Who Bears the Welfare Costs of Monopoly? The Case of the Credit Card Industry*

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Abstract

We measure the distribution of welfare losses from non-competitive behavior in the U.S. credit card industry during the 1970s and 1980s. The early credit card industry was characterized by regional monopolies. Ensuing legal decisions led to competitive reforms that resulted in greater, but still limited, oligopolistic competition. We measure the distributional consequences of these reforms by developing and estimating a heterogeneous agent, defaultable debt framework with oligopolistic lenders. The transition from monopoly to oligopolistic competition yields welfare gains equivalent to a one-time transfer worth $3,600 (in 2016 dollars) for the bottom decile of earners (roughly 50% of their annual income) versus $1,200 for the top decile of earners. As the credit market expands, low-income households benefit more since they rely disproportionately on credit to smooth consumption. Greater competition also explains rising bankruptcies, chargeoffs, and credit to income ratios. Lastly, we bound the welfare gains from competition by computing a perfectly competitive benchmark. Aggregate welfare gains are 40% larger from perfect competition but distributed similarly to oligopolistic competition.

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1 Introduction

The view that the deadweight losses from monopoly are small – for example, Harberger (1954)'s study of American manufacturing in the 1920s – has been refuted repeatedly (see a summary of arguments by Schmitz (2012)). Recent work by Schmitz (2016) argues that across a number of industries, the costs of monopoly are large and borne by low-income households. We contribute to this literature by quantifying the welfare costs of monopoly in the U.S. credit card industry. We focus on the U.S. credit card industry in the 1970s and 1980s, a time period in which long-standing regional monopolies were broken down through a series of antitrust lawsuits and reforms. We analyze the distributional consequences of these reforms by integrating oligopolistic lenders into a Bewley-Huggett-Aiyagari framework with default. We find that increased competition during the late 1970s and early 1980s disproportionately benefited low-income households via enhanced consumption smoothing and also yielded sizeable aggregate welfare gains.

The first part of our paper synthesizes the historical narrative of competition in the credit card market from the 1960s through the 1980s. We draw on various secondary data sources, including Stearns (2007)'s interviews with Visa officers, to argue that credit card issuing banks (and the networks they owned) were effectively regional monopolies.[1] Interest rates charged far exceeded break-even pricing, and the industry engaged in openly non-competitive behavior that included blocking entry (e.g., the *MountainWest* case described in Section 2). Several landmark antitrust cases ultimately led to reforms. Even as the industry transitioned towards greater – but still limited – oligopolistic competition in the 1980s, there is suggestive evidence that lenders tacitly colluded on interest rates (e.g., Knittel and Stango (2003) and the California Attorney General lawsuit described in Section 2). Whether there was collusion or some intermediate form of competition in the 1980s, in our quantitative exercise, we bound the potential welfare losses from monopoly pricing by additionally considering a perfectly competitive market structure in the 1980s.

We then move beyond existing studies of competition by providing new analysis of lender price-setting behavior across credit cards and other loan markets. This part of our empirical analysis leads to two key takeaways. First, using quarterly bank-level data on interest rates from 1975 to 1982, we document that credit cards display a unique lack of price dispersion compared to similar 24-month unsecured personal expenditure loans. Second, we develop a method to measure pass-through in the presence of interest rate caps, and show that all other forms of consumer credit (subject to the same rate caps and regulations as credit cards) move in lockstep with both expected and unexpected movements in interest rates. Credit cards are uniquely unresponsive, yielding precisely zero pass-through from unexpected rate cuts to the *lowest* offered interest rate. We show the opposite behavior for comparable consumer credit loans, allowing us to rule out technological limitations, lender-household risk sharing, and regulations as explanations for the extremely low pass-through rate. We argue that greater competition for

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[1] It is important to note that the credit card networks (e.g., Visa's predecessor, the BankAmericard network, and Mastercard's predecessor, the Interbank Card Association) were owned by collections of banks, making the separation of payment network rents and card issuance rents both difficult and arbitrary.

consumer and auto loans – which were not subject to network licensing agreements in the credit card industry– drive the observed differences. Our empirical results are new to the literature and are at odds with existing competitive models, which predict high (or even complete) pass-through from the risk-free rate to the *lowest* offered interest rate (e.g., Livshits, MacGee, and Tertilt (2007, 2010) and Chatterjee, Corbae, Nakajima, and Ríos-Rull (2007)).

We use our empirical analysis to justify our departure from standard competitive models of the consumer credit market that typically assume atomistic, zero-profit lenders. Our primary theoretical contribution is to develop a Bewley-Huggett-Aiyagari framework in which a finite number of credit card firms strategically compete for customers. Additionally, our model integrates defaultable debt and non-exclusive credit lines, complementing the work of Bizer and DeMarzo (1992), Hatchondo and Martinez (2018), and Kovrijnykh, Livshits, and Zetlin-Jones (2019). We then use our model to measure the distributional consequences of competitive reforms that emerged from court rulings on exclusivity, competitor entry, and regional usury laws.

Our pre-reform benchmark economy features a single monopolist lender with limited ability to price-discriminate. This assumption is motivated by the historic narrative of BankAmericard's (subsequently Visa's) propensity to only license dominant banks within a region. Moreover, Wolters (2000) documents an extreme lack of price dispersion in the pilot BankAmericard program and Stearns (2007) documents lenders' reliance on uncustomized mass credit card solicitations, motivating our restrictions on price discrimination. While our model does not explicitly feature geographic regions, we view this calibration as capturing the key features of the regional monopolies in the 1960s and early 1970s. After estimating our model to match key credit card market moments, we show that our pure monopoly economy can replicate the zero pass-through rates observed in the data, whereas our competitive benchmark cannot. Additionally, our pure monopoly economy accounts for roughly 40% of the observed excess spreads in the 1970s and replicates the limited evidence available on the disparate access to credit among low- and high-earning households.

