The Interoperability of Financial Data

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Abstract

This paper studies how data interoperability — third-party direct access to customers' financial information — affects competition and welfare in the finance sector. Our model reveals a trade-off: while sharing customer data improves competition in information intensive services like credit, it may increase prices of data-generating services like payments. We show that targeted data-sharing regimes (e.g., Open Banking) preserve the ability of banks to extract surplus by shifting market power from credit to payment markets. Although some firms benefit in aggregate from increased competition, others are left worse off by changes in prices. Wider-reaching data-sharing initiatives (e.g., Open Finance) further level the playing field and diminish banks' capacity to monetize their data, reallocating surplus toward firms and alternative lenders. Our findings underscore the need to account for cross-market spillovers when designing policies that regulate access to financial data.

Keywords: Data sharing · Banking · FinTech · Credit · Payment · Information spillovers.

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1 Introduction

Information plays a key, yet ambiguous, role in financial services. On the one hand, information asymmetries between firms and investors limit firms' capacity to access external funding. On the other hand, exclusive access to a firm's sensitive information allows for rent extraction. In the modern economy, information is mainly stored in the form of data. The conditions around production, access, and consumption of financial data are, therefore, key to balance market failures, economic incentives, and competition.

In this paper, we study how the overall interaction between (i) incentives to produce financial data and (ii) benefits from processing such data impact the funding capacity of firms. In particular, we analyze how both supply and demand for financial services are affected by different levels of information-sharing regimes. Key to our approach is the information spillover between services that produce financial data and services that consume it. For instance, lending - a data-driven financial service - benefits from accessing payment accounts - a data-producing financial service - as the latter improves the information-intensive process of monitoring borrowers (Puri et al., 2017; Ghosh et al., 2021). If data is not shared, spillovers between the two vertical services can only be captured by integration (e.g., a bank offering both credit and payment services). When data can be shared, alternative investors can access data produced by any data-producing service - not only their own - in order to support their monitoring capacity. Different data sharing regimes can therefore directly impact how credit market surplus is generated and shared across firms and investors.

Around the world, public and private initiatives are emerging to lower information barriers and to take full advantage of financial data. These so-called *open data* initiatives aim to facilitate data exchange within and between industries. They have been particularly influential in the banking industry, commonly referred to as *Open Banking* (OB). 95 jurisdictions around the world have current OB efforts at various stages of development, while 54 of these also undertake effort towards implementing *Open Finance* (OF), that is, an expansion of data sharing mandates to the rest of the financial ecosystem (CCAF, 2024). The primary goal behind these initiatives is to enable financial clients to share their data with third parties to promote competition and facilitate new business opportunities (e.g. FinTechs).[1]

Despite the appeal of open data, the design of a dominant solution across the production and consumption of financial information is not straightforward, specially when incentives to generate data stem from the gains of its exclusive use. Current data-sharing policies primarily impose infrastructure and compliance costs on financial institutions while simultaneously aiming to increase competition against them, thereby eroding their revenues from data-driven services. This dynamic risks disincentivising efforts to produce valuable financial data in the first place, ultimately undermining the very purpose of open data initiatives.[2] As a result, the overall welfare effects of data sharing remain uncertain if information spillovers are not properly accounted for. This paper seeks to address this ambiguity.

The model. We develop a general equilibrium setting with information spillovers to analyze the economic impact of different data sharing regimes. The novelty of our approach owes to an emphasis on the outcomes of *data-interoperability* - rather than *data-portability*. [3] Data interoperability unlocks new services that rely on synchronized access to data (e.g., monitoring of payment behavior) which are not economically feasible under discrete data transfer settings (i.e., data portability). According to this distinction, we formulate our main friction as a moral hazard problem driven by monitoring incentives. Whereas previous work focused on adverse selection issues in the context of data-sharing for screening (Parlour et al., 2022; He et al., 2023; Babina et al., 2024) - and to the best of our knowledge - this model is the first to treat the interoperability dimension of financial data sharing.

For sake of clarity, our presentation consists of (i) a payment services market where data

[1] For instance, Babina et al. (2024) shows that adoption of OB increases venture capital investment in FinTech start-ups across a wide range of services such as financial advice applications, credit, payments, and regtech.

[2] A 2023 industry survey across OECD countries reports that Open Banking challenges banks' incentives to engage in the costly task of processing and storing data (OECD, 2023b). A recent joint statement by European financial industry associations argues that the costliness of the policy may divert resources away from innovation, reducing the EU's long-term competitiveness in the financial sector (EBF, 2024). Similar concerns, among others, were echoed by the French government, reportedly leading to the postponement of FiDA, the upcoming EU regulation for Open Finance (Faggionato and Pollet, 2025).

[3] Data interoperability refers to a synchronized data sharing protocol where live data can be retrieved, processed and operated continuously by any authorized third party. In contrast, data portability refers to the capacity for clients to share their historical data with third parties. While historical data may be sufficient for screening (e.g., loan applicants), monitoring requires continuous supervision of activity. Therefore, third-party access to monitoring hinges on data interoperability rather than data-portability.

is produced and (ii) a market for business loans where payment data can be used for loan monitoring. However, the analysis holds significance for other applications where similar information spillovers prevail. Such an example could be found in the context of sensory data (e.g., health) and insurance schemes.

The financial system in our model revolves around two markets: payments and credit. Each market consists of two competing entities. In both markets, an integrated financial institution is present, henceforth *the bank*. In each separate market, the bank faces a specialized non-bank competitor – a payment and a credit institution, that operate exclusively within their respective business lines. Firms are endowed with heterogeneous equities and identical investment projects for which external funding is required. Firms are subject to moral hazard à la Holmstrom and Tirole (1997) which creates financing frictions in the form of credit rationing. In order to limit moral hazard, investors can supervise a firm's effort by monitoring its transaction data, which is collected and stored by the firm's payment provider. Payment providers offer a uniform price for their services.

This minimal setting allows us to explicitly address the tensions between the data-producing and data consumption as a function of market structure and data-sharing regimes. For ease of presentation, we will refer to the non-bank competitor in the payment market as the *FinTech payment provider* and the non-bank competitor in the credit market as the *FinTech creditor/lender*.

Data-sharing regimes. While a bank can always monitor its own payment clients using internal data, this is not necessarily true of other configurations. The data regime in place determines which investor can access which data source. In turn, the nature of the regime shapes the general equilibrium outcomes.

In line with current developments worldwide, we distinguish between three data-sharing regimes. The first is *no data sharing* where data can only be accessed by the original producer, that is, the bank. The second regime emulates OB initiatives and requires banks exclusively to share their data with other creditors. In this case, firms that use the bank's payment service can give the FinTech lender access to their payment information while those that use FinTech payments cannot do so. The third regime we consider applies to a wider scope of data producers in the spirit of OF. In this case, firms can share payment information with all creditors regardless of their payment choice.

Finally, we consider a last setting in which the bank competes in the payment market with a public payment provider that allows data sharing, similar to the government issuing a Central Bank Digital Currency (CBDC).[4] This setting allows us to study the interaction between two important policy initiatives, i.e. Open Data and CBDC, and offer design guidance in their interrelated implementations.

Main findings. Our main results rest on two opposing effects of data interoperability: while (i) it makes the credit market more competitive, (ii) it also increases the prices of payment services. The intuition is as follows. When data cannot be shared, firms constrained by moral hazard can only access financing if they are payment clients of the bank, as the bank is always capable of monitoring its own clients. Data-sharing allows the FinTech lender to compete for these firms. By increasing competition in the credit market, data-sharing allocates weakly more surplus toward the firms that receive credit. However, this first-order effect originates externalities on the payment market. Under OB, the increase in the loan surplus of the bank's payment clients increases the overall demand for the bank's payment services. At the same time, the loss of information rent in the credit market reduces incentives for the bank to subsidize payment services, thus reducing its supply. Together, both effects lead to a more expensive payment service. Under Open Finance, if the value of payment data is sufficiently large, the price of payment services increases for both the FinTech payment service and the bank.

The population of firms is therefore differentially affected by the opposing effects of data-sharing. The two main types of beneficiaries are the firms that increase their credit surplus and the ones that would otherwise not obtain funding. The former set is composed of firms who benefit more from monitoring than they lose out from the increase in payment price. The latter results from the fact that data sharing addresses an inefficiency resulting

[4]As of March 2024, 134 countries, representing 98% of the global GDP, are exploring CBDC. There are 36 ongoing pilots including the EU, Brazil, Russia, India, China and South Africa. 19 of the G20 countries are now in the advanced stages of CBDC development (For an up-to-date reporting, see the CBDC tracker by Atlantic Council).

from the pricing constraints of the bank. The intuition is as follows. In the no-data sharing equilibrium, some firms are credit rationed while the bank can generate positive overall surplus by serving them. These firms would benefit from monitoring but still chose the alternative payment option making them ineligible for external funding. This happens because the bank cannot credibly commit to share surplus with such firms. In order to do so, the bank would have to offer them either reduced loan rates in the credit market or a reduced price for its payment service. However, the bank can do neither. The former is infeasible because a monopolist bank cannot credibly commit to charge favorable rates to its borrowers ex-post. The latter is infeasible due to the uniform pricing constraint on the payment market. Given these constraints, some firms remain credit rationed despite their potential to generate positive economic surplus. When a data-sharing regime comes into place, these firms are offered competitive credit rates, eliminating the bank's commitment problem and increasing demand for the bank's payment service. As a result, data sharing generates additional surplus by enabling more projects to be implemented.

While the overall net benefit for firms may dominate in general, the price effect of data-sharing on the payment market can be so large as to counteract the gains from competition in the credit market and result in a net negative outcome for firms. In particular, firms that do not benefit from monitoring (i.e., highly constrained firms that would always be rationed and capital rich firms that do not need monitoring to access credit) are hurt when the only effect on them is the increase in the price of payments. Under OB, there is an additional set of firms that is worse of. These are firms which do not get funded in the presence of the data-sharing regime. They are characterized by two conditions: (i) in absence of data-sharing, they obtain a large share of the credit surplus and (ii) they have a low valuation of the bank's payment service. As such, these firms are particularly sensitive to an increase of the bank's payment service price. Under OB, the bank recoups the credit surplus that is lost by increasing the price of its payment service. As a result, these firms prefer the FinTech payment option and their projects are rationed under OB.

Regarding the effects of introducing data-sharing for the bank, we find that growth in revenues from increasing payment prices may be larger than the profit losses from increased competition in credits. As such, banks may stand to gain from data sharing overall, even when it reduces revenues from credit provisioning, in particular. Our results also suggest that the FinTech payment provider would remain unaffected by OB whereas it would strictly benefits from OF.

When comparing OB and OF outcomes, we find that OF leaves banks worse off than the OB regime while both firms and the FinTech payment provider become strictly better off under OF. The intuition is that, under OB, banks benefit from being the exclusive gateway to data-driven services by (partially) transferring their rent extraction capacities from credit to payments. This mechanism is however muted when OF applies.[5] As a result, banks strictly prefer OB over OF while firms and Fintech payments strictly prefer OF over OB.

Our final finding relates to the interaction between data-sharing mandates and the provision of a public payment service (e.g., CBDC) that would allow data sharing. We find that, in the presence of such an interoperable CBDC, banks strictly benefit from data-sharing. Such an outcome, however, results in a reduction of aggregate firm surplus despite improving overall welfare. These findings indicate that certain CBDC design choices may not only render data-sharing mandates obsolete - as the banks themselves would voluntarily engage in data sharing - but also render such practices undesirable from a social perspective.

Taken together, our results underscore the importance of accounting for cross-market spillovers in evaluating the overall effect of information sharing policies. They also highlight the importance of accounting for the interaction between policies that target the same markets in evaluating their broader welfare impact.

Related literature. Our paper contributes to several strands of the literature. First is the role of information production and sharing in credit. Previous works have studied information acquisition through relationship lending in which banks have incentives to subsidize activities that produce information on borrowers for establishing informational barriers to entry (Dell'Ariccia et al. (1999), Dell'Ariccia (2001)) and facilitating future rent extraction. The latter has first been demonstrated by Sharpe (1990) in the form of subsidized loans to new borrowers and then by Hauswald and Marquez (2006) in the context of the investment

[5] Technically, this mechanism is possible as transaction costs still leave room for some rent extraction. It is however much smaller when the benefits of the two payment services become identical.

choice of banks in screening technology. These analyses further indicate that subsidization of information production results in inefficiencies, either by improving credit access to high-risk borrowers or by leading to overinvestment in screening technologies from a social welfare perspective. By contrast, our results rest on information acquired from payment services where a different source of inefficiency applies: the uniform pricing constraint on the payments market. Accordingly, we find that banks benefit from subsidizing payment accounts among firms in need of monitoring for financing. However, as banks set a single price for all payment accounts, this results in over-subsidization of certain firms and under-subsidization of others where the latter results in credit rationing for projects with positive NPV.[6]

Other works also studied how competition in the credit market affects banks' incentives to subsidize information producing activities (e.g., Petersen and Rajan (1995) and Marquez (2002)). In contrast with these learning by lending frameworks, our modelling of information spillovers from payments to lending reveals an additional effect of competition driven by data-sharing, i.e. enhancing demand for payment services by allowing banks to commit to not exploit their access to data for rent extraction in the credit market.[7]

A related literature analyses the incentives for banks to share information acquired about their customers with other competitors. In a landmark paper, Padilla and Pagano (1997) show that information sharing among banks benefits them by disciplining borrowers to exert high effort on projects. More recently, Castiglionesi et al. (2019) show that information

[6]A similar distortive impact of uniform pricing is displayed in Bouvard et al. (2022) where an e-commerce platform extends financing to its merchants alongside a traditional bank. Merchants with insufficient collateral are credit rationed in the traditional banking system whereas the platform is able to align incentives by offering cheap loans to these merchants and compensating for it by increasing the fee of the platform service. The uniform fee hike however applies to all merchants and forces some marginal high collateral merchants to switch from unmonitored bank loans to monitored platform loans, creating inefficiencies.

