of golden visas initially granted to primary applicants through real estate investments in Spain from 2014 to 2023, decomposed by (a) age group and (b) gender. The data is sourced from [Observatorio Permanente de la Inmigración \(OPI\)](#).

Figure A.2: Real estate transactions above 500,000 Euro excluding mortgages in Spain



(a) Non-EU vs. EU



(b) Top 10 Non-EU

Notes: This figure presents the evolution of real estate transactions above 500,000 Euro excluding mortgages over the period 2008-2019 in Spain. Panel (a) compares the evolution of transactions between non-EU and EU investors. The EU investors group excludes transactions made by Spaniards, but includes all transactions made by UK nationals (as the UK was still part of the EU during that period of time). Panel (b) shows the evolution of these high-end real estate transactions for the top 10 nationalities of non-EU investors. The top 10 nationalities are obtained based on the counts of golden visas investments in real estate over the post-reform period (28 September, 2013 up to 31 December, 2019) using registrars dataset.

Figure A.3: Urban Real Estate Transactions Using Own Capital (Price $\geq 500,000$ Euro, Excluding Mortgage) By Spaniards, 2008-2019 (Normalized to 2012)

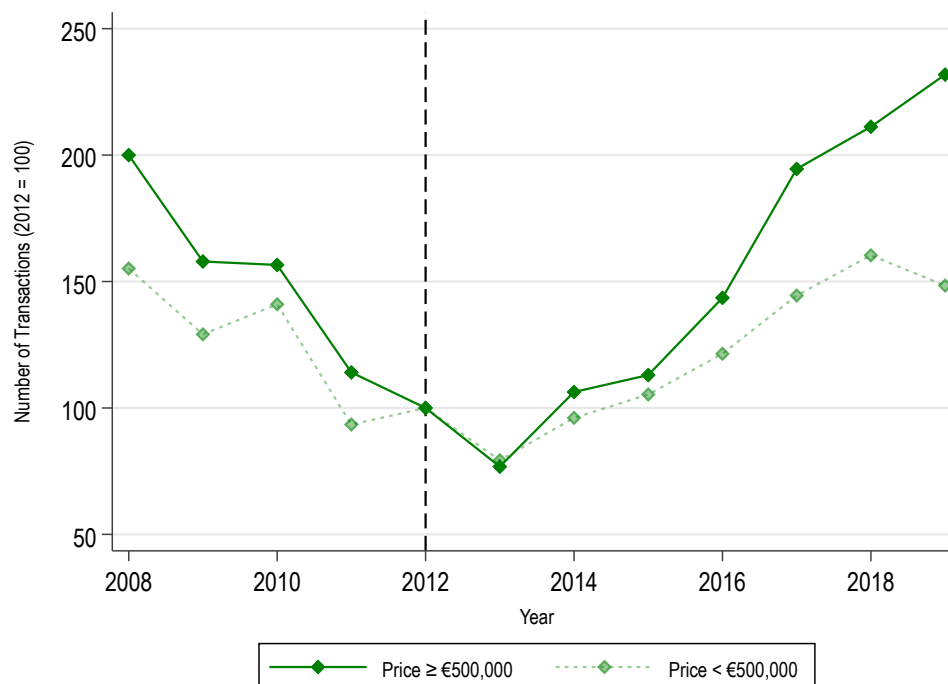


Figure A.4: Comparison of Urban Property Price Distributions for Spain Before and After 2013 (Bin Size: 5,000 Euro)



Figure A.5: Post-2013 Price Distributions of Urban Properties: A Comparison Between EU and Non-EU Countries