We conduct two main experiments: (1) we measure the welfare gains from replacing a monopoly lender with an oligopoly, and (2) we measure the gains from perfect competition. Our first experiment is designed to capture gains from greater entry resulting from the abandonment of exclusivity rules (e.g., following the *Worthen* case, which we discuss in the next section, Visa member banks were able to issue Mastercard credit cards) and the 1978 *Marquette* decision. Based on existing evidence of collusion and our new evidence on the extreme lack of price competition uniquely occurring in the credit card market, we view the 1970s and early 1980s as a period in which lenders colluded on interest rates but competed by issuing credit cards (i.e., lenders competed on credit limits).[2] We call this form of competition *collusive-Cournot*. While we appeal to academic and legal accusations of collusion to motivate this market structure, we also entertain a perfectly competitive market structure in our second experiment as a way to bound the gains from competition. In each experiment, we measure the distributional con-

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[2] While limited by the computationally demanding nature of our problem, we show that an alternate market structure that relaxes the assumption of interest rate collusion generates counterfactual implications for interest rate dispersion as well as charge-offs.

sequences of imperfect competition in the credit card market using Wealth Equivalent Variation (WEV). This is the one-time asset transfer that makes an individual in the monopoly environment indifferent to the oligopoly environment. WEV provides two advantages over the traditional Consumption Equivalent Variation (CEV): (i) since WEV is in terms of dollars, it provides simple aggregation; and (ii) agents are allowed to reoptimize upon receipt of the one-time transfer. Nonetheless, we also provide CEV for all of our experiments.

Our first experiment assumes that the monopolist is replaced by a collusive-Cournot oligopoly of 20 lenders, where the number of lenders is motivated by the inverse Herfindahl in the late 1980s. We find that moving from pure monopoly to a 20-lender collusive-Cournot oligopoly yields welfare gains to the lowest-income decile of households equivalent to a one-time transfer worth $3,600 (in 2016 dollars), or 50% of their annual income. Most of these gains result from the 90% increase in credit limits, which improves consumption smoothing. Spreads fall; however, the magnitudes are relatively small. This is because lenders maintain collusion on interest rates. Those in the top earnings decile also gain for similar reasons, but by roughly three times less than the bottom decile. This reflects the disproportionate burden of monopoly power borne by low-income households, providing further support to Schmitz (2016). More generally, the reform is worth 0.73% of lifetime consumption for a newborn individual with zero assets. Further, the transition from monopoly to collusive-Cournot oligopoly is a near Pareto improvement. Only a small minority of households are hurt because lender profits, which are re-distributed to households with high earnings, decrease along the transition path.

We additionally show that the transition from monopoly to collusive-Cournot oligopoly simultaneously captures the observed trends in credit, bankruptcies, chargeoffs, credit among bankrupts, and interest rate dispersion. We view increased competition as a rationale for these trends, complementing existing work by Athreya, Tam, and Young (2012), Livshits, MacGee, and Tertilt (2016), and Sánchez (2018) who argue that technological changes in credit scoring are important in accounting for these trends during this time period.

Our second experiment computes the welfare gains from forcing a single lender monopoly to price competitively and earn zero profits. Rather than impose a market structure that assumes collusion, this exercise entertains the idea that lenders behaved perfectly competitively after the reforms of the 1960s and 1970s, and thus establishes an upper bound on the welfare costs of monopoly pricing. For the lowest 10% of earners, transitioning from monopoly to competitive pricing is equivalent to a one-time transfer worth nearly $5,000 (in 2016 dollars), or roughly 70% of annual income. Low earners benefit from higher credit limits, which double, and lower interest rates, which fall by 50%. Relative to the top 10% of earners, the bottom 10% have WEV welfare gains from competitive pricing that are three times larger. This further substantiates the point that low-income households disproportionately suffer welfare losses from monopolistic credit card pricing. Comparing these welfare gains to our first experiment, welfare gains are 40% larger but distributed in a similar way to oligopolistic competition.

We next review the literature and then proceed as follows: Section 2 empirically analyzes the competitive structure of the U.S. credit card market; Section 3 describes the model; Section 4 discusses model estimation; Section 5 provides model validation exercises; Section 6 delivers the main results from our simulated reforms; Section 7 includes robustness exercises; and Section 8 concludes.

Relation to literature. Our paper is related to competitive consumer credit models (Livshits et al. (2007, 2010) and Chatterjee et al. (2007)) as well as recent models that generate lender market power via search and bargaining (e.g., Wasmer and Weil (2004), Drozd and Nosal (2008), Petrosky-Nadeau and Wasmer (2013), Bauducco and Janiak (2015), Galenianos and Nosal (2016), Herkenhoff (2019), Raveendranathan (2020), Galenianos, Law, and Nosal (2021)). What makes the search models of the credit market tractable are the assumptions of atomistic lenders, free entry, and a small open economy. There is also a relatively new and innovative Industrial Organization literature that uses discrete choice frameworks to generate monopoly power among credit card lenders (Grodzicki (2015), Nelson (2018), and Galenianos and Gavazza (2022)). What makes Grodzicki (2015) and Nelson (2018) tractable is the partial equilibrium nature of the models and exogenous default. Our paper is closest to Galenianos and Gavazza (2022)'s which develops and estimates a static search model of lending that they use to study welfare implications of interest rate caps. We contribute to both of these literatures by developing a dynamic model of credit market oligopoly with defaultable debt.

Another class of models relates improvements in screening technology to greater credit limits and greater competition in the credit market (e.g., Livshits et al. (2016), Grodzicki (2019), and Sánchez (2018)). Whereas early contributions such as Ausubel (1991) document a lack of competition in the credit market throughout the 1970s and 1980s, Grodzicki (2019) makes a strong empirical argument that there has recently been an increase in competition in the credit market. Drozd and Nosal (2008) and Galenianos and Nosal (2016) also argue that reductions in entry costs – and thus increased competition – are quantitatively consistent with the rise in debt and defaults from the 1980s to the 1990s. In our framework, as additional oligopolists enter the credit market (i.e., as the market moves from monopoly to oligopoly in the 1980s), our competitive structure generates increases in credit access and defaults that likely complement screening technology improvements.

Our paper relates to theoretic and quantitative models of credit lines (Drozd and Nosal (2008), Mateos-Planas and Seccia (2006), Mateos-Planas and Seccia (2013), Drozd and Serrano-Padial (2013), Drozd and Serrano-Padial (2017), Raveendranathan (2020), and Braxton, Herkenhoff, and Phillips (2018)). Others, including Bizer and DeMarzo (1992), Hatchondo and Martinez (2018), and Kovrijnykh et al. (2019), consider one-period debt contracts without commitment. Our contribution to this literature is to incorporate non-exclusive credit lines into a Bewley-Huggett-Aiyagari economy with default.