[7]This observation also connects our study to the industrial organization literature on sequential bundling and second-sourcing. This literature demonstrates that when a manufacturer has exclusive control over the supply of a main component (e.g. a car) and the aftermarket goods (e.g. spare parts of a car) a dynamic consistency problem arises. Consumers anticipate being locked in by the manufacturer and experiencing price gouging in the aftermarket. The manufacturer would benefit from being able to commit not to do so, but it cannot make such a commitment credibly. This anticipation reduces consumers' willingness to pay for the main component. In this case, the manufacturer may in fact benefit from inducing competition in the aftermarket, i.e. enabling second-sourcing, in order to credibly commit to an aftermarket with reasonable prices (Farrell and Gallini, 1988), high service quality (Shepard, 1987) or better product variety (Kende, 1998). Our analysis illustrates that credit market competition induced by OB can serve as a 'second-sourcing' strategy and benefit banks overall.

sharing also helps maintain asset market liquidity by mitigating adverse selection in secondary markets for loans. Closer to our application are credit market models with information frictions and switching costs such as Bouckaert and Degryse (2004) and Gehrig and Stenbacka (2007). Both models show that information sharing may benefit banks by eliminating the ex-post lock-in, thereby softening competition for new borrowers. Particularly, Bouckaert and Degryse (2004) show that a bank may prefer sharing information without reciprocity. This last result echoes insights from our model showing that banks are better off under an OB regime - where they remain sole producers of borrower-based information - rather than an OF regime. Most recently, Brunnermeier and Payne (2024) examine information sharing incentives of banks and platforms when the two competes in lending and the latter provides the only medium for trade. They conclude that, unlike banks, platforms are strictly in favor of information sharing as it indirectly improves the trade volume on the platform by supporting credit expansion. Their analysis suggests that platform lobbying is likely to be an important driver of policies promoting more information sharing between the financial sector and platforms.

The information spillover we model leverages a longstanding literature documenting the informative value of payment data in assessing and managing credit risk. The checking account hypothesis (Nakamura et al., 1992) - with origins dating back to Black (1975) and Fama (1985) - argues that borrowers' checking accounts contain valuable information that can be leveraged for improved screening and monitoring. Recent empirical studies support this hypothesis by demonstrating the predictive power of borrowers' credit line usage, limit violations, and cash inflows on default risk (Norden and Weber, 2010), the value of access to high frequency transaction data in assessing loan collateral value (Mester et al., 2007) and of historical transaction data in providing a baseline for a more accurate evaluation of borrowers' current financial standing (Puri et al., 2017). Lastly, Ghosh et al. (2021) provides empirical evidence of a reinforcing loop between transaction data and lending quality for Indian commercial loans.

The core of our analysis ultimately belongs to the more recent and growing literature studying the impact of data-sharing policies in banking and finance. Through a cross-country analysis, Babina et al. (2024) present early empirical evidence that Open Banking promotes FinTech entry and improves access to financial services for both consumers and SMEs. Assuming that FinTechs have access to superior screening technology, He et al. (2023) theoretically show that OB may overpower FinTech to the point of deteriorating market competitiveness. In a discrete choice model with firm entry, Babina et al. (2024) show that OB unambiguously increases competition and innovative entry, while it may end up hurting risky or privacy-concerned borrowers. Both He et al. (2023) and Babina et al. (2024) ultimately argue that in the presence of privacy-conscious borrowers and adverse selection, the signaling effects of opting out of OB distorts market dynamics and reduces total economic surplus.[8]

In contrast to OB studies, Parlour et al. (2022) focus on the exchange of data from FinTechs to banks. Also, considering an adverse selection scenario in a credit model, the authors study the impact of a monopoly bank's loss of information due to the entry of FinTech payment services. They show that allowing FinTechs to sell payment data back to the bank dominates a customer-centric voluntary data sharing regime for two reasons: revenues from data sales help subsidise FinTech payment services while voluntary data sharing is subject to unravelling.[9]

Overall, these works have studied the adverse welfare effects stemming from data-sharing primarily due to concerns over signaling, unravelling and privacy. In contrast, our results abstract from such frictions and focus on another channel through which welfare may be affected: the interaction between data producing activities and the consumption of such data in financial services. Our results show that data-sharing regimes affect both the demand and

[8]Other noteworthy studies on data sharing in banking have showcased additional channels of interaction between the governance of financial data and consumer welfare. Goldstein et al. (2022) shows that, in a framework where maturity transformation leads to a feedback loop between bank financial cost and bank investment, adopting OB may lead to inefficient resource allocation, although improving borrower welfare. Ahnert et al. (2022) studies the joint choice of payment methods and distribution channels by merchants where online distribution generates higher sales but requires using digital payments that leave a trail of information that can be used by the bank to extract rent from the merchants during lending. They find that a digital payment means that allow for user control over data sharing improves welfare by enabling sellers to get the best of both worlds.

[9]Brunnermeier and Payne (2023) present another - yet less related - rationale for why empowering platform users over the control of their data may not be optimal in a contested market setting. They illustrate that platforms with their own currency/ledger can expand uncollaterized lending by contracting upon sellers' future stream of revenue by means of smart contracts. When given the opportunity, sellers that migrate to a new platform choose not to bring this contract with them to the new platform in order to default more easily. This, in turn, destroys the incumbent platform's incentives for supplying uncollaterized loans in the first place.

supply of data production services (i.e., payments). Under our moral hazard framework, our results therefore suggest that data-sharing policies may deteriorate consumer welfare even when their first order effects are weakly positive and unraveling is absent.[10]

The remainder of the paper is organized as follows. Section 2 presents further institutional background on open data initiatives around the world. Section 3 introduces the model. Section 4 studies a benchmark setting with no data interoperability. Section 5 studies the effect of introducing different data regimes on the economy and section 6 studies the interaction between data sharing initiatives and the provision of an interoperable public payment provider. Section 7 concludes.

2 Institutional background

The Open Banking movement was pioneered by the UK in 2017 with a mandate by the Competition and Markets Authority (CMA) which initially applied to the nine largest UK banks. This initiative was soon followed by other early adopters such as Australia, Hong Kong and the EU, and since then, spread across the world including emerging economies such as Brazil, Nigeria and Thailand. The most commonly cited objective for adopting OB is to enhance competition within the financial services industry, alongside secondary objectives such as fostering innovation, promoting digital and financial inclusion (most notably in emerging countries) and enhancing consumer protection (CCAF, 2024; Babina et al., 2024) [11]. OB lowers informational barriers to entry into markets for financial services, creating new business opportunities for FinTechs [12]. For consumers, it implies an improved

[10] In a generic framework, Krämer et al. (2021) also study data policies in the presence of cross-market information spillovers. They examine a model where an integrated firm provides both data-producing and data-consuming services, and competes with a specialized firm in the latter. They find that the welfare maximizing data policy involves complete data-sharing but no data-siloing. In contrast to our framework, both firms' innovation incentives play a key role in their analysis.

[11] For instance, India, where a significant share of the population is still unbanked, prioritizes the financial inclusion aspect of OB whereas the UK's priority is to tackle adverse effects of market concentration in its banking sector.

[12] A cross-country analysis by Babina et al. (2024) shows that adoption of OB increases venture capital investment in FinTech start-ups across a wide range of services such as financial advice applications, credit, payments and regtech.

customer experience [13], higher security standards, lower prices and financial inclusion [14]. From a regulatory standpoint, it has the potential to improve efficiency of supervision and compliance by complementing regtech and suptech (World Bank, 2022). Other expected benefits of OB include stimulating economic growth by supporting SMEs' access to a wider range of financial services alizing the informal economy, strengthening financial sovereignty by reducing reliance on international card schemes and enhancing market integrity (CCAF, 2024).

Countries with different regulatory capacities, market dynamics, and digital infrastructures show considerable variation in their motivations for adopting OB as well as their design choices in policy implementation. A key policy design decision is whether to adopt a regulation-led approach or a market-driven one. The former is naturally more effective in leveling the playing field in data sharing, however it imposes a disproportionate compliance burden on smaller players. This approach requires a robust legal, institutional and technical capacity (Plaitakis and Staschen, 2020) and is more often favored by countries where a few incumbent financial entities control access to data (OECD, 2023a). A market-led approach, on the other hand, is likely to be favored in the absence of such capacity or when the desired policy direction already aligns strongly with commercial incentives (Plaitakis and Staschen, 2020). According to CCAF (2024), around two thirds of the jurisdictions with OB efforts - with an overwhelming presence in Europe, Central Asia, the Middle East and North Africa - currently opt for a regulation-led approach while the remaining one third - more present in Sub-Saharan Africa and Asia Pacific regions - adopts for a market driven one. That being said, OB strategies around the world are still actively in the making. Accordingly, 18 jurisdictions where OB first developed by market efforts are currently in a gradual transition towards regulatory frameworks, two notable examples being the U.S and New Zealand.

Another important design choice for OB is whether to ensure technical standardization. On one hand, enforcing technical standards on businesses goes against the princi-

[13] Babina et al. (2024) notes financial advice, credit, identity verification, savings, accounting, automatic overdraft borrowing, and financial product suggestions among the emerging use cases of OB.

[14] Babina et al. (2024) also show that using OB for financial management purposes is associated with greater financial knowledge among consumers while using it for loan seeking is associated with greater access to credit products.

ple of technology neutrality adopted by most countries (OECD, 2023b). Moreover, it brings along additional challenges for efficient regulation and supervision, and raises barriers to adoption for smaller data holders by raising integration costs (EU Commission, 2022). On the other hand, harmonization of API standards facilitates system interoperability and lowers barriers to entry for smaller TPPs that lack the resources to adapt to multiple systems (OECD, 2023a,b). Standardization may also improve the robustness and convenience of customer experience and help build trust, which in turn may accelerate innovation and FinTech entry (FCA, 2021) [15]. Countries demonstrate considerable variation in their approach to standardization. While a big majority of the countries with a regulation led approach opt simultaneously for mandatory data sharing and establishment of technical standards, there also exist cases, albeit less common, that adopt only one of these design principles but not the other. For instance, several countries in the Asia Pacific regions prioritize establishing clear technical standards without necessarily imposing a mandate for data sharing. On the opposite end, the EU, while mandating data sharing for certain financial entities, did not set any technical standards until recently. Notably, the EU is preparing to change this approach with the upcoming PSD3 directive and issue technical standards in order to drive adoption and inclusion [16].

Another policy design aspect, often referred to as 'data reciprocity', concerns whether all entities that benefit from data sharing are in turn obliged to share their data as well. OECD (2023a) suggests that data reciprocity, especially across different sectors, can be instrumental in incentivizing data-holders to undertake costly API development and leveling the playing field among different players. Banking industry raises concerns regarding the unfair competition effect of asymmetric information sharing, especially by overempowering BigTech that already hold exclusive access to large amounts of user data (Faggionato and Pollet, 2025). Regardless, currently only a minority of jurisdictions, e.g. Brasil, Germany and Turkiye, enforce data reciprocity and a few more, Canada and Chile, are planning to move in that direction. However, an overwhelming majority of data sharing man-

[15] Babina et al. (2024) shows that higher levels of consumer trust towards FinTech services is associated with higher venture capital investment in the FinTech industry post-OB adoption.

[16] See https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3543fordetails.

dates around the globe still apply exclusively to 'Account Information Service Providers' which constitute mostly of banks (OECD, 2023b; Babina et al., 2024).

Receiving financial compensation in return of sharing data is considered another strong incentive for banks to develop high quality APIs (OECD, 2023a). Yet, another equally important policy objective is not to deprive SMEs from access to data due to financial limitations and protect TPPs in general from anti-competitive behaviours. Data-sharing frameworks around the world demonstrate great diversity. A third of OECD countries allow charging TPPs for data access (e.g. US, Japan) while another third mandates free data sharing (e.g. Chile) and the remaining third adopts hybrid approaches (OECD, 2023b). Notably, the EU - which initially prescribed data sharing without financial compensation - is planning to allow banks to charge TPPs for access to data with its upcoming regulatory update. This new framework is to follow a principle of proportionality such that the compensation required from SMEs will be capped at cost to ensure inclusivity (EU Commission, 2022).

3 Model setup

Our economy consists of a unit mass of firms with financial constraints and a financial system that provides two services: payment accounts and credit. The financial system includes a 'universal' bank that offers both services under one roof, as well as specialized non-bank entities – a FinTech payment provider and a FinTech lender – that operate exclusively within their respective business lines.

Firms. Firms have access to an identical, indivisible project that requires one unit of funding. Each firm is endowed with heterogeneous equity, $k \in [0,1]$, distributed according to $F(k)$. Consequently, all firms require external funding to implement their projects. Projects yield a gross return of $\phi > 1$ if they succeed and zero if they fail. Following Holmstrom and Tirole (1997), firms are subject to moral hazard: the probability of success depends on the effort exerted by the firm, which is not contractible. Let $s_i \in \{0,1\}$ denote whether firm i shirks (i.e., exerts low effort) or not. If a firm exerts high effort ($s_i = 0$), the probability of project success is ρ_H, whereas with low effort ($s_i = 1$), the probability is ρ_L where $\rho_L < \rho_H$.

Shirking provides firms with private benefits b_m, the size of which depends on the lender's monitoring decision, denoted by $m \in \{0,1\}$. When the project is monitored, $m = 1$, the private benefits are lower: $b_1 < b_0$.