Our model is also related to the quantitative banking literature (e.g., Corbae and D'erasmo (2011), Corbae and D'Erasmo (2021), Jamilov (2021)) and the partial equilibrium industrial organization banking literature (e.g., Egan, Hortaçsu, and Matvos (2017), Benetton (2021), and Wang, Whited, Wu, and Xiao (2022)). Of particular note, Corbae and D'Erasmo (2021) consider a Stackelberg leader bank that faces a competitive fringe – the fringe takes rates as given and competes in Cournot competition with the leader where free entry reduces ex-ante profits to zero.

In terms of empirics, we make several advances relative to Ausubel (1991), Knittel and Stango (2003), and Grodzicki (2015) and the existing empirical literature. First, we use comprehensive quarterly data covering the highest/lowest and most common credit card interest rates charged between 1975 and 1982.[3] Second, we make methodological improvements to the measurement of pass-through. Both Ausubel (1991) and Grodzicki (2015) ignore interest rate caps as well as forecastable components of monetary policy by simply regressing the most common interest rate on lagged federal funds rates. Our identification circumvents these issues by measuring pass-through from *surprise* monetary rate cuts to the *lowest* charged interest rate *among banks whose lowest credit card interest rate is below the cap*. We find zero pass-through to the lowest credit card rate, allowing us to rule out several competitive market structures that are common in the literature. Third, we compare pass-through of the lowest offered credit card and consumer loan rates to rule out various explanations for the lack of pass-through observed in the data. We deduce the presence of imperfect competition.

Lastly, we contribute to a recently growing macroeconomic literature that attempts to quantify the welfare consequences of market power and strategic interactions (e.g., Mongey (2019), Edmond, Midrigan, and Xu (2018), Baqaee and Farhi (2017), and Berger, Herkenhoff, and Mongey (2022)).

2 Competition in the U.S. credit card industry

In this section, we provide a description of market structure and pricing practices in the credit card industry from the 1950s through the 1980s. Our analysis in this section motivates our modeling assumptions about competition as well as our competitive reform counterfactuals.

2.1 The early years of credit card industry

Market concentration. Our narrative for competition in the 1950s and 1960s relies on Stearns (2007) who used a series of primary data sources and interviews to characterize the early credit card industry. Stearns (2007) discusses the creation of the first credit card by Bank of America in 1958, and he writes that in the early 1960s, "Initially BofA licensed only one bank in any particular geographic area, essentially providing it with a local monopoly. These licensee banks typically had correspondent relationships with BofA, and thus were 'loyal' or at least tied to BofA in some sense" (p. 50). Moreover, Stearns (2007) documents that there were only 254 licensed banks as of 1968, and, through interviews with Bennett Katz, Visa's long-time general counsel, Stearns (2007) writes that most licensed banks were "dominant in their geographic area" (p. 62) and that "when BofA franchised the program in 1966, it gave most banks exclusive licenses for their territory" (p. 123). BankAmericard and its licensee banks faced limited competition from outside their network. Evans and Schmalensee (2005) describe regional specialization of the three main bank-network groups during this era: BankAmericard was primarily in the West; American Express was primarily in New York, New England, New Jersey, and Pennsylvania; and the Interbank Card Association was primarily in the Midwest (Evans and Schmalensee (2005), p. 62-63).

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[3] Ausubel (1991)'s pass-through analysis was based on a small, self-administered survey of roughly 50 banks. Knittel and Stango (2003) only digitized the most common rate for a different time period.

It is important to discuss the ownership of networks during this time period. The credit card networks (e.g., Visa and Mastercard, where BankAmericard would eventually become known as Visa and the Interbank Card Association would eventually become known as Mastercard) were owned by collections of banks. Accordingly, in our model, we treat the banks and networks as one profit maximizing entity during this time period.

Credit card pricing. We briefly discuss the lack of price discrimination observed in early years of the credit card industry, and then document significant deviations from competitive pricing in 1974, the first year for which the G.19 series is available from the Board of Governors.[4]

First, we discuss price discrimination. Through primary source documents from Bank of America's corporate archives, Wolters (2000) obtained copies of the planning documents for the first BankAmericard program in Frenso, California in 1958. Wolters (2000) writes that "Customers who met appropriate credit standards would receive cards with maximum limits of either \$300 or \$500" (p. 329). He also writes that "...the proposed 'Bank of America Credit Card' consisted of only one type of account, assessed a service charge of 1.5 percent per month on unpaid balances carried thirty days past the end of a billing cycle..." (p. 329). These historic accounts imply very little contract contingency (i.e., interest rates and limits were not individually tailored or dynamically updated). Stearns (2007) documents that many early credit card campaigns were "unsolicited mass-issuance of cards in the late 1960s." The mail contained a usable credit card in the recipients' name, implying no further income checks.[5]

Second, we measure deviations from competitive pricing beginning in the early 1970s. To measure how far the credit card industry is from competitive pricing, we use the limited data available during this time period to measure *excess spreads*. We compute excess spreads as the difference between the *actual spread* and the *zero-profit spread*. The *actual spread* (τ_{actual}) is computed as the difference between the (cross-sectional) average credit card interest rate and the Moody's Aaa rate. The *zero-profit spread* is defined as the spread that credit card firms must charge on interest income to break even. Let τ_{zero} denote the zero-profit spread, D denote the charge-off rate, B denote outstanding revolving credit, r denote the Moody's Aaa rate, and τ_o denote the transaction cost net of non-interest income. We compute τ_o as follows: (operational cost + rewards and fraud - fee income - interchange income)/(outstanding revolving credit). Note that interchange income accrues to the issuing bank (e.g., Bank of America), not to the network (e.g., Visa).[6] Given D, B, r, and τ_o, we estimate the zero-profit spread from the following break even equation:

$$(1-D)B(1+r+\tau_{zero}) = B(1+r+\tau_o). \tag{1}$$

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[4] The historic G.19 series data are available here: `http://www.federalreserve.gov/publications/other-reports/credit-card-profitability-2012-recent-trends-in-credit-card-pricing.htm`.

[5] This practice led to widespread fraud and spurred Congress to ban the practice through the Truth in Lending Act (Stearns (2007), p. 59)

[6] Visa and Mastercard earn profits from *network fees* (also called *credit association fees*) that are typically 0.5% of transaction volume. Visa and Mastercard also set a separate fee called an *interchange fee*. Interchange fees are paid directly to the issuer banks and are typically equal to 1.5% to 3.0% of the transaction price. These interchange fees are tied to the generosity of the rewards program that the issuing banks choose. Cards that provide greater rewards can charge higher interchange fees, thus reward cards do not yield lower profits to issuer banks. See Hunt (2003) for more discussion.