Payment providers. Prior to seeking credit, each firm chooses a payment provider. Let $\theta \in \{b, ft\}$ denote the chosen provider where b is the bank and ft is the FinTech. The total surplus a firm derives from using a payment service has two components. The first is a homogeneous component, $u > 0$, which is identical and positive for all digital payment options. The second is a heterogeneous taste component, given by $\tau \cdot x_i$, where τ is a Hotelling parameter and x_i is the "distance" between firm i and its selected payment provider. This distance captures private tastes and preferences, including convenience benefits associated with one provider over another. We assume the firm's location γ_i is uniformly distributed over the unit interval $[0,1]$, and is independent of its capital k. The two payment providers are located at the opposite ends of the interval, with the bank located at $\gamma = 0$ and the FinTech at $\gamma = 1$.

All digital payment services have an identical marginal cost c to offer, meaning we do not consider technological differences between banks and FinTech providers other than the dimension of data interoperability. This way we can cleanly isolate the potential impact of various data sharing regimes on prices and surplus. The prices of payment services offered by the bank and the FinTech will be denoted by p_b and p_{ft}, respectively.

Lenders. Investors – the bank and the FinTech lender – have deep pockets and offer identical loan products. For each firm, they simultaneously decide whether to offer a loan, and if they do, at what interest rate r_i, as well as whether to monitor the firm ($m_i \in \{0,1\}$), where $m_i = 1$ indicates monitoring and $m_i = 0$ no monitoring. Monitoring reduces private benefits from shirking and thus reduces incentives to exert low effort. However, it requires access to firms' transaction data, and incurs a monitoring cost of M per loan. With this setup we naturally capture the incremental informational value of having access to a firm's payment transactions. The extent to which various lenders can access such data depends on the prevailing data interoperability regime (detailed below).

We assume that a project generates positive expected return if and only if the firm does not shirk. Let $\nu = \rho_H\theta - 1 - M$ denote the net expected return from a monitored project. We impose:

Assumption 1. $\nu > 0 > \rho_L\phi - 1$.

Data interoperability regimes In this section, we discuss how data interoperability policies determine the capacity of various investors to access a firm's payment data for monitoring purposes. We study three data-sharing regimes:

- **No data interoperability**: In this scenario, a lender can access transaction data only if it is also the payment service provider. That is, only the bank can monitor borrowers, and only those borrowers who also have an account with the bank.
- **Open Banking**: Under this regime, data interoperability is enabled between the bank's payment data and the monitoring technology of all investors (i.e., the bank and the FinTech lender) at no cost. However, data collected by the FinTech payment provider, which is not subject to this regulation, cannot be accessed by any of the lenders.
- **Open Finance**: Under this regime, data interoperability is enabled between all data generating and consuming services at no cost. Consequently, both types of lenders can monitor all firms that utilize a digital payment service.

Timing. The key interaction we focus on is how a firm's choice of payment service provider affects the subsequent monitoring capacity of its lender, and in turn, influences the firm's funding conditions. We capture this dynamic with the two-period game summarized in Figure **??**. In period 1, firms choose a digital payment provider – either the bank or the FinTech. This covers data generation, which, together with the data-sharing regime in place, determines which lenders will have access to the firm's transaction data for monitoring purposes.

Period 2 covers data consumption for investment decisions. Each firm requires external funding and approaches both lenders (the bank and the FinTech), who simultaneously offer a loan rate (or reject the applicant) and jointly decide whether to deploy their costly

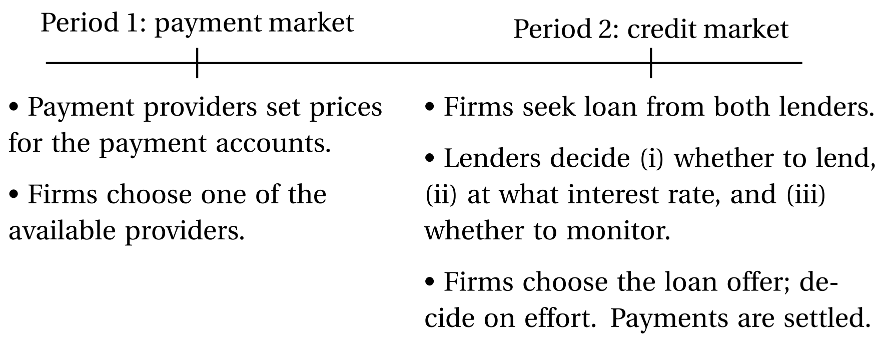

Figure 1: Timeline

monitoring technology to mitigate the moral hazard problem – provided they have access to the firm's payment flows. The equilibrium concept is perfect Bayesian Nash; all players are rational and fully anticipate the equilibrium in the second period when making their first-period choices.

4 Information spillovers without data interoperability

We begin by analyzing prices and profits in an environment without data interoperability. This analysis constitutes our first contribution to the literature: we rigorously establish the interaction between data-producing (payment) and data-driven (lending) services and demonstrate how prices one one market depend on the surplus allocation on the other. Recall that in this setting, transaction data is generated and accessed exclusively by the bank. Hence, monitoring is only feasible for loans extended by the bank to its own payment clients. We solve the model using backward induction, starting from the credit market equilibrium in the second stage and then analyzing the payment market in the first stage.

4.1 Credit market

Our analysis of the credit market builds on Holmstrom and Tirole (1997). Given Assumption 1, a bank will never finance a project unless the firm can credibly commit to not shirking. This leads to the firms' incentive compatibility (IC) constraint:[17]

[17] For brevity, we suppress the firm subscript i.

$$\rho_L(\phi - (1-k)r) + (b_0 - m \cdot \Delta b) - k \geq \rho_H(\phi - (1-k)r) - k \tag{1}$$

where $\Delta b = b_0 - b_1$. Rearranging (1) defines the maximum gross loan interest rate a bank can charge a firm with equity k, while still preventing shirking, conditional on its monitoring decision m:

$$r \leq r_m^{IC}(k) := \frac{1}{1-k}\left(\phi - \frac{b_0 - m \cdot \Delta b}{\Delta \rho}\right)$$

where $\Delta\rho = \rho_H - \rho_L$. Notice that since monitoring reduces private benefits from shirking, it enables banks to charge higher loan rates without inducing shirking.

Next, firms' individual rationality (IR) constraint dictates that they must achieve a non-negative expected profits. Given that a firm can be funded only if it does not shirk, we consider the IR constraint in the no-shirking case:

$$\rho_H(\phi - (1-k)r) - k \geq 0 \tag{2}$$

Rearranging (2) yields the maximum acceptable interest rate for a firm with equity k:

$$r \leq r^{IR}(k) := \frac{1}{1-k}\left(\phi - \frac{k}{\rho_H}\right)$$

Notice that $r^{IR}(k)$ increases with the firm's equity k because smaller loan size decreases the effect of the interest rate on the firm's expected profits from borrowing. Define $\bar{r}_m(k) := min\{r_m^{IC}(k), r^{IR}(k)\}$ as the binding upper threshold of interest rates for a firm with equity k conditional on the bank's monitoring decision m. Furthermore, let $\hat{k}$ be the value of k which solves $r_1^{IC}(k) = r^{IR}(k)$. We have

$$\hat{k} = \frac{\rho_H b_1}{\Delta\rho}. \tag{3}$$

For $k < \hat{k}$ the IC constraint is binding, whereas the IR constraint is binding otherwise.

Lenders can condition the interest rate on the loan size (equivalently, firm equity), thus offering every firm an interest rate $r(k)$. The lender's profit from lending to a firm with equity

k at an interest rate $r(k)$ given monitoring decision m is:[18]

$$\pi_\theta(r(k), m) := \rho_H(1-k)r(k) - (1-k) - m \cdot M$$

The lender's must obtain nonnegative profit (individual rationality), which implies a minimum interest rate, denoted by $\underline{r}_m(k)$:

$$r \geq \underline{r}_m(k) := \frac{1}{\rho_H} + \frac{m \cdot M}{(1-k)\rho_H} \tag{4}$$

The bank, for its own payment clients, jointly decides whether to monitor the firm and the interest rate to charge. Notice that, ceteris paribus, it is costlier to borrow with monitoring than without monitoring, that is, $\underline{r}_0(k) < \underline{r}_1(k)$. Furthermore, $\underline{r}_1(k)$ increases with firm equity as a result of the implicit economies of scale in monitoring. We can formulate the lenders' problem for $\theta \in \{b, ft\}$ as follows:

$$\begin{aligned} &\max_{r,m} \pi_\theta(r(k), m) = \rho_H \cdot (1-k) \cdot r(k) - (1-k) - m \cdot M \\ &\text{subject to} \quad \underline{r}_m(k) \leq r \leq \bar{r}_m(k) \\ &\qquad\qquad m = 0 \text{ if } \theta \neq b. \end{aligned} \tag{5}$$

The first constraint ensures participation with high effort by the firm and participation of the lender, and the second constrain states the FinTech lender's inability to monitor.

Next, we analyze equilibrium interest rates achieved by clients of the FinTech payment provider and the bank, respectively.

FinTech payment clients. The bank and the FinTech lender compete for clients of the FinTech payment provider from a symmetric information position: neither can observe the payment flows, so monitoring is not possible ($m = 0$). Bertrand-competition pushes interest rates down to the zero-profit condition (equation (4)), that is, $\underline{r}_0 = \frac{1}{\rho_H}$, and firms extract all project surplus.

Under these conditions, some firms are rationed: lending breaks down for $\underline{r}_0 > \bar{r}_0(k)$,

[18] Recall that monitoring is not possible ($m = 0$) for outside lenders ($\theta = ft$).

that is, when the bank cannot offer low enough rates to maintain the no-shirking condition. As $\bar{r}_0(k)$ is monotone in k, lending breaks down above the threshold $\bar{k}$, defined implicitly by $\underline{r}_0 = \bar{r}_0(\bar{k})$. This threshold is:

$$\overline{k} = 1 - \rho_H \phi + \frac{\rho_H b_0}{\Delta\rho} \tag{6}$$

Only firms with equity more than $\overline{k}$ have enough skin in the game to avoid moral hazard. Firms with lower equity are rationed as there is no interest rate that would both prevent shirking absent monitoring and yield a nonnegative profit for the lender.

Bank payment clients. While both creditors can offer unmonitored loans to firms with payments from the bank, only the bank can offer loans with monitoring. Firms with high enough equity ($k > \overline{k}$) prefer unmonitored loans as it is cheaper than monitored loans. Such loans will be priced at $\underline{r}_0$ due to the Bertrand competition between creditors.

For monitored loans, we derive a lower bound on firm equity. Note that projects cannot be funded if $\underline{r}_1(k) > \bar{r}_1(k)$, that is, when the lender's break-even rate with monitoring exceeds the maximum incentive-compatible rate of the firm. Let us define $\underline{k}$ as the value of k which solves $\underline{r}_1(k) = \bar{r}_1(k)$. This is:

$$\underline{k} = 1 + M - \rho_H \phi + \frac{\rho_H b_1}{\Delta\rho} \tag{7}$$

Firms with equity less than $\underline{k}$ cannot be funded even with monitoring. These firms have such strong incentives to shirk that the bank would have to reduce its interest rate below the zero-profit condition to overcome firm moral hazard. Firms with medium level of equity, i.e., $\underline{k} < k < \overline{k}$, effectively face a monopolistic creditor. The bank will monitor these borrowers and charge them the highest possible rates, $\overline{r}_1(k)$.

To sum up, we can distinguish between three categories of borrowers:

1. *Highly constrained firms*: $k < \underline{k}$. These firms cannot credibly commit to exert effort even when monitored and, therefore, do not receive funding.

2. *Moderately constrained firms*: $\underline{k} \leq k < \bar{k}$. These firms can credibly commit to exert effort only when monitored. Absent data interoperability, they receive funding only if they use the bank's payment service. The interest rate offered to these firms is $\bar{r}_1(k)$.

3. *Unconstrained firms*: $\bar{k} \le k$. These firms are offered funding without monitoring by both creditors, regardless of their choice of payment service. They are charged the competitive (zero profit) interest rate $\underline{r}_0$ and appropriate the entire project surplus.

We adopt the least restrictive modeling approach by assuming the following:

Assumption 2. $0 \le \underline{k} \le \hat{k} \le \overline{k} \le 1$

Assumption 2 implies that, at least for some firms, the incentive compatibility is more stringent than than the individual rationality constraint. This allows all types of firms to exist without imposing any restrictions on the firm equity distribution. Figure 2 illustrates equilibrium loan interest rates conditional on firm equity.

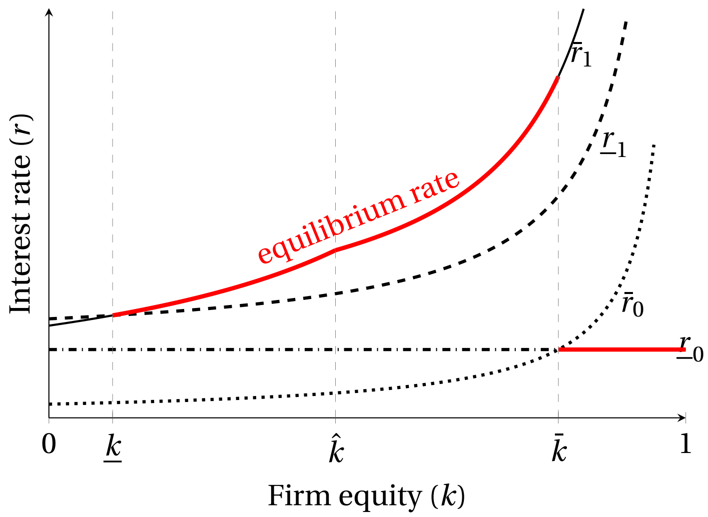

Figure 2: **Equilibrium loan interest rate without data interoperability**
The figure shows the firm-incentive compatible ($\bar{r}$) and bank-individually rational ($\underline{r}$) interest rates with- (index $_1$) and without ($_0$) monitoring for firms with equity k. Contract is possible if and only if $\bar{r}_m > \underline{r}_m$. The equilibrium rate is depicted with bold/red.