The left hand side of (1) is total interest income net of charge-offs, and the right hand side is total cost net of non-interest income. Table 1 first presents the average excess spreads (1974-2016) under the assumption of zero transaction costs and zero non-interest income ($\tau_o = 0$). We then progressively add in the components of the transaction cost (e.g., operational costs, rewards and fraud) and components of the non-interest income (e.g., fee income, interchange income). We use estimates of the components of τ_o from Agarwal, Chomsisengphet, Mahoney, and Stroebel (2015), and in many instances, including our preferred specification, τ_o is negative.[7] A negative τ_o implies that the credit card industry makes profits even if we ignore interest income.

Table 1 shows that the average spread on credit cards is 3.42 percentage points above breaking even if we ignore transaction costs net of non-interest income. If we include all components of non-interest income, the excess spread reaches 8.84 percentage points above breaking even. This implies a range of markups between 44% and 115% on the Moody's Aaa average rate from 1974 to 2016 (7.72%). Our preferred specification adjusts for all components of non-interest income.

Figure 1 graphically depicts the times series of excess spreads. After adjusting for non-interest income (red line), excess spreads are positive every year from 1974 to 2016. Thus, compensation for risk is an unlikely explanation for the large deviation from break even spreads. While excess spreads remain significant in the 2000s, they have generally declined over time. Although other factors outside of the scope of this paper may simultaneously be increasing or decreasing spreads, this downward trend in spreads is consistent with increased competition in the credit card market (see contemporaneous work by Dempsey and Ionescu (2021) who also document large excess spreads post-2012 in Y-14 micro regulatory data).

Table 1: Credit card industry excess spreads (source: authors' calculations, see text)

Excess spread definition	**Avg. 1974-2016 (pp)**
Excess spread: no adjustments	3.42
Excess spread: operational costs, interchange income	3.21
Excess spread: operational costs, fee income, interchange income	11.13
Excess spread: operational costs, fee income, interchange income, rewards & fraud	8.84

Notes. 'Excess spread: no adjustments' is defined to be $\tau_{actual} - \tau_{zero}$ *where* τ_{zero} *is calculated from equation 1 using* $\tau_o = 0.0$. *'Excess spread: operational costs, interchange income' is defined to be* $\tau_{actual} - \tau_{zero}$ *where* τ_{zero} *is calculated from equation 1 using* $\tau_o = 0.002$. *'Excess spread: operational costs, fee income, interchange income' is computed similarly using* $\tau_o = -0.076$. *'Excess spread: operational costs, fee income, interchange income, rewards and fraud' is computed similarly using* $\tau_o = -0.052$. *Operational costs, fee income, interchange income, rewards and fraud expenses as a fraction of average daily balances are taken from Agarwal et al. (2015) Table III, Column 1, Rows 9 to 16.*

Model market structure for the 1970s. The narrative that credit card lenders enjoyed regional monopolies, charged large excess spreads, and offered limited contract contingencies motivates our model market structure. Through the lens of our model, we interpret the mass solicitations of credit cards as uncustomized offers that are not plausibly a function of contemporaneous employment status but may

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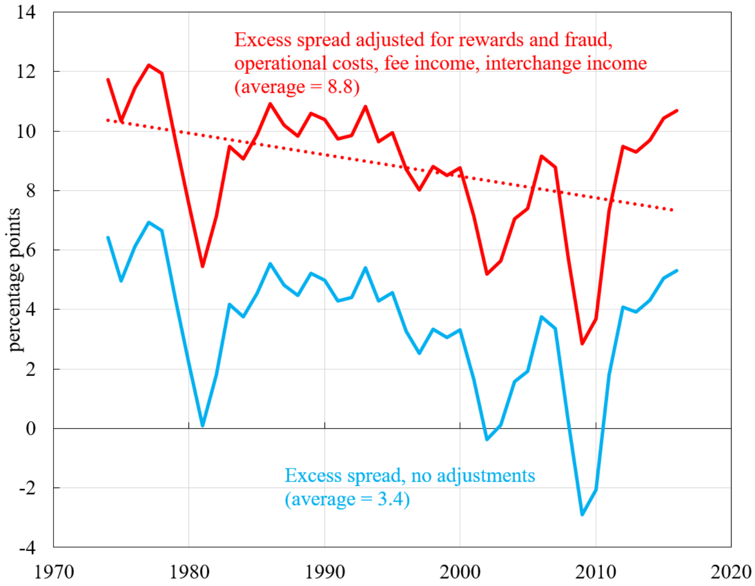
[7] One important caveat to using Agarwal et al. (2015)'s measure of overhead costs is that costs of developing new contracts/technologies are not necessarily included in this metric.

Figure 1: Credit card industry excess spreads (source: authors' calculations, see text)



Notes."Excess spread, no adjustments" is defined to be $\tau_{actual} - \tau_{zero}$ *where* τ_{zero} *is calculated from equation 1 using* $\tau_o = 0.0$*."Excess spreads adjusted for rewards and fraud, operational costs, fee income, interchange income" is computed similarly using* $\tau_o = -0.052$*. Operational costs, fee income, interchange income, and rewards and fraud expenses as a fraction of average daily balances are taken from Agarwal et al. (2015) Table III, Column 1, Rows 9 to 16.*

be a function of permanent income levels (reflecting their neighborhood etc.). Moreover, based on the regionally dominant licensing discussed in Stearns (2007) and the presence of significant excess spreads ranging between 6 and 12 percentage points in 1974, we treat lenders in the late 1960s and early 1970s as *pure monopolists*.

2.2 Market structure, pricing, and reforms in the 1980s

Market concentration. The credit card industry remained concentrated in the 1980s. Unfortunately, no systematic data on *regional* market concentration for credit card receivables exist for the 1970s or 1980s. Instead, we use bank call reports to describe *national* concentration in the post-reform 1980s. To measure national market concentration of credit card issuers (e.g., banks such as Citigroup, JP Morgan, Capital One, and Bank of America), we use their national share of credit card receivables. Table 2 shows that the top 10 card issuers accounted for 45% of outstanding revolving credit in 1984-Q1, the earliest quarter for which we have credit card receivables data. The top 20 card issuers accounted for 56% of outstanding revolving credit. The maximal Herfindahl–Hirschman Index (HHI) during the 1980s occurs in 1988-Q4, when the HHI for credit card receivables reaches 0.0494. This HHI implies a degree of competition equivalent to 20.2 [=1/.0494] equally sized banks.[8]

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[8] Here we use the common interpretation of the inverse Herfindahl–Hirschman Index. If all banks were equally sized $1/HHI = 1/(N \times (1/N)^2) = N$.