Lemma 1 presents the equilibrium allocation of project return between firms and credit providers:

Lemma 1. *(Credit market.) Absent data interoperability, equilibrium interest rates are:*

$$r(k) = \begin{cases} \underline{r}_0 & \text{for } \bar{k} \le k \\ \bar{r}_1(k) & \text{for } \underline{k} \le k < \bar{k} \text{ and } \theta = b, \\ \oslash \text{(no offer)} & \text{otherwise.} \end{cases}$$

A firm's surplus from borrowing is:

$$\pi_f(k,\theta) = \begin{cases} v + M & \text{if} \quad \bar{k} \leq k \\ \hat{k} - k & \text{if} \quad \underline{k} \leq k < \hat{k} \text{ and } \theta = b, \\ 0 & \text{otherwise} \end{cases}$$

The bank's profit from lending to its own payment clients is:

$$\pi_b(k) = \begin{cases} v & \text{if} \quad \hat{k} \leq k < \bar{k} \\ k - \underline{k} & \text{if} \quad \underline{k} < k < \hat{k} \\ 0 & \text{otherwise.} \end{cases}$$

On the clients of the FinTech payment service provider, lenders make zero profit.

Proof. See appendix A.1 □

Lemma 1 establishes how the total project surplus v from monitored loans is split between the lender and the firm First, we note that the bank indeed has market power over moderately constrained firms and generates a positive profit from lending to them. However, the bank does not expropriate all surplus, despite its monopoly position. Firms with $\underline{k} < k < \bar{k}$ have to be left with positive surplus in order to ensure incentive-compatibility. Figure 3 illustrates the allocation of project returns between the bank and its borrowers. The FinTech lender, on the other hand, can lend exclusively to financially unconstrained firms in a competitive way and generates no economic profit.

4.2 Payment Market

In the first-period market for payment services, the bank and the FinTech payment provider announce prices $\{p_b, p_{ft}\}$ respectively. Then, firms decide which service to use. In doing so, firms are fully rational: they anticipate the second-period equilibrium interest rate offers and recognize the possibility of credit rationing. A firm with capital k located at γ is

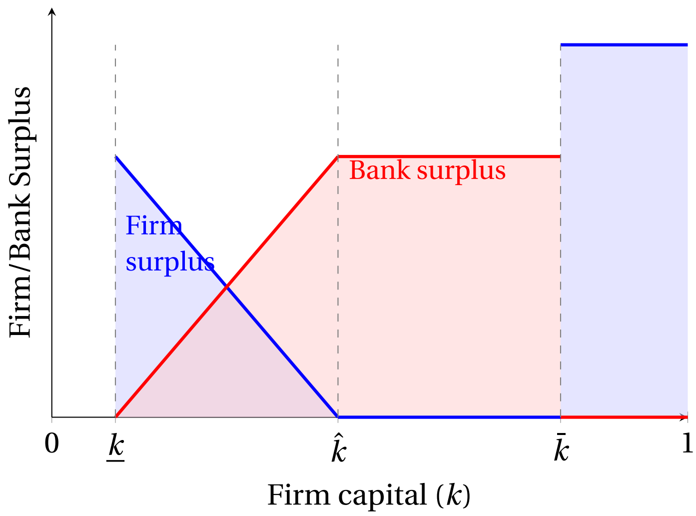

Figure 3: **Allocation of project return**
The figure shows how the project return is allocated between the firm (blue) and the bank (red) in equilibrium as a function of equity k for the bank's clients. Notice that the total surplus is higher for non-monitored loans $(k > \bar{k})$.

indifferent between the two payment offers if and only if:

$$u - p_b - \tau\gamma + \pi_f(k,b) = u - p_{ft} - \tau(1-\gamma) + \pi_f(k,ft).$$

Let us define the *excess* surplus a firm obtains in the credit market by choosing the bank's payment service rather than that of the FinTech's as:

$$\pi_f(k) := \pi_f(k,b) - \pi_f(k,ft)$$

It follows that

$$\gamma(k) = \frac{1}{2} + \frac{p_{ft} - p_b}{2\tau} + \frac{\pi_f(k)}{2\tau} \tag{8}$$

It is clear from Lemma 1 that $\pi_f(k)$ is positive for firms with moderate equity (those with $\underline{k} < k < \hat{k}$), and zero otherwise. Demand for the bank's payment service is higher among these firms as a result of the extra surplus it generates in the second period. Thus, despite offering symmetric products at the payment market, exclusive access to data provides the bank an upper hand against the FinTech payment service.

In Lemma 1 we have established that for monitored firms the total project surplus (minus monitoring costs) is split between the bank and the firm as $v = \pi_f(k,b) + \pi_b(k)$. For notational convenience, let us aggregate the surplus over all monitored firms and introduce $\Pi_f = \int_{\underline{k}}^{\bar{k}} \pi_f(k,b)dF(k)$, $\Pi_b = \int_{\underline{k}}^{\bar{k}} \pi_b(k)dF(k)$ and $\Pi = \Pi_f + \Pi_b$. We solve for the optimal payment market prices in Lemma 2:

Lemma 2. *(Payment market.) Absent data interoperability, the prices of payment services are:*

$$p_b = \tau + c + \frac{\Pi}{3} - \Pi_b$$
$$p_{ft} = \tau + c - \frac{\Pi}{3}$$

Proof. See appendix A.2 □

Lemma 2 shows that the equilibrium outcomes of payment and credit markets become interdependent when some lenders have access to a monitoring technology based on transaction data. The extra demand for the bank's payment service raises the price of bank and lowers that of FinTech payments by a third of the total credit market surplus from monitored loans ($\Pi/3$). Meanwhile, the bank subsidizes its payment service price in proportion to the profits it can collect from clients in the credit market (Π_b).

4.3 Discussion

Our analysis highlights the interlinkages between data-producing (payments) and data-driven (lending) financial services in the absence of data interoperability. Extensive literature on relationship banking shows that banks with exclusive access to data about their borrowers possess market power in the credit markets when that market is considered in isolation. However, when there is competition for such clients in the upstream data-producing market, these profits may be competed away. This dynamic is captured in Lemma 2, which shows that the bank's payment service prices are effectively subsidized by an amount Π_b, the aggregate surplus a bank can grab from the credit market.

There is, however, a second effect on payment service prices. Firms must retain a positive surplus in the credit market to ensure incentive compatibility. This means that having access to monitored loans is valuable to the firm, which generates excess demand for the bank's services. This allows the bank to raise its payment service prices, whereas the FinTech provider's equilibrium price must be lowered by the same amount to remain competitive.

In Corollary 1 we derive conditional market shares for each payment provider:

Corollary 1. *The bank's market share within firms of capital k is:*

$$\gamma(k) = \frac{1}{2} + \frac{\Pi}{6\tau} + \frac{\pi_f(k) - \Pi_f}{2\tau} \tag{9}$$

Integrating out over k gives the total market share:

$$\gamma = \frac{1}{2} + \frac{\Pi}{6\tau} \tag{10}$$

Proof. The result follows after substituting the equilibrium prices back into Equation (8). □

The formula for $\gamma(k)$ stresses the role of firm equity on market outcomes. Some firms do not generate any surplus from monitored loans, either because they are rationed even with monitoring ($k < \underline{k}$), do not require monitoring ($k > \bar{k}$), or the bank exploits all rents ($k \in [\hat{k}, \bar{k}]$). For these firms, the choice between bank and FinTech payments depends purely on their heterogeneous taste in payment services and the prices, which are in turn determined by the split of the *total* credit market surplus between the bank and the firms. As the firms' relative share from the total surplus grows (Π_f increases), the bank's incentives for subsidizing its payment service reduces and its market power as information monopolist increases, tilting demand of such firms in favor of the FinTech ($\gamma(k)$ in (9) decreases).

For firms that do obtain positive surplus from monitoring, the choice between bank and FinTech depends also on their capital: the lower is the firm capital k, the more the firm has to gain from monitoring (Π_f larger), and the more likely it is that they choose the bank over the FinTech. Finally, note that in a case with no information spillovers between the two markets, both providers would have an equal payment market share of $1/2$. As $\gamma > 1/2$ in (10), we immediately observe that the aggregate effect of leveraging transaction data for lending on the bank's payment market share is always positive.

5 Interoperability of financial data

In this section, we study the impact of data interoperability on prices, profits, and surplus. First, we analyze the Open Banking (OB) framework, where a data interoperability mandate applies only to the bank. Then, we study the broader Open Finance (OF) initiative, which require all producers of financial data to allow data interoperability and contrast the welfare implications and distributional effects of the two policies.

5.1 Open Banking

When Open Banking is introduced, the FinTech lender gains access to the transaction data generated by the bank. The information asymmetry between the two creditors is therefore eliminated and the credit market becomes perfectly competitive. Lemma 3 presents the credit market equilibrium in an OB framework.

Lemma 3. *(Credit market.) Under Open Banking, the equilibrium interest rates are:*

$$r^{OB}(k) = \begin{cases} \underline{r}_0 & \text{for } \bar{k} \leq k \\ \underline{r}_1(k) & \text{for } \underline{k} \leq k < \bar{k} \text{ and } \theta = b \\ \oslash \text{(no offer)} & \text{otherwise.} \end{cases}$$

A firm's expected surplus from borrowing is given by:

$$\pi_f^{OB}(k,\theta) = \begin{cases} v + M & \text{if } \bar{k} \leq k \\ v & \text{if } \underline{k} \leq k < \overline{k} \text{ and } \theta = b, \\ 0 & \text{otherwise} \end{cases}$$

Both the bank and the FinTech lender make zero profit from lending.

Proof. See appendix A.3 □

Figure 4 illustrates the equilibrium interest rates under the Open Banking framework. Notice that Open Banking does not affect borrowing terms for unconstrained or highly-constrained firms. It however introduces symmetric information between the two competitors in the credit market and eliminates the bank's ability to collect information rents. As a result, credit becomes cheaper for moderately-constrained firms that require monitoring to get financing. With OB, firms appropriate all project surplus. As standard with perfect competition, lenders make zero profit.

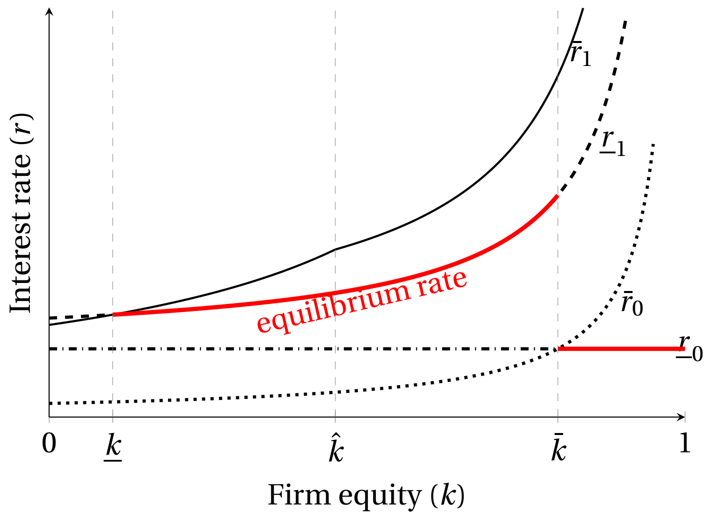

Figure 4: **Equilibrium loan interest rate with Open Banking**
The figure shows the firm-incentive compatible ($\bar{r}$) and bank-individually rational ($\underline{r}$) interest rates with- (index $_1$) and without ($_0$) monitoring for firms with equity k. Contract is possible if and only if $\bar{r}_m > \underline{r}_m$. The equilibrium rate is depicted with bold/red.

The reallocation of the credit market surplus from banks to borrowers affects prices in the upstream payment market. We establish this key result in Lemma 4:

Lemma 4. *(Payment market equilibrium.) Under Open Banking, the prices of payment services are:*

$$\begin{aligned} p_b^{OB} &= \tau + c + \frac{\Pi}{3} \\ p_{ft}^{OB} &= \tau + c - \frac{\Pi}{3} \end{aligned} \tag{11}$$

Proof. See appendix A.4 □

Comparing the payment service prices between no data interoperability (Lemma 2) and OB, we observe that the bank stops directly cross-subsidizing its upstream payment service. This is because with aftermarket rent extraction abilities diminished, the bank has no extra incentive anymore to attract more clients in the first stage. At the same time, the value of the bank's payment service – as opposed to that of the FinTech provider – increases for moderately-constrained firms. These firms are now able to retain a larger share of the project surplus thanks to the increased credit market competition. The access to this surplus however still hinges upon having a payment account at the bank and the verifiable interoperability service it provides. Thus, demand for the bank's payment service increases among these firms. Both effects simultaneously drive the payment service price of the bank upward, while the FinTech's price remains unchanged. Effectively, the bank can still leverage its monopoly as a data producer, which becomes even more valuable with the loss of its credit market power.

Taking together, Lemma 3 and Lemma 4 show that OB decreases credit prices while increasing payment service prices. Does that lead to an increase or decrease of the aggregate welfare? We address this in Proposition 1.

Proposition 1. *Comparing Open Banking to a regime without data interoperability leads to*

- *A change in the total surplus on payment markets given by:*

$$\Delta S_{payment} = \frac{var(\pi_f(k)) - var(\pi(k))}{4\tau}$$

- *A change in the total surplus on credit markets given by:*

$$\Delta S_{credit} = \frac{v - \Pi}{2\tau}\Pi_b$$

- *A change in total surplus given by:*

$$\Delta S = \frac{var(\pi_b(k))}{4\tau}$$

Proof. See appendix A.5 □

Open Banking brings positive surplus because it eliminates an important pricing friction, as we explain below. Unlike the credit market – where lenders can practice first-degree price discrimination based on the firm's equity –, payment services are constrained to uniform pricing.[19] Hypothetically, if the bank were free to charge different prices for payment services, the bank's optimal pricing strategy would be to subsidize the payment service for those firms from which it captures a surplus from lending, and charge higher rates for firms that tend to be left with larger loan surplus. This is not possible – the requirement that payment prices must be uniform and independent of firm equity introduces a market inefficiency, which is proportional to the extent of the heterogeneity among firm. This explains why the surplus increase depends on the *variance* of the bank's share of the project surplus in the credit market. In particular, the greater the variation in the surplus the bank can extract from projects, the larger the gap between the first-best (heterogeneous) payment prices and the equilibrium uniformly constrained prices, exacerbating the inefficiency.