Table 2: Revolving credit share by issuer, 1984-Q1 (source: Call Reports)

Bank	Share	Bank	Share
1. Citibank	12.70%	6. First Interstate Bank	2.73%
2. Seattle-First National Bank	9.33%	7. Westminster Bank	2.20%
3. First Chicago International	4.93%	8. Wells Fargo Bank	1.80%
4. Bank of Hancock City	4.53%	9. Security Pacific	1.67%
5. Chase Manhattan Bank	3.76%	10. Hong Kong Bank	1.58%
Top 10 Share	45.2%	Top 20 Share	56.0%

Notes: 1984 Quarter 1, Consolidated Report of Condition for a Bank and its Domestic and Foreign Subsidiaries, nominal credit card receivables (RCFD2008) aggregated to highest holding company.

Credit card pricing in the 1980s. Several academic and legal sources argued that interest rate pricing remained non-competitive throughout the 1980s. We review this evidence and contribute novel analysis of pass-through rates that we use to motivate non-competitive pricing. Among existing studies, Knittel and Stango (2003) argue that tacit interest rate collusion among issuing banks occurred in the 1980s.[9] Using disaggregated interest rate data from historical editions of the *Quarterly Report of Interest Rates on Selected Direct Consumer Installment Loans* from 1979 to 1989, Knittel and Stango (2003) show that the average spread between the "most common" credit card interest rates and the cost of funds was higher in states where firms faced relatively tight interest ceilings and lower in states with no ceilings. They argue that firms colluded on interest rate ceilings until the late 1980s.[10] Moreover, Wells Fargo and First Interstate Bank of California were sued by the California Attorney General for interest rate fixing on millions of credit cards (White (1992)). The two banks ultimately settled the case for $55 million, fearing potentially large losses in court.[11]

To complement the existing legal and academic evidence of non-competitive interest rate setting behavior (e.g., Ausubel (1991), Knittel and Stango (2003), and Livshits et al. (2016)), we analyze pass-through rates and interest rate dispersion using quarterly bank-level data between 1975 and 1982.[12] These data are a digitized archive of *Interest Rates Charged on Selected Types of Loans* (Form *FR 2835* and its variants), created and hosted at the Board of Governors. We refer to the data set as *LIRS*, which is the data set's abbreviation within the Federal Reserve System. The data include roughly 200 banks in the

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[9] Over and above interest rate collusion, Lande and Marvel (2000) summarize United States v. Visa USA, Inc., 1999-2 Trade Cas. (CCH) 72,584 which alleged collusion to not adopt new technologies (raising prices).

[10] Knittel and Stango (2003) cite several professional sources alleging collusion: "The Michigan Citizens Lobby asserted that the failure of virtually all VISA and Mastercard issuers in the state, including the 10 largest, to reduce their rates from the maximum 18 percent allowed by law may indicate 'potentially illegal activi- ties.' 'Since smaller banks have assured us that they are making profits charging interest rates of 15 percent and below, it is clear that this uniformity is not justified by actual costs. We fear the alternative may be tacit or explicit collusion,' said the Citizens Lobby director. -American Banker, March 26, 1987" (p. 1703)

[11] White reported quotes from Barbara Brady-Smith who was the executive vice president of the Wells Fargo: "Wells Fargo also weighed the prospect that it might be forced to pay a huge award if it lost at trial, Brady-Smith said. The bank, she said, would have had to pay at least $150 million if a jury concluded there was a conspiracy to keep interest rates artificially high by just 1%. Instead, Wells Fargo will pay $37.5 million to those issued credit cards between Oct. 28, 1982, and last Dec. 31 and an additional $6 million in plaintiff attorney fees."

[12] 1982 is the date that the original LIRS credit card survey was discontinued; thus, our data set ends in 1982.

panel each year, resulting in 4,600 bank-quarter observations spanning the seven-year period from 1975 to 1982. The data set records the lowest, highest, and most common charged interest rates on each bank's *newly issued* credit card plans in the week prior to the survey (note that after 1994, the newly introduced FR2835a form began collecting information on rates charged on all accounts, not new issuances).[13]

We first establish several facts on credit card interest rate dispersion and rigidity that are new to the literature. Table 3 reports summary statistics for the pooled LIRS data set from 1975 to 1982 (see Online Appendix A for detailed summary statistics by year). One of the key takeaways from Table 3 is the lack of dispersion in interest rates across and within banks. The majority of banks report a most common interest rate charged of 18%. For example, the 25th and the 75th percentiles for the most common charged interest rate is 18%. The extreme clumping aligns with Knittel and Stango (2003)'s hypothesis of tacit collusion as well as Livshits et al. (2016)'s hypothesis about limited price discrimination technology (which we discuss further below). Knittel and Stango (2003) argue that most issuers tacitly colluded on an interest rate of 18%, which was the relevant rate cap for roughly 80% of issuers. Figure 1 shows that even with binding caps, lenders were extremely profitable. To measure interest rate dispersion within banks, we compute the highest charged interest rate minus the lowest charged interest rate. In Table 3, we find that 68% of lenders report no interest rate dispersion, and 54% of lenders report a highest and lowest interest rate equal to 18%. The 75th percentile of interest dispersion is a mere 3 percentage points.

The lack of dispersion is further illustrated in Panels (a) and (b) of Figure 2. Panel (a) plots the histogram of interest rates in 1975. While most lenders charged an interest rate of 18%, there is smaller bunching at interest rates of 15% and 12%. A minority of lenders charged rates below 10%. Panel (b) plots the histogram of the dispersion in interest rates (measured as the highest minus lowest interest rate charged by a bank) in 1975, 1978, and 1982. Upwards of 60% of lenders report no interest rate dispersion across their plans; that is, their highest charged credit card interest rate is equal to their lowest one. By 1982, over 60% of issuers charged an interest rate of 18% to all customers, and more than 70% of banks reported zero interest rate dispersion. Bunching worsens and interest rate dispersion declines over time despite major deregulation (e.g., the *Marquette* decision discussed below) and the adoption of new technologies.

We also observe extreme price rigidity in this period. As Table 3 shows, only 9% of banks change their lowest charged interest rate from quarter to quarter (i.e., on average, they adjust their lowest rate once every 2.7 years). Likewise, 4% change their highest rate from quarter to quarter (corresponding to an adjustment once every 6.25 years). While the non-responsiveness of the highest charged rate may reflect interest rate caps, the rigidity of the lowest charged rate in a period of large surprise monetary rate cuts is striking. We illustrate this in Panels (c) and (d) of Figure 2, which plot the level and changes of the lowest charged credit card interest rate, averaged across banks, against the Romer and Romer (2004) monetary surprise series, updated by Wieland and Yang (2020).[14] It is clear that interest rates are

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[13] LIRS7812/3/4 record the "Lowest/Highest/Most common interest rate charged for credit card plans."

[14] We include all banks that report non-missing, non-negative, and non-zero credit card interest rates. The Romer and Romer (2004) series consists of the residuals from a regression of the federal funds rate on lagged Greenbook forecasts as a proxy for Federal Reserve's information set.

Table 3: LIRS Summary Statistics

Variable	Mean	p25	p50	p75	SD	Min	Max
Lowest Interest Rate Charged	15.9	12	18	18	3.0	6	25.92
Highest Interest Rate Charged	17.5	18	18	18	1.8	10	30
Most Common Interest Rate Charged	17.4	18	18	18	1.9	9	25.92
Highest Minus Lowest Rate Charged	1.7	0	0	3	2.7	0	13
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0.54						
Fraction of Banks Reported No Difference B/w Highest and Lowest Charged Rate	0.68						
Quarterly Probability That {Lowest, Highest, Most Common} Charged Rate Changes	{0.09, 0.04, 0.05 }						
Number of Lender-Quarter Observations	4629						
Number of Banks in sample {1975,1982}	{217,159}						

Notes. Summary statistics for pooled LIRS data set between 1975 and 1982. We require non-missing and positive lagged interest rates to be in the sample. "Lowest Interest Rate Charged" corresponds to LIRS7812 question "Lowest interest rate charged for credit card plans," from FR 2835. "Highest Interest Rate Charged" corresponds to LIRS7813 question "Highest interest rate charged for credit card plans," from FR 2835. "Most Common Interest Rate Charged" corresponds to LIRS7814 question "Most common interest rate charged for credit card plans," from FR 2835. "Highest Minus Lowest Rate Charged" is LIRS7813 minus LIRS7812.

not responsive to movements in the cost of funds. In particular, the lowest charged interest rate does not move in response to the 4% surprise rate cut in 1980-II.

To formalize the graphical analysis in Panel (d) of Figure 2 and measure pass-through rates from surprise monetary rate cuts to credit card interest rates, we must circumvent the issue of binding interest rate caps. Our identification of pass-through addresses the issue of interest rate caps by isolating lenders whose lowest charged rate is less than the interest rate cap. Focusing on the lowest charged interest rate and restricting the sample to lenders that charge interest rates less than the cap allow us to obtain unbiased estimates of pass-through rates for two reasons. First, if the lowest rate charged is less than the interest rate cap, then the lender does not face a binding constraint for a subset of customers. Second, if the lender does not face a binding constraint, then in a competitive environment the lowest rate charged should decline following a surprise rate cut. Since there were sizable surprise rate cuts between 1975 and 1982, including one of over 4 percentage points, we would expect that in a competitive environment, issuers facing non-binding rate caps would decrease their lowest charged interest rates. As we discuss below, in consumer loan and auto loan markets, which are objectively more competitive, we find significant pass-through from rate cuts to the lowest offered rate.[15]

Let $i \in \mathcal{I}$ denote the set of lenders and $t \in \mathcal{T}$ denote the set of quarters included in the analysis. Let Δr_{it}^{Low} denote the change in the lowest offered interest rate between quarter $t+1$ and t for bank i (as we discuss below, Panel (b) of Figure 3 justifies this timing assumption). To recover pass-through rates, we regress Δr_{it}^{Low} on the Romer and Romer (2004) monetary surprise series in quarter t (RR_t). We include bank fixed effects α_i to remove permanent unobserved heterogeneity among lenders. We estimate the following specification:

$$\Delta r_{it}^{Low} = \alpha_i + \beta RR_t + \epsilon_{it} \qquad \forall i \in \mathcal{I}, t \in \mathcal{T}. \tag{2}$$

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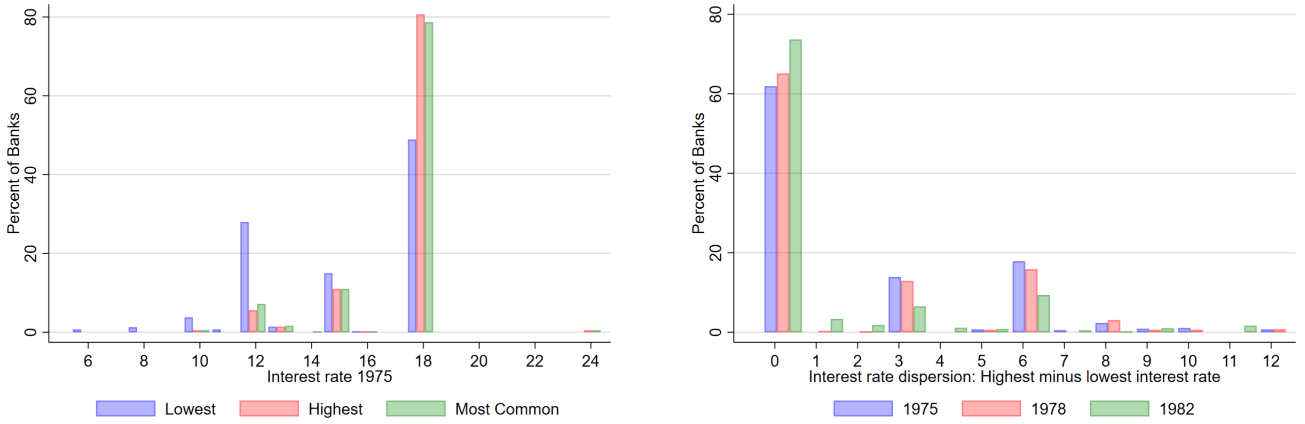
[15] Online Appendix K provides an analytical solution for what to expect from a two-period model with lending and market power.