Absent data interoperability, the uniform pricing which arises in equilibrium can drive away some firms from the bank even though serving these firms in both markets would increase the number of (positive NPV) projects being implemented. Absent the pricing friction, the bank could convince these firms to become payment clients by sharing part of the credit surplus with them. However, it cannot do so. In the payment market, it is prevented by the uniform pricing constraints as discussed above. In the credit market, the bank is a de facto monopolist, and it is unable to commit ex-ante to decrease the ex-post monopolist price. In conclusion, without data interoperability the surplus from financing these projects remains unrealized .

The crucial impact of Open Banking which fuels aggregate value creation is that it decreases heterogeneity in the project surplus allocation. By eliminating information frictions, OB reallocates surplus from the lender to the borrower and enables all non-rationed firms to appropriate the entire project surplus. This makes firms more homogeneous in terms of their valuation of credit access, and in turn, the inefficiency of uniform first-period pricing constraint is reduced. As a result, more firms receive financing than before, increasing the total credit market surplus unambiguously.[20]

We have explained that the total surplus unambiguously increases after the introduc-

[19]This is not an ad-hoc assumption. It is virtually impossible to condition prices of an upstream product based on the characteristics of *future* potential loan applications.

[20]See Appendix for further algebraic details about surplus change on the credit- and payment markets separately.

tion of Open Banking. However, it remains to be seen how this surplus is distributed among banks and firms. One might naturally expect that the level playing field on credit market hurts banks and unambiguously benefit firms. In the next Proposition, we show that this is not necessarily the case.

Proposition 2. *Comparing Open Banking to a regime without data interoperability leads to*

- *A change in total firm surplus given by*

$$\Delta S_f = \frac{1}{4\tau} var(\pi_b(k)) + \frac{1}{2\tau} cov(\pi_b(k), \pi_f(k))$$

- *A change in total bank profit given by*

$$\Delta S_b = -\frac{1}{2\tau} cov(\pi_b(k), \pi_f(k))$$

Profits of the FinTech lender and FinTech Payment Service Provider are not affected.

Proof. See appendix A.6 □

Proposition 2 suggests that it is the bank, rather than the firms which is better positioned to pick up the extra surplus created by OB. Firms in aggregate attach higher value for monitoring, thus are willing to pay more in the first stage for the ability to being monitored in the second. This drives first period prices up. While the bank loses its monopoly as a data *user*, it still retains market power as a data *producer*. Thus, the bank can at least partially transfer its rent extraction capabilities from the credit market to the payment markets. This not only mitigates the impact of lost profits from lending, but may even reverse it, leading to an increase in bank profit.

As Proposition 2 shows, whether banks benefit or lose out on OB depends on the *covariance* in the split of total surplus between the bank and the firm. For the subset of parameter space that is practically relevant this covariance is positive – meaning banks gain from OB. Intuitively, the total size of the pie – the credit market surplus v – is fixed and constant for all firms, and is split between the lender and the firm in a heterogeneous way depending on the firm's capital, suggesting a negative correlation. Therefore, counter-intuitively, the bank gains as a result of opening up data to competitors.[21] Furthermore, the magnitude of the covariance depends on the relative number of firms for which the participation constraint is binding, i.e., ones that obtain nonzero economic profit in equilibrium. Banks gain the largest from open banking if they have to leave relatively large portion of the pie to firms before data interoperability in order to maintain incentive compatibility of firms.

As a result of changing prices on payment markets, firms that do not value payment data for credit (that includes not only rationed firms but also firms who do not need monitoring) are now increasingly priced out and opt for FinTech payments. These firms unambiguously lose out on OB due to higher payment prices. While this has a negative effect on aggregate welfare (higher transport costs), on the aggregate, it is weakly dominated by the former positive effect.

5.2 Open Finance

In the Open Finance (OF) framework, data interoperability mandate applies to all payment services. Therefore, *both* credit providers are now capable of monitoring *all* firms. Lemma 5 describes credit market equilibrium in the OF framework.

Lemma 5. *(Credit market.) Under Open Finance, equilibrium interest rates are:*

$$r^{OF}(k) = \begin{cases} \underline{r}_0 & \text{for } \bar{k} \leq k \\ \underline{r}_1(k) & \text{for } \underline{k} \leq k < \bar{k}, \\ \oslash \text{ (no offer)} & \text{otherwise.} \end{cases}$$

Proof. Trivial from Lemma 3, as now all firms can be monitored and receive the competitive (zero-profit) price, irrespective of their payment service provider. □

Under OF, both lenders are able to extend monitored loans to *all* moderately constrained firms, rather than only to those that use the bank's payment service as under OB. This levels

[21] In the general case this covariance may be positive as firms outside $[\underline{k}, \bar{k}]$ contribute positively to the covariance term. The sign therefore depends on the proportion of unconstrained (unmonitored) and rationed firms relative to the constrained (monitored) ones.

the playing field on the payment service market as it removes the bank's monopoly power as data producer. With frictionless competition restored, and all data fully utilized, all surplus goes to the firms. Prices of payment services are established in the following Lemma:

Lemma 6. *(Payment market.) Under Open Finance, the prices of payment services are:*

$$p_b^{OF} = \tau + c$$
$$p_{ft}^{OF} = \tau + c$$

Proof. With all information frictions and dependencies removed, the price is the standard Hotelling-price. □

The FinTech payment provider now charges a higher price for its payment service – this can be seen directly by comparing Lemma 6 with Lemma 2. Intuitively, this is because FinTech clients are no longer penalized in the credit market compared to those of the bank and the FinTech firm can fully capture the convenience yields represented by τ. One might expect the bank also reduce its price as it responds to lower demand in order to remain competitive. This is not necessarily the case. As the bank cannot capture economic profit from the aftermarket, it no longer subsidizes prices, leaving the overall price impact ambiguous compared to the no-interoperability case. However, as compared to Open Banking (Lemma 4), the bank's payment service price unambiguously decreases.

We have established how prices of services change as informational frictions are removed due to full data interoperability. However, the question remains how this changes the aggregate economic surplus and the allocation of that surplus between firms and financial institutions. Proposition 3 establishes our main result of this section:

Proposition 3. *Comparing Open Finance to a regime without data interoperability leads to*

- *A change in the total surplus on payment markets given by:*

$$\Delta S_{payment} = \frac{\Pi^2}{36\tau} + \frac{var(\pi_f(k))}{4\tau}$$

- *A change in the total surplus on credit markets given by:*

$$\Delta S_{credit} = \frac{\Pi}{2} - \frac{\Pi^2}{6\tau} - \frac{\Pi_f(v-\Pi)}{2\tau}$$

- *A change in total surplus given by:*

$$\Delta S = \frac{\Pi}{2} + \frac{\Pi^2}{9\tau} - \frac{\Pi v}{4\tau} + \frac{var(\pi_b(k))}{4\tau}$$

Proof. See A.7 □

Proposition 3 establishes the effect of OF on each market compared to the benchmark of no data sharing. As in the case with OB, the increase in credit market surplus originates from new financing for the previously rationed (moderately constrained) firms. Note that OF eliminates credit rationing at a greater scale compared to OB given that not only the bank's payment clients but also the payment clients of the FinTech become capable of sharing their data and access financing.

In contrast to Open Banking, Open Finance strictly increases payment market surplus. To understand this, we note that in the first period payment market our model imposes a full-service constraint – all firms choose one of the providers. Therefore, prices do not affect total surplus only reallocate between sellers (bank, FinTech) and buyers (firms). But surplus is decreased compared to the first-best, if distortative prices in either period make a firm choose a payment provider which is not its most preferred one with respect to convenience (i.e., the closest one according to its taste "location"). Because the payment market exhibit symmetric non-distortative pricing under OF and only under OF, firms choose their payment service provider purely based on distance. This minimizes the total distance traveled by firms to their payment provider keeping all else equal and thus maximizes surplus from the payment market.

Open Finance increases overall welfare more than Open Banking. But how does it effect firms, banks and FinTechs separately? Proposition 4 addresses this point.

Proposition 4. *Comparing Open Finance to a regime without data interoperability leads to*

- *A change in total firm surplus given by:*

$$\Delta S_f = \frac{\Pi}{2} - \frac{\Pi^2}{36\tau} - \frac{var(\pi_f(k))}{4\tau}$$

- *A change in total bank profit given by:*

$$\Delta S_b = -\left(\frac{\Pi}{3} + \frac{\Pi^2}{18\tau} + \frac{cov(\pi_b(k), \pi_f(k))}{2\tau}\right)$$

- *A change in the FinTech payem profit given by:*

$$\Delta S_{ft} = \frac{\Pi}{3}\left(1 - \frac{\Pi}{6\tau}\right)$$

Profits of the FinTech lender are not affected.

Proof. See A.8 □

The key difference between OF and OB lies in the impact on the bank's data production monopoly in the upstream market. With OF, the bank can no longer use its market power in the payment market to collect partial rents from its clients in advance of financing them at competitive rates. One cannot say for sure whether the bank loses or gains from this policy in overall in absence of additional market specifications. It is, however, clear that the is worse of under OF in comparison to OB, either because it benefits less or suffers more. The same ambiguity holds for the effect on aggregate firm surplus. However, it is again clear that OF is preferable over OB for firms as it either benefits them more or hurts them less.

6 Interoperability with public digital payments (CBDC)

In this section we examine how data interoperability interacts with another important policy initiative, that is, the provision of a public digital payment service (CBDC). We assume an *interoperable* CBDC, meaning that its users are able to share their payment data with third parties in the spirit of open data. Below, we first establish the equilibrium for credit and payment markets when a bank competes with an interoperable CBDC in absence of a data sharing mandate on the bank. We then introduce a data sharing mandate on the bank and investigate its impact on firm surplus and bank profit.

6.1 Credit and payment markets with CBDC

6.1.1 Credit market

The credit market is organized as in previous sections: a vertically integrated bank competes with a specialized payment service. The terms of access to firms' transaction data is however different. While the bank does not share any transaction data with the FinTech creditor as before in the benchmark setting, the public payment provider may share transaction data with both creditors. Lemma 7 presents the equilibrium allocation of project return between firms and creditors given this information structure:

Lemma 7. *(Credit market equilibrium.) Absent banking data interoperability and in presence of an interoperable CBDC, equilibrium interest rates are:*

$$r = \begin{cases} \underline{r}_0 & \text{for } \bar{k} \leq k \\ \bar{r}_1(k) & \text{for } \underline{k} \leq k < \bar{k} \text{ and } \theta = b, \\ \underline{r}_1(k) & \text{for } \underline{k} \leq k < \bar{k} \text{ and } \theta \neq b, \\ \oslash \text{(no offer)} & \text{otherwise.} \end{cases}$$

A firms' expected surplus from borrowing is given by:

$$\pi_f(k,\theta) = \begin{cases} v + M & \text{if } \bar{k} \leq k \\ \hat{k} - k & \text{if } \underline{k} \leq k < \hat{k} \text{ and } \theta = b, \\ v & \text{if } \underline{k} \leq k < \overline{k} \text{ and } \theta \neq b, \\ 0 & \text{otherwise} \end{cases} \tag{12}$$

The bank's profit from lending to its own payment clients is given by:

$$\pi_b(k) = \begin{cases} v & \text{if} \quad \hat{k} \leq k < \bar{k} \\ k - \underline{k} & \text{if} \quad \underline{k} < k < \hat{k} \\ 0 & \text{otherwise.} \end{cases}$$

The bank makes zero profit from lending to CBDC users and The FinTech creditor makes zero profit.

Proof. See appendix A.9 □

Credit market outcomes are equivalent to the benchmark case for most firm types. Highly-constrained firms are credit rationed and unconstrained firms are financed without monitoring and retain the entire project surplus. Similarly, moderately-constrained firms which use the bank's payment service receive monopolistic loan rates given that they can only be monitored and financed by their own bank. Credit market conditions change only for the moderately-constrained firms choosing to use the CBDC alternative. Such firms were unable to share their payment data with any creditor and thus were rationed in the benchmark setting. With an interoperable CBDC, they can share their payment data with both creditors and receive competitive loan offers. Notice that the excess surplus $\pi_f(k)$ is negative for firms with moderate equity and zero for the rest. Ceteris paribus, moderately constrained firms have a preference for CBDC over bank payments.

6.1.2 Payment market

The payment market is organised as in Section 4.2 where the bank's market share among firms with capital k is denoted by (8), that is,

$$\gamma(k) = \frac{1}{2} + \frac{p_p - p_b}{2\tau} + \frac{\pi_f(k)}{2\tau}$$

where p_p is the price of the public payment service (CBDC).[22]

[22]Note that we assume the CBDC to be priced by a social planner that maximizes total welfare, however, our findings hold for a free public CBDC as well.

We solve for the equilibrium prices and present the payment market equilibrium with an interoperable CBDC and no data-sharing mandate for the bank in Lemma 8.

Lemma 8. *Absent banking data interoperability and in presence of an interoperable CBDC, theprices of payment services are:*

$$p_b = c + \frac{\tau}{2} - \Pi_b$$

$$p_p = c$$

Proof. See appendix A.10 □

The public payment service maximizes total firm surplus by setting the smallest possible price subject to its budget constraint. This forces the bank to drive its own payment price down to compete with the CBDC. Notice that the equilibrium price for the bank's payment service is smaller when competing with a public payment provider compared to when it competes with FinTech payments.