Figure 2: Interest rates 1975 to 1982 (Data based on FR 2835)

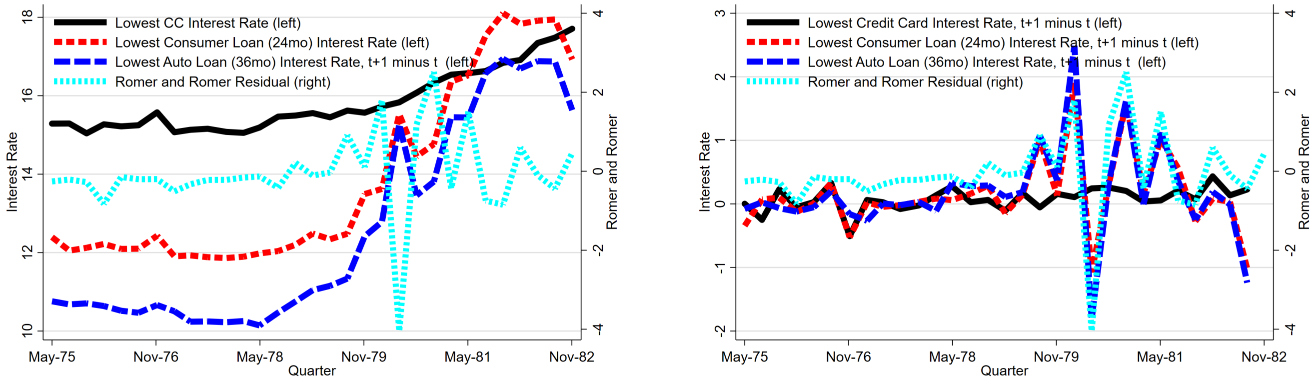
(a) Histogram of interest rates at bank level

(b) Histogram of interest rates dispersion (highest−lowest)



(c) Time series of lowest interest rate (levels)

(d) Time series of lowest interest rate (changes)



In Panel A of Table 4, we report estimates of β in equation (2). Both Δr_{it}^{Low} and RR_t are in percentage points, and so β is interpretable as a pass-through rate.

Columns (1) and (2) of Table 4 report pass-through rates using all time periods and all lenders ($\mathcal{I}$ includes all lenders, $\mathcal{T}$ includes all quarters). The estimate in Column (1) implies a pass-through rate of 0.4% from the monetary surprise (measured in percentage points) to the change in the lowest charged interest rate (also measured in percentage points) with a relatively tight standard error. The upper bound of the 95% confidence interval is a pass-through rate of 5.1%. Column (2) adds in lender fixed effects, and the point estimate remains largely unchanged. Since rate caps were binding for many lenders, pass-through rates in columns (1) and (2) may be biased downward.

Columns (3) through (5) progressively impose restrictions on the sample to avoid any downward bias from rate caps. Column (3) considers only time periods in which there was a surprise cut at date t ($\mathcal{I}$ includes all lenders, $\mathcal{T}$ includes only quarters in which $RR_t < 0$). The pass-through rate becomes *negative*, surprisingly. However, the upper bound of the 95% confidence interval is -2.2% which we view as effectively zero and economically insignificant. Column (4) additionally imposes that the lender's lowest credit card rate is less than 18% in the prior quarter, the most common rate cap ($\mathcal{I}$ includes only lenders which have $r_{t-1}^{low} < 18\%$, $\mathcal{T}$ includes only quarters in which $RR_t < 0$). The sample of lenders in Column (4) are not facing binding interest rate caps on at least a subset of their credit cards. Again, we find a *negative* coefficient on the pass-through rate. The upper bound of the 95% confidence interval is a pass-through rate of -2.8%. Lastly, Column (5) restricts the set of lenders to those whose lowest credit card rate is less than 15% in the prior quarter. The point estimate is nearly identical to Column (4), and the upper bound of the 95% confidence interval is a pass-through rate of -0.7%.

Table 4: Pass-through rates, Romer and Romer

Panel A	(1)	(2)	(3)	(4)	(5)
	Dependent variable is Δr_{it}^{low} (ppt), lowest **credit card** interest rate in quarter $t+1$ minus t				
Monetary surprise (ppt), RR_t	0.00394	0.000650	-0.0486***	-0.101**	-0.0973**
	(0.0241)	(0.0219)	(0.0135)	(0.0370)	(0.0460)
Sample	Full	Full	$RR_t < 0$	$RR_t < 0$ & r_{it-1}^{low} <18%	$RR_t < 0$ & r_{it-1}^{low} <15%
Lender Fixed Effect	N	Y	Y	Y	Y
Observations	4,629	4,593	3,340	1,371	965
R-squared	0.000	0.014	0.029	0.060	0.067

Panel B	(1)	(2)	(3)	(4)	(5)
	Dependent variable is $\Delta r_{it}^{low,cons}$ (ppt), lowest **consumer loan** (24mo) interest rate in quarter $t+1$ minus t				
Monetary surprise (ppt), RR_t	0.459***	0.457***	0.286***	0.296***	0.308***
	(0.0874)	(0.0869)	(0.0266)	(0.0244)	(0.0212)
Sample	Full	Full	$RR_t < 0$	$RR_t < 0$ & $r_{it-1}^{low,cons}$ <18%	$RR_t < 0$ & $r_{it-1}^{low,cons}$ <15%
Lender Fixed Effect	N	Y	Y	Y	Y
Observations	4,050	4,020	2,849	2,233	1,903
R-squared	0.078	0.091	0.052	0.075	0.101

Panel C	(1)	(2)	(3)	(4)	(5)
	Dependent variable is $\Delta r_{it}^{low,auto}$ (ppt), lowest **auto loan** (36mo) interest rate in quarter $t+1$ minus t				
Monetary surprise (ppt), RR_t	0.586***	0.583***	0.449***	0.448***	0.443***
	(0.0886)	(0.0873)	(0.0226)	(0.0222)	(0.0162)
Sample	Full	Full	$RR_t < 0$	$RR_t < 0$ & $r_{it-1}^{low,auto}$ <18%	$RR_t < 0$ & $r_{it-1}^{low,auto}$ <15%
Lender Fixed Effect	N	Y	Y	Y	Y
Observations	4,445	4,411	3,217	2,823	2,441
R-squared	0.222	0.230	0.149	0.166	0.177

Panels A and B of Table 5 repeat the exercise using the lagged ($FF_t - FF_{t-1}$) and contemporaneous ($FF_{t+1} - FF_t$) differences of the corporate federal funds rate as independent variables, respectively. The results are broadly consistent with the Romer and Romer (2004) series. Among all specifications in Table 5, the upper bound of the 95% confidence interval in Column (5) yields the highest pass-through rate of 3.12%.