6.2 Open Banking and CBDC

Let us now assume that a data-sharing mandate is introduced for the bank, i.e. all firms can now share their transaction data with all creditors regardless of their chosen payment service. This setting results in an equilibrium akin to Open Finance in section 5.2: all firms - except highly constrained ones - are financed while retaining the entire project surplus and both payment services are priced identically. Equilibrium interest rates are given by Lemma 5 while payment prices follow the structure presented in Lemma 8. Notice, however, that under data-sharing the bank makes no profit from lending, i.e. $\Pi_b^{OB} = 0$, which indicates a hike in the bank's payment service price by Π_b. Proposition 5 shows the effect of such a mandate on each market.

Proposition 5. *In the presence of an interoperable CBDC, a mandate for the bank to make its data interoperable leads to*

- *A change of the total surplus in the payment market given by*

$$\Delta S_{payment} = \frac{var(\pi_b(k))}{4\tau}$$

- *No change in the total surplus in the credit market*

Proof. See appendix A.11 □

Section 4 shows that - absent data interoperability - moderately constrained firms choosing FinTech payments are credit rationed. It also showed that data interoperability eliminates friction and thus improves credit market surplus. Such form credit rationing is not present in the setting where the bank competes with an interoperable CBDC. Moderately constrained firms are always financed, albeit at different loan rates, given that at least one creditor can always access their transaction data and offer monitored loans. Accordingly, the only impact of data sharing is to enable payment clients of the bank to share data with the FinTech lender and receive competitive loan rates. This changes the surplus allocation for some firms but does not alter the share of projects that are financed and the resulting credit market surplus.

Notice that the change in the payment market surplus is driven by the change in the total distance traveled by firms. Intuitively, the distance is minimized when all firms choose the closest payment provider to them. However, this is not the case when payment services are asymmetric in terms of data interoperability. Without data sharing, moderately constrained firms have a preference for the CBDC and may choose it over the bank's payment service despite it being further away. Similarly, the price subsidy of the bank attracts some firms towards its payment services despite the CBDC being the closer option. With data sharing, this asymmetry clears up. Both payment services become identical in terms of data interoperability and the bank stops subsidizing its payments. Consequently, firms become more likely to choose the closest option,indicating a reduction in the distance traveled by firms and an increase in the surplus generated in the payment market.

Proposition 6 summarizes the effect of data sharing on aggregate firm surplus and bank profit in presence of an interoperable CBDC.

Proposition 6. *In the presence of an interoperable CBDC, a mandate for the bank to make its data interoperable leads to*

- *A change in total firm surplus is*

$$\Delta S_f = -\frac{var(\pi_b(k))}{4\tau}$$

- *A change in total bank profit is*

$$\Delta S_b = \frac{var(\pi_b(k))}{2\tau}$$

The FinTech lender and the public payment provider always make zero profit.

Proof. See appendix A.12 □

The bank sharing data benefits moderately constrained firms that have a preference for the bank's payment service by enabling them to switch to their preferred means of payment data without foregoing the opportunity to share their payment data and receive competitive loan terms. On the other hand, with data sharing, the bank seizes its subsidy on its payment service, hurting its payment clients. Proposition 6 shows that the negative impact on the payment market dominates the positive impact on the credit market and leaves firms worse off overall. The opposite holds for the effect on bank profit. The bank loses all profit in the credit market once it no longer holds monopoly over its payment data. However, it simultaneously experiences a positive demand shift in payment market where it makes more profit by setting a higher price without losing any market share. The latter effect outweighs the former and the total bank profit increases with the data sharing mandate.

7 Concluding remarks

Our results offer insights for initiatives (private or public) aiming to reshape the financial sector by promoting data-sharing. We find that ,somewhat surprisingly, data sharing is likely to bolster banks' profitability rather than hurting it when banks are considered as holistic entities performing in interconnected markets. This finding challenges the rationale that banks need financial compensation to implement effective data-sharing, suggesting instead that banks may willingly do so as long as their market power in the upstream payment market allows them to indirectly capitalize on their information rents. Our results also challenge the notion that data-sharing unambiguously benefits bank customers. We show that, given the spillover effect on payment markets, data-sharing may in some cases do more harm than good overall for bank customers, especially those that have little interest in data-driven financial services and products. This finding supports a more general policy insight, that is, market power in the financial sector should be addressed by jointly considering related markets given the substantial presence of information spillovers and synergies across them.

The comparison of Open Banking and Open Finance approaches reveals other policy considerations. While our results support the transition from Open Banking to Open Finance from a social perspective, it challenges banks' position in favor of Open Finance over Open Banking. We show that while Open Banking permits banks to transfer rent collection to their payment services, Open Finance eliminates information rents completely. The former therefore emerges as a preferable regime for banks. However, it is important to note that this insight may shift if banks are forced to compete with vertically integrated non-bank institutions in data-driven services, such as BigTech lending. It remains an open question whether Open Banking would than still remain the dominant policy approach over Open Finance for banks.

Lastly, we show that central bank digital currencies (CBDCs) add complexity to the optimal design of data sharing frameworks. According to our analysis, in the presence of an interoperable CBDC, a data-sharing mandate increases economic surplus just as much. However, this surplus accrues only to banks while their customers are strictly worse off. Two policy insights emerge from this observation. First, if the core policy objective of data-sharing is to enhance customer surplus, the design of these two policies must consider their interaction. Else, if increasing the overall economic efficiency is the core objective, there may be no need for regulatory action to support data interoperability since providing an interoperable public payment service would naturally incentivize private providers to follow suit.

To conclude, our analysis sheds light on to the importance of adopting a holistic approach in designing policies that target the financial sector. We provide important insights to the role cross-market information spillovers and policy design choices play in determining the ultimate implications of data sharing policies. This study restrains itself to a framework where vertically integrated financial activities are provided exclusively by the banking sector. A promising extension in terms of informing effective policy design would be to consider a framework where such services can also be offered by non-bank institutions, such as the BigTech, that remains outside the jurisdiction of current data-sharing regulations.

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A Proofs of Lemmas and Propositions

A.1 Proof of Lemma 1

The credit offer is conditional on capital k by both credit providers, therefore we can consider competition for each firm (each k) separately. It is straightforward from the discussion in the main text that firms with $k < \underline{k}$ do not get funded. For firms with $k > \bar{k}$ monitoring is not necessary; every offer $r > \underline{r}_0$ will be undercut by the competitor, which leads to the unique pure-strategy Nash equilibrium of $r = \underline{r}_0$. By implication, the firm gets the entire project surplus, $\rho_H \phi - 1$.

Firms with $k \in [\underline{k}, \bar{k})$ cannot be funded without monitoring, so the bank is a monopolistic provider and expropriates all the surplus it can while still preserving the incentive compatibility and participation constraint of the firm. By construction, for $k < \hat{k}$ the IC is binding and $r = r_1^{IC}(k)$. With this interest rate the firm's surplus is:

$$\pi_f(k,b) = \rho_H \left(\phi - (1-k) \cdot \frac{1}{1-k} \left(\phi - \frac{b_1}{\Delta\rho} \right) \right) - k = \hat{k} - k,$$

where the right hand side follows from substituting (3). Similarly, substitution to the objective function in (5) and using (7) leads to

$$\pi_b(k) = \rho_H (1-k) \cdot \frac{1}{1-k} \left(\phi - \frac{b_1}{\Delta\rho} \right) - (1-k) - M = k - \underline{k}.$$

It is straightforward to verify that $\hat{k} - \underline{k} = \rho_H \phi - 1 - M$, that is, the total surplus of the project conditional on monitoring.

For firms with $k \geq \hat{k}$, the participation constraint is the binding one, implying that the bank can extract the entire project surplus, that is $\pi_f(k) = 0$ and $\pi_b(k) = \rho_H \theta - 1 - M$.

A.2 Proof of Lemma 2

We formulate the total profit of the bank - from both markets - and the total profit of the FinTech payment service as follows:

$$S_b := \int_0^1 (p_b - c + \pi_b(k)) \cdot \gamma(k) dF(k) \tag{A.1}$$

$$S_{ft} := \int_0^1 (p_{ft} - c) \cdot (1 - \gamma(k)) dF(k) \tag{A.2}$$

Recall from (8) that:

$$\gamma(k) = \frac{1}{2} + \frac{p_{ft} - p_b}{2\tau} + \frac{\pi_f(k)}{2\tau}$$

Substituting $\gamma(k)$ into (A.1) and (A.2), the first-order condition for the bank and the FinTech payment is:

$$\frac{\partial S_b}{\partial p_b} = \int_0^1 \left(\gamma(k) - \frac{(p_b - c + \pi_b(k))}{2\tau}\right) dF(k) = 0$$
$$\frac{\partial S_{ft}}{\partial p_{ft}} = \int_0^1 \left(1 - \gamma(k) - \frac{(p_{ft} - c)}{2\tau}\right) dF(k) = 0$$

Using Lemma 1, let $\Pi_b = \int_{\underline{k}}^{\bar{k}} \pi_b(k) dF(k)$ and $\Pi_f = \int_{\underline{k}}^{\bar{k}} \pi_f(k,b) - \pi_f(k,ft) dF(k)$. Then the best response functions are:

$$p_b(p_{ft}) = \frac{p_{ft} + c + \tau + \Pi_f - \Pi_b}{2},$$
$$p_{ft}(p_b) = \frac{p_b + c + \tau - \Pi_f}{2}.$$

This leads to the following equilibrium payment service prices of the bank and the FinTech payment:

$$p_b = \tau + c + \frac{\Pi_f - 2\Pi_b}{3},$$
$$p_{ft} = \tau + c - \frac{\Pi_b + \Pi_f}{3}.$$

Let us define $\Pi = \Pi_b + \Pi_f$ which allows us to rewrite equilibrium prices as

$$p_b = \tau + c + \frac{\Pi}{3} - \Pi_b$$
$$p_{ft} = \tau + c - \frac{\Pi}{3}$$

A.3 Proof of Lemma 3

When OB is introduced, competition drives down the loan rates of both credit providers to the break-even condition which translates to $\underline{r}_0$ without monitoring and $\underline{r}_1$ with monitoring. The discussion in the main text substantiates that firms with $k > \overline{k}$ are financed without monitoring while those with $\overline{k} > k > \underline{k}$ are financed with monitoring and the remaining firms are rationed.

A.4 Proof of Lemma 4

The equilibrium analysis of Lemma 2 remains unchanged, i.e. equilibrium prices still follow the same general expressions. With OB, the bank makes zero profit from the credit market, while financed firms capture the entire project surplus. Following the notation from Lemma

2, one can write

$$\Pi_b^{OB} = 0$$
$$\Pi_f^{OB} = \Pi$$

Substituting these into the general expressions for equilibrium prices gives

$$p_b^{OB} = \tau + c + \frac{\Pi}{3}$$
$$p_{ft}^{OB} = \tau + c - \frac{\Pi}{3}$$

By comparison with Lemma 2 it follows that introduction of OB raises the bank's PS price by Π_b and leaves the FinTech PS price unchanged.

A.5 Proof of Proposition 1

Payment market surplus. The total surplus generated in the payment market is governed by the total distance traveled to payments by customers alongside the total utility acquired by customers and the total cost incurred by service providers:

$$\begin{aligned} S_{payment} &= u - c - \tau \int_0^1 \left(\int_0^{\gamma(k)} x \partial F(x) + \int_0^{1-\gamma(k)} x \partial F(x) \right) \partial F(k) \\ &= u - c - \frac{\tau}{2} \int_0^1 \gamma^2(k) + (1-\gamma(k))^2 \partial F(k) \end{aligned}$$

The change in the payment market surplus under OB regime is then given by

$$\Delta S_{payment} = -\tau \int_0^1 (\gamma^{OB}(k) - \gamma(k)) \cdot (\gamma^{OB}(k) + \gamma(k) - 1) \partial F(k)) \tag{A.3}$$

Corollary 1 provides a generic expression for the bank's market share conditional on firm equity. Substituting $\pi_f^{OB}(k) = \pi(k)$ and $\Pi_f^{OB} = \Pi$ gives the bank's market share under the OB regime, that is

$$\gamma^{OB}(k) = \frac{1}{2} + \frac{\Pi}{6\tau} + \frac{\pi(k) - \Pi}{2\tau} \tag{A.4}$$

Substituting (A.4) and (9) into the expression above gives

$$\begin{aligned} \Delta S_{payment} &= -\tau \int_0^1 \frac{\pi_b(k) - \Pi_b}{2\tau} \cdot \left(\frac{\Pi}{3\tau} + \frac{\pi_f(k) - \Pi_f}{\tau} + \frac{\pi_b(k) - \Pi_b}{2\tau} \right) \partial F(k) \\ &= -\left(\frac{\Pi}{3} \underbrace{\int_0^1 \frac{\pi_b(k) - \Pi_b}{2\tau}}_{0} + \frac{\int_0^1 (\pi_b(k) - \Pi_b)(\pi_f(k) - \Pi_f) \partial F(k)}{2\tau} + \frac{\int_0^1 (\pi_b(k) - \Pi_b)^2 \partial F(k)}{4\tau} \right) \\ &= -\left(\frac{cov(\pi_b(k), \pi_f(k))}{2\tau} + \frac{var(\pi_b(k))}{4\tau} \right) \end{aligned}$$

Credit market surplus. OB changes nothing in terms of the financing rule of different firm types. Just as before, all highly-constrained firms are rationed, all unconstrained firms are financed without monitoring while moderately-constrained firms are financed, with monitoring, if and only if they use the bank's payment service. What changes with OB is the bank's market share among these firms. As a result of the increase in the bank's market share among moderately-constrained firms, more projects can be realized under the OB regime, that is

$$\Delta S_{credit} = v \int_{\underline{k}}^{\overline{k}} \left(\gamma^{OB}(k) - \gamma(k)\right) \partial F(k)$$

where $v = \rho_H \theta - 1 - M$ denotes the net value of a monitored project. Substituting (9) and (A.4) gives

$$\Delta S_{credit} = v \int_{\underline{k}}^{\overline{k}} \frac{\pi_b(k) - \Pi_b}{2\tau} \partial F(k)$$

Using the following equality

$$\Pi = v \int_{\underline{k}}^{\overline{k}} \partial F(k)$$

the change in credit market surplus can be denoted as

$$\Delta S_{credit} = \frac{v - \Pi}{2\tau} \Pi_b$$

Total surplus. Total change in economic surplus is the sum of the changes in credit and payment markets derived above:

$$\Delta S = \frac{v - \Pi}{2\tau} \Pi_b - \frac{cov(\pi_b(k), \pi_f(k))}{2\tau} - \frac{var(\pi_b(k))}{4\tau}$$

Rearranging the terms gives

$$\begin{aligned}
\Delta S &= \frac{\int_0^1 \pi_b(k) v - \Pi_b \Pi_f - \Pi_b^2 - \int_0^1 \pi_b(k) \pi_f(k) \partial F(k) + \Pi_b \Pi_f}{2\tau} - \frac{var(\pi_b(k))}{4\tau} \\
&= \frac{\int_0^1 \pi_b(k)(v - \pi_f(k)) \partial F(k) - \Pi_b^2}{2\tau} - \frac{var(\pi_b(k))}{4\tau}
\end{aligned}$$

Remember that $\pi_b(k) = 0$ for $k \not\in [\underline{k}, \overline{k}]$ and that $\pi(k) = v$ for $k \in [\underline{k}, \overline{k}]$ and zero otherwise. Using these we can write

$$\int_0^1 \pi_b(k)(v - \pi_f(k)) \partial F(k) = \int_{\underline{k}}^{\overline{k}} \pi_b(k)(\pi(k) - \pi_f(k)) \partial F(k) = \int_{\underline{k}}^{\overline{k}} \pi_b^2(k) \partial F(k) = \int_0^1 \pi_b^2(k) \partial F(k)$$

Substituting this into ΔS gives

$$\begin{aligned}\Delta S &= \frac{\int_0^1 \pi_b^2(k)\partial F(k) - \Pi_b^2}{2\tau} - \frac{var(\pi_b(k))}{4\tau} \\ &= \frac{var(\pi_b(k))}{2\tau} - \frac{var(\pi_b(k))}{4\tau} \\ &= \frac{var(\pi_b(k))}{4\tau}\end{aligned}$$

A.6 Proof of Proposition 2

Bank profit. Aggregating (A.4) over k gives the bank's aggregate market share under the OB regime:

$$\gamma^{OB} = \frac{1}{2} + \frac{\Pi}{6\tau}$$

Notice that $\gamma^{OB} = \gamma$, i.e. the aggregate market share is unchanged under the OB regime despite the bank charging higher prices for its payment service. The bank's new profit can be written as

$$S_b^{OB} = p_b^{OB} \cdot \gamma^{OB}$$

We know that the change in bank's payment service price is

$$\Delta p_b = \Pi_b$$

The change in bank profit is then given by

$$\Delta S_b = \underbrace{\Pi_b \cdot \gamma}_{\text{gain PS market}} - \underbrace{\int_0^1 \pi_b(k)\gamma(k) dF(k)}_{\text{loss credit market}}$$

where the first term captures the bank's profit increase at the payment market and the second term is the loss of all surplus at the credit market. Remember that bank's market share among firms with capital k absent interoperability is

$$\gamma(k) = \underbrace{\frac{1}{2} + \frac{\Pi}{6\tau}}_{\gamma} + \frac{\pi_f(k) - \Pi_f}{2\tau}$$

Rearranging the expression above and substituting $\gamma(k)$ gives

$$\begin{aligned}
\Delta S_b &= \Pi_b \cdot \int_0^1 \gamma(k) dF(k) - \int_1^0 \pi_b(k)\gamma(k) dF(k) \\
&= \int_0^1 (\Pi_b - \pi_b(k))\gamma(k) dF(k) \\
&= \gamma \underbrace{\int_0^1 (\Pi_b - \pi_b(k)) dF(k)}_{0} + \frac{1}{2\tau}\int_0^1 (\Pi_b - \pi_b(k))(\pi_f(k) - \Pi_f) dF(k) \\
&= \frac{1}{2\tau}\left(\Pi_b \Pi_f - \int_0^1 \pi_b(k)\pi_f(k) dF(k)\right) \\
&= -\frac{cov(\pi_b(k), \pi_f(k))}{2\tau}
\end{aligned}$$

FinTech payment's profit. Neither the aggregate market share nor the equilibrium payment service price changes for the FinTech payment under the OB regime. Consequently, its profit remains the same.

Total firm surplus. The total surplus of firms across both markets is given by

$$\begin{aligned}
S_f &= \int_0^1 \left(\underbrace{\int_0^{\gamma(k)} (\pi_f(k,b) + u - p_b - \tau \cdot x) \partial F(x)}_{\text{bank customers}} + \underbrace{\int_0^{1-\gamma(k)} (\pi_f(k,ft) + u - p_{ft} - \tau \cdot x) \partial F(x)}_{\text{FinTech payment customers}} \right) \partial F(k) \\
&= u - p_{ft} + \int_0^1 \Big(\gamma(k)(\pi_f(k,b) + p_{ft} - p_b) + (1-\gamma(k))\pi_f(k,ft) - \frac{\tau}{2}(\gamma^2(k) + (1-\gamma(k))^2)\Big) \partial F(k) \\
&= u - p_{ft} - \frac{\tau}{2} + \int_0^1 \big(\pi_f(k,ft) + \gamma(k)(\pi_f(k) + \tau(1-\gamma(k)) + p_{ft} - p_b)\big) \partial F(k) \qquad \text{(A.5)}
\end{aligned}$$

Notice that neither the part outside the integral nor the credit market payoffs for FinTech payment customers change with OB. Then, the change in total firm surplus can be written as

$$\Delta S_f = \int_0^1 \Big(\gamma^{OB}(k)(\pi_f^{OB}(k) + \tau(1-\gamma^{OB}(k)) + p_{ft}^{OB} - p_b^{OB}) - \gamma(k)(\pi_f(k) + \tau(1-\gamma(k)) + p_{ft} - p_b)\Big) dF(k)$$

Substituting equilibrium prices and rearranging the expression gives

$$\Delta S_f = \int_0^1 \big(\gamma^{OB}(k) - \gamma(k)\big)\left(\tau(1-\gamma^{OB}(k) - \gamma(k)) - \frac{2\Pi}{3} + \pi(k)\right) + \gamma(k)\,(\pi_b(k) - \Pi_b)\, dF(k)$$

Substituting equilibrium market shares gives

$$\Delta S_f = \int_0^1 \frac{\pi_b(k)-\Pi_b}{2\tau}\cdot\frac{\pi_b(k)-\Pi_b}{2} + \left(\frac{1}{2}+\frac{\Pi}{6\tau}+\frac{\pi_f(k)-\Pi_f}{2\tau}\right)\cdot(\pi_b(k)-\Pi_b)dF(k)$$
$$= \int_0^1 \frac{(\pi_b(k)-\Pi_b)^2}{4\tau} + \frac{(\pi_b(k)-\Pi_b)(\pi_f(k)-\Pi_f)}{2\tau}\partial F(k) + (\frac{1}{2}+\frac{\Pi}{6\tau})\underbrace{\int_0^1 (\pi_b(k)-\Pi_b)\partial F(k)}_{0}$$
$$= \frac{var(\pi_b(k))}{4\tau} + \frac{cov(\pi_b(k),\pi_f(k))}{2\tau}$$

A.7 Proof of Proposition 3

Payment market surplus. Following from (A.3), the change in the payment market surplus under the OF regime is given by

$$\Delta S_{payment} = -\tau \int_0^1 (\gamma^{OF}(k)-\gamma(k))\cdot(\gamma^{OF}(k)+\gamma(k)-1)\partial F(k))$$

Notice that, under the OF regime, the bank makes no profit from lending, that is $\pi_b^{OF}(k) = 0$ for all k, and being a bank PS customer brings firms no additional surplus at the credit market, that is $\pi_f^{OF}(k) = 0$ for all k. These also imply

$$\Pi_f^{OF} = \Pi_b^{OF} = \Pi_b = 0$$

Substituting these into (9) gives the bank's market share under the OF regime, that is

$$\gamma^{OF}(k) = \frac{1}{2} \tag{A.6}$$

Substituting (A.4) and (9) into the expression above gives

$$\Delta S_{payment} = -\tau \int_0^1 \left(-\frac{\Pi}{6\tau}-\frac{\pi_f(k)-\Pi_f}{2\tau}\right)\left(\frac{\Pi}{6\tau}+\frac{\pi_f(k)-\Pi_f}{2\tau}\right)\partial F(k)$$
$$= \frac{1}{36\tau}\int_0^1 (\Pi + 3(\pi_f(k)-\Pi_f))^2 \partial F(k)$$
$$= \frac{1}{36\tau}\left(\Pi^2 + 9\underbrace{\int_0^1 (\pi_f(k)-\Pi_f)^2\partial F(k)}_{var(\pi_f(k))} + 6\Pi\underbrace{\int_0^1 (\pi_f(k)-\Pi_f)\partial F(k)}_{0}\right)$$
$$= \frac{\Pi^2}{36\tau} + \frac{var(\pi_f(k))}{4\tau}$$

Credit market surplus. Just as before, all highly-constrained firms are rationed and all unconstrained firms are financed without monitoring under the OF regime. What changes with OF is that moderately-constrained firms are no longer obliged to use the bank's payment service in order to access financing. These firms can now be monitored and financed by any creditor irrespective of their choice of payment service. The change in the total surplus created at the credit market is then given by

$$\Delta S_{credit} = v \int_{\underline{k}}^{\overline{k}} \left(1 - \gamma(k)\right) \partial F(k)$$

where $v = \rho_H \theta - 1 - M$ denotes the net value of a monitored project. Substituting (9) gives

$$\begin{aligned}
\Delta S_{credit} &= v \int_{\underline{k}}^{\overline{k}} \left(\frac{1}{2} - \frac{\Pi}{6\tau} - \frac{\pi_f(k) - \Pi_f}{2\tau} \right) \partial F(k) \\
&= \left(\frac{1}{2} - \frac{\Pi}{6\tau} + \frac{\Pi_f}{2\tau} \right) \underbrace{\int_{\underline{k}}^{\overline{k}} v \partial F(k)}_{\Pi} - \frac{v}{2\tau} \underbrace{\int_{\underline{k}}^{\overline{k}} \pi_f(k) \partial F(k)}_{\Pi_f} \\
&= \frac{\Pi}{2} - \frac{\Pi^2}{6\tau} - \frac{\Pi_f}{2\tau}(v - \Pi)
\end{aligned}$$

Total surplus. Total change in economic surplus is the sum of the changes in credit and payment markets derived above:

$$\begin{aligned}
\Delta S &= \Delta_{payment} + \Delta_{credit} \\
&= \frac{\Pi}{2} + \frac{\Pi^2}{9\tau} - \frac{\Pi v}{4\tau} + \frac{var(\pi_b(k))}{4\tau}
\end{aligned}$$

A.8 Proof of Proposition 4

Bank's profit. Remember that the bank loses all credit market surplus under the OF regime. The change in bank profit is then given by

$$\Delta S_b = \underbrace{(p_b^{OF} - c)\gamma^{OF} - (p_b - c)\gamma}_{\text{gain PS market}} - \underbrace{\int_{\underline{k}}^{\bar{k}} \pi_b(k) \gamma(k) dF(k)}_{\text{loss credit market}}$$

Substituting equilibrium prices and market shares gives

$$\begin{aligned}
\Delta S_b &= \frac{\tau}{2} - \left(\tau + \frac{\Pi}{3} \right) \cdot \left(\frac{1}{2} + \frac{\Pi}{6\tau} \right) - \int_{\underline{k}}^{\bar{k}} (\pi_b(k) - \Pi_b) \left(\frac{1}{2} + \frac{\Pi}{6\tau} + \frac{\pi_f(k) - \Pi_f}{2\tau} \right) dF(k) \\
&= -\frac{\Pi}{3} - \frac{\Pi^2}{18\tau} + \left(\frac{1}{2} + \frac{\Pi}{6\tau} \right) \underbrace{\int_{\underline{k}}^{\bar{k}} (\pi_b(k) - \Pi_b) dF(k)}_{0} - \frac{1}{2\tau} \underbrace{\int_{\underline{k}}^{\bar{k}} (\pi_b(k) - \Pi_b)(\pi_f(k) - \Pi_f) dF(k)}_{cov(\pi_b(k), \pi_f(k))} \\
&= -\left(\frac{\Pi}{3} + \frac{\Pi^2}{18\tau} + \frac{cov(\pi_b(k), \pi_f(k))}{2\tau} \right)
\end{aligned}$$

Total firm surplus. Adapting (A.5), the change in total firm surplus under OF is given by

$$\Delta S_f = p_{ft} - p_{ft}^{OF} + \int_0^1 \pi_f^{OF}(k, ft) - \pi_f(k, ft)\partial F(k)$$
$$+ \int_0^1 \left(\gamma^{OF}(k)(\pi_f^{OF}(k) + \tau(1-\gamma^{OF}(k)) + p_{ft}^{OF} - p_b^{OF}) - \gamma(k)(\pi_f(k) + \tau(1-\gamma(k)) + p_{ft} - p_b)\right) dF(k)$$