Interpreting low pass-through rates by comparing to competitive markets. There are four potential explanations for the lack of pass-through: (1) interest rate caps; (2) technology; (3) risk sharing (lender commitment/household insurance); (4) imperfect competition. Our identification strategy rules out in-

Table 5: Pass-through rates, federal funds

Panel A	(1)	(2)	(3)	(4)	(5)
	Dependent variable is Δr_{it}^{low} (ppt), lowest credit card interest rate in quarter $t+1$ minus t				
$FF_t - FF_{t-1}$	-0.00657	-0.00783	-0.0322**	-0.0589	-0.168**
	(0.0137)	(0.0124)	(0.0123)	(0.0463)	(0.0748)
Sample	Full	Full	$RR_t < 0$	$RR_t < 0$ & r_{it-1}^{low} <18%	$RR_t < 0$ & r_{it-1}^{low} <15%
Lender Fixed Effect	N	Y	Y	Y	Y
Observations	4,296	4,290	3,064	1,371	965
R-squared	0	0.014	0.029	0.06	0.073

Panel B	(1)	(2)	(3)	(4)	(5)
	Dependent variable is Δr_{it}^{low} (ppt), lowest credit card interest rate in quarter $t+1$ minus t				
$FF_{t+1} - FF_t$	-0.00165	-0.00180	-0.0384***	-0.0890**	-0.0650
	(0.0134)	(0.0136)	(0.0101)	(0.0418)	(0.0491)
Sample	Full	Full	$RR_t < 0$	$RR_t < 0$ & $r_{it-1}^{low,cons}$ <18%	$RR_t < 0$ & $r_{it-1}^{low,cons}$ <15%
Lender Fixed Effect	N	Y	Y	Y	Y
Observations	4,629	4,593	3,340	1,371	965
R-squared	0	0.014	0.03	0.062	0.067

terest rate caps. To rule out (2)-(3), Panels (c) and (d) of Figure 2 and Panels B and C of Table 4 compare credit cards to 24 month personal loans (henceforth *consumer loans*)[16] and 36-month auto loans (henceforth *auto loans*).[17] Since consumer loans are subject to the same rate caps and have a similar lender-borrower match duration to credit cards, comparisons to consumer loans allow us to rule out differences in rate caps, technology, and risk sharing. Since banks could issue personal loans outside of credit card licensing agreements, we view personal loans as significantly more competitive than credit cards. Moreover, the auto loan market faced added competition from non-bank captive lenders (e.g., General Motors and Ford financing divisions, among others).[18]

Panels (c) and (d) of Figure 2 plot the lowest offered rate in levels and differences, respectively, across all loan types. Panel (d) makes clear that the lowest offered rate for both consumer loans and automobiles moved in lockstep with the Romer and Romer shock series. Credit cards are the outlier, remaining unresponsive throughout the sample period.

Panels (a) and (b) of Figure 3 make it clear that banks had the technology to price discriminate (i.e., they were not pooling due to technology constraints as in Athreya (2002)). Panel (a) plots rate dispersion conditional on both the highest (and implicitly the lowest) rate being less than 15% in 1975 in order to avoid distortions due to rate caps. In this sample, 90% of banks reported zero interest rate dispersion on credit card plans. Roughly half as many banks reported zero interest rate dispersion on consumer loans. Panel (b) illustrates the kernel density of lowest offered rates for credit cards and consumer loans conditional on the lowest rate being less than 15% (i.e., rate caps are not binding). Consumer loans

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[16] LIRS 7806/7/8 "Lowest/Highest/Most Common interest rate charged for other loans for consumer goods and personal expenditures (24 month)"

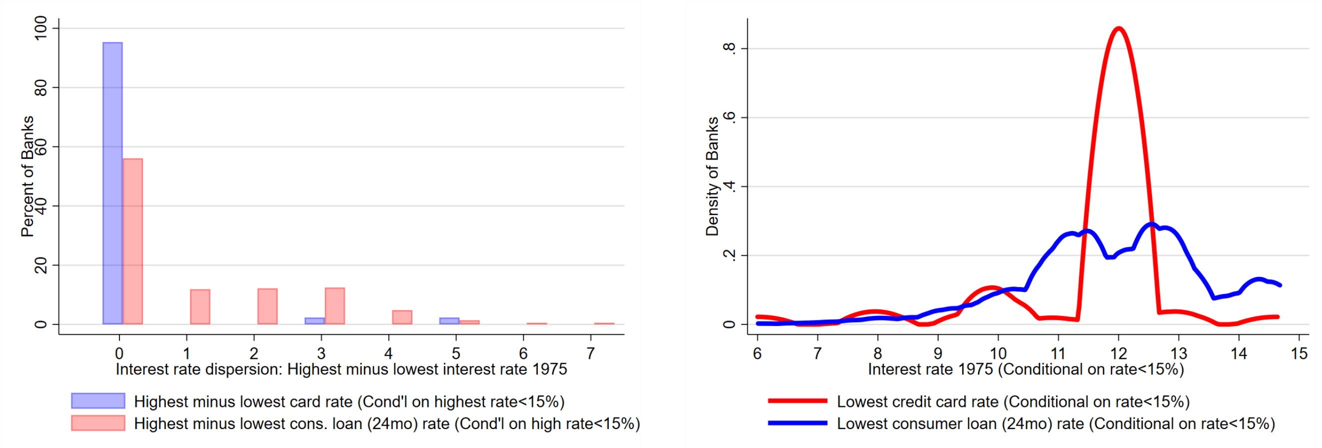
[17] LIRS 7800/1/2 "Lowest/Highest/Most Common interest rate charged for new automobiles (36 month)"

[18] We note that Knittel and Stango (2003) noted in the text of their paper that consumer installment loans have less 'clumping' at rate ceilings, but do not provide a formal comparison of rate dispersion or pass-through across credit card and installment loans. They do report a lower standard deviation of 'most common' rates for auto loans; however, that is not the focus of their analysis.

exhibit much more dispersion (and offered rates take fractional values) and significantly less bunching.

Panels B and C of Table 4 include the pass-through rate from Romer and Romer shocks to the lowest offered rate on consumer loans and auto loans, respectively. The consumer loan pass-through rate ranges from 29.6% to 45.9% and the auto loan pass-through rate ranges from 44.3% to 58.6%. The stark difference between the near-zero