Remember that data regimes do not affect credit market outcomes for highly-constrained and unconstrained firms. Also remember that the moderately constrained firms that use the FinTech payment alternative do not get financed in the absence of data sharing while they all receive financing and retain the entire project surplus under the OF regime, i.e.

$$\int_0^1 \pi_f^{OF}(k, ft) - \pi_f(k, ft)\partial F(k) = \Pi$$

Lastly, remember that under the OF regime, a firm's choice of payment service does not affect its credit market outcome, i.e. $\pi_f^{OF}(k) = 0$ for all k. Using these observations and substituting the equilibrium prices and market shares into the expression for the change in total firm surplus gives

$$\begin{aligned}
\Delta S_f &= -\frac{\Pi}{3} + \Pi + \tau \int_0^1 \frac{1}{4} - \left(\frac{1}{2} + \frac{\Pi}{6\tau} + \frac{\pi_f(k) - \Pi_f}{2\tau}\right)^2 \partial F(k) \\
&= -\frac{\Pi}{3} + \Pi - \tau \left(\frac{\Pi}{6\tau} + \frac{\Pi^2}{36\tau^2} + \frac{1}{4\tau^2} \underbrace{\int_0^1 (\pi_f(k) - \Pi_f)^2 \partial F(k)}_{var(\pi_f(k))} + \left(\frac{1}{2} + \frac{\Pi}{6\tau}\right) \underbrace{\int_0^1 (\pi_f(k) - \Pi_f)\partial F(k)}_{0}\right) \\
&= \frac{\Pi}{2} - \frac{\Pi^2}{36\tau} - \frac{var(\pi_f(k))}{4\tau}
\end{aligned}$$

FinTech payment's profit. The change in the FinTech payment's profit is given by

$$\Delta S_{ft} = (p_{ft}^{OF} - c)(1-\gamma^{OF}) - (p_{ft} - c)(1-\gamma)$$

Substituting equilibrium prices and market shares gives

$$\begin{aligned}
\Delta S_{ft} &= \frac{\tau}{2} - \left(\tau - \frac{\Pi}{3}\right)\left(\frac{1}{2} - \frac{\Pi}{6\tau}\right) \\
&= \frac{\Pi}{3}\left(1 - \frac{\Pi}{6\tau}\right)
\end{aligned}$$

Let us validate our solutions by showing that we find the same expression for total surplus both when summing over the markets and when summing over sectors:

$$
\begin{aligned}
\Delta S &= \Delta S_f + \Delta S_b + \Delta S_{ft} \\
&= \frac{\Pi}{2} - \frac{5\Pi^2}{36\tau} - \frac{var(\pi_f(k)) + 2cov(\pi_f(k), \pi_b(k))}{4\tau} \\
&= \frac{\Pi}{2} - \frac{5\Pi^2}{36\tau} - \frac{1}{4\tau}\int_0^1 (\pi_f(k) - \Pi_f)(\pi_f(k) - \Pi_f + 2(\pi_b(k) - \Pi_b))\partial F(k) \\
&= \frac{\Pi}{2} - \frac{5\Pi^2}{36\tau} - \frac{1}{4\tau}\left(\int_0^1 (\pi(k) - \Pi)^2 \partial F(k) - \underbrace{\int_0^1 (\pi_b(k) - \Pi_b)^2 \partial F(k)}_{var(\pi_b(k))}\right) \\
&= \frac{\Pi}{2} - \frac{5\Pi^2}{36\tau} - \frac{\int_0^1 (\pi(k))^2 \partial F(k)}{4\tau} + \frac{\Pi^2}{4\tau} + \frac{var(\pi_b(k))}{4\tau}
\end{aligned}
$$

Remember the following equality

$$
\int_0^1 (\pi(k))^2 \partial F(k) = \int_{\underline{k}}^{\bar{k}} (\pi(k))^2 \partial F(k) = v\Pi
$$

Substituting this to the surplus change expression above gives

$$
\Delta S = \frac{\Pi}{2} + \frac{\Pi^2}{9\tau} - \frac{v\Pi}{4\tau} + \frac{var(\pi_b(k))}{4\tau}
$$

which is equivalent to the total surplus expression derived in section A.7.

A.9 Proof of Lemma 7

Equilibrium results follow the same reasoning in Lemma 1 for all firms except for those that are moderately constrained and do not use the bank's payment service. These firms now can be monitored by either creditor and thus will be offered the competitive loan rate for monitored loans, i.e. $\underline{r}_1$. Consequently, these firms will retain the entire project surplus, i.e. $\rho_H \phi - 1 - M$, while the bank makes no profit from lending them.

A.10 Proof of Lemma 8

The public payment maximizes total firm surplus subject to its budget constraint:

$$\max_{p_p} S_f = \int_0^1 \left(\underbrace{\int_0^{\gamma(k)} (\pi_f(k,b) + u - p_b - \tau \cdot x) \partial F(x)}_{\text{bank customers}} + \underbrace{\int_0^{1-\gamma(k)} (\pi_f(k,p) + u - p_p - \tau \cdot x) \partial F(x)}_{\text{public payment customers}} \right) \partial F(k)$$

$$\text{subject to} \quad p_p \geq c$$

We can rewrite this expression as follows:

$$\begin{aligned} S_f &= u - p_p + \int_0^1 \Big(\gamma(k)(\pi_f(k,b) + p_p - p_b) + (1-\gamma(k))\pi_f(k,p) - \frac{\tau}{2}(\gamma^2(k) + (1-\gamma(k))^2) \Big) \partial F(k) \\ &= u - p_p - \frac{\tau}{2} + \int_0^1 \big(\pi_f(k,p) + \gamma(k)(\pi_f(k) + \tau(1-\gamma(k)) + p_p - p_b) \big) \partial F(k) \end{aligned} \tag{A.7}$$

Setting first-order derivative to zero gives

$$\begin{aligned} \frac{\partial S_f}{\partial p_p} &= -1 + \int_0^1 \left(\frac{p_p - p_b + \pi_f(k) + \tau(1-\gamma(k))}{2\tau} + \frac{\gamma(k)}{2} \right) \partial F(k) \\ &= \frac{p_p - p_b + \Pi_f - \tau}{2\tau} = 0 \iff p_p = p_b + \tau - \Pi_f = p' \end{aligned} \tag{A.8}$$

The second-order derivative of the surplus expression is positive

$$\frac{\partial^2 S_f}{\partial p_p^2} = \frac{1}{2\tau} > 0$$

i.e. the surplus function is convex and reaches the minimum at p'. We constrain our analysis to interior solutions, i.e. we are interested in equilibria where $0 < \gamma(k) < 1$ holds for all k. By (8), the generic expression for the bank's market share is given by

$$\gamma(k) = \frac{1}{2} + \frac{p_p - p_b}{2\tau} + \frac{\pi_f(k)}{2\tau}$$

which is maximized at $\underline{k}$:

$$\gamma(\underline{k}) = \frac{\tau + p_p - p_b}{2\tau}$$

and minimized for equity values $k \in (\hat{k}, \overline{k})$:

$$\gamma(k) = \frac{\tau + p_p - p_b - v}{2\tau} \quad \text{for} \quad k \in (\hat{k}, \overline{k})$$

By equating these expressions to 1 and 0 respectively, we can derive that an interior solution must satisfy

$$p_p \in [p_b - \tau + v, p_b + \tau]$$

We assume $\frac{v}{2} < \tau$ to ensure that this interval is not empty. Notice that $p_b + \tau < p'$ which indicates

$$\frac{\partial S_F}{\partial p_p} < 0 \quad \text{for} \quad [p_b - \tau + v, p_b + \tau]$$

i.e. the smaller is p_p, the higher is the total firm surplus in this interval. Let us assume that $p_p = c$ satisfies the interior solution condition above. Then, the public payment service price that brings the highest total firm surplus is given by

$$p_p = c$$

Let us now turn to the bank's problem. The bank maximizes its total surplus across both markets, i.e.

$$S_B = \int_0^1 (\pi_b(k) + p_b - c)\gamma(k)\partial F(k)$$

Setting the first-order derivative to zero gives

$$\frac{\partial S_B}{\partial p_b} = 0 \iff p_b = \frac{\tau + c + p_p - 2\Pi_b}{2}$$

Substituting for p_p gives

$$p_b = \frac{\tau}{2} + c - \Pi_b \tag{A.9}$$

We rewrite the condition for an internal solution by substituting for equilibrium prices:

$$c \in [v - \frac{\tau}{2} + c - \Pi_b, \frac{3\tau}{2} + c - \Pi_b] \iff \tau > \frac{2\Pi_b}{3} \ \& \ \tau > 2(v - \Pi_b)$$

We assume that τ satisfies the conditions above.

A.11 Proof of Proposition 5

Payment market surplus. Let us first derive the equilibrium for when a data-sharing mandate is imposed on private payments. The public payment again maximizes total firm surplus subject to its budget constraint. Notice that, this time, firms attain the same surplus in the credit market regardless of their choice of payment method, i.e.

$$\pi_f(k) = 0 \quad \forall k \longrightarrow \Pi_f = 0$$

The bank's conditional market share is then given by

$$\gamma(k) = \frac{1}{2} + \frac{p_p - p_b}{2\tau}$$

which translates to the following condition for an interior solution

$$p_p \in [p_b - \tau, p_b + \tau]$$

Assuming once again that $p_p^{OB} = c$ satisfies the condition above, we find the public payment service price that brings the highest total firm surplus is the same as the case with no data-sharing mandate, i.e.

$$p_p^{OB} = c$$

Solving for the bank's optimization problem and substituting for $p_b^{OB} = c$ gives (A.9). Notice that the bank makes no profit from lending in this data regime given that it has no more informational advantage over the FinTech lender, i.e. $\Pi_b = 0$. Substituting this to (A.9) gives the equilibrium bank payment service price:

$$p_b^{OB} = \frac{\tau}{2} + c$$

Rewriting the condition for an internal solution by substituting for equilibrium prices shows that the equilibrium solution satisfies the condition:

$$c \in [c - \frac{\tau}{2}, c + \frac{3\tau}{2}]$$

Notice that Lemma 7 implies the following equivalence

$$\pi_b(k) = -\pi_f(k) \quad \forall k$$

which allows us to rewrite (8) as

$$\gamma(k) = \frac{1}{2} + \frac{p_p - p_b}{2\tau} - \frac{\pi_b(k)}{2\tau}$$

Substituting respective equilibrium prices for both data regimes to this expression gives the equilibrium market shares:

$$\gamma(k) = \frac{1}{4} - \frac{\pi_b(k) - \Pi_b}{2\tau}$$
$$\gamma^{OB}(k) = \frac{1}{4}$$

Finally, substituting the equilibrium market share expressions above into the generic expression for the change in payment market surplus denoted by (A.3) gives

$$\Delta S_{payment} = \tau \int_0^1 \left(\frac{\pi_b(k)-\Pi_b}{2\tau}\right)\left(\frac{1}{2}+\frac{\pi_b(k)-\Pi_b}{2\tau}\right)\partial F(k)$$
$$= \frac{var(\pi_b(k))}{4\tau}$$

Credit market surplus. The credit market surplus remains the same since OB changes nothing in terms of the financing rule of different firm types. Just as before, all highly-constrained firms are rationed, all unconstrained firms are financed without monitoring while all moderately-constrained firms are financed with monitoring.

Total surplus. The change in total surplus is equal to the sum of the changes in each market's surplus.

$$\Delta S = \frac{var(\pi_b(k))}{4\tau}$$

A.12 Proof of Proposition 6

Firm surplus. Let us now derive the total firm surplus by substituting for equilibrium prices and market shares into (12). When there is no data-sharing mandate on private payments, total firm surplus is given by

$$S_F = u - c - \frac{7\tau}{16} + \int_0^1 \pi_f^P(k,p)\partial F(k) + \frac{var(\pi_b(k))}{4\tau}$$

whereas with a data-sharing mandate on private payments it is given by

$$S_F^{OB} = u - c - \frac{7\tau}{16} + \int_0^1 \pi_f^P(k,p)\partial F(k)$$

Subtracting the former from the later gives the change in the total firm surplus:

$$\Delta S_F = -\frac{var(\pi_b(k))}{4\tau}$$

Bank profit. Aggregating over $\gamma(k)$

$$\gamma = \int_0^1 \frac{1}{4}\partial F(k) + \underbrace{\int_0^1 \frac{\pi_b(k)-\Pi_b}{2\tau}\partial F(k)}_{0} = \frac{1}{4}$$

shows that $\gamma = \gamma^{OB}$, i.e. the total market share of the bank does not change with the introduction of OB. Let us derive the change in the bank's payment service price after OB as

$$p_b^{OB} - p_b = \Pi_b$$

We also know that the bank loses all credit market profit when OB is implemented. Using these, we can denote the change in bank profit as

$$\Delta S_b = \underbrace{\Pi_b \cdot \gamma}_{\text{gain PS market}} - \underbrace{\int_0^1 \pi_b(k)\gamma(k)dF(k)}_{\text{loss credit market}}$$

Substituting for the equilibrium market share gives

$$\begin{aligned}\Delta S_b &= \frac{\Pi_b}{4\tau} - \int_0^1 \left(\frac{1}{4} - \frac{\pi_b(k) - \Pi_b}{2\tau}\right)\pi_b(k)\partial F(k) \\ &= \frac{var(\pi_b(k))}{2\tau}\end{aligned}$$

Public payment. Public payment prices its payment service at cost and thus operates at zero profit under both data regimes.

FinTech lender. FinTech lender operates at a competitive setting under both data regimes and thus makes no profit from lending.

The change in total surplus is given by

$$\frac{var(\pi_b(k))}{2\tau} - \frac{var(\pi_b(k))}{4\tau} = \frac{var(\pi_b(k))}{4\tau}$$

which is equivalent to what we find by summing over the two markets at A.11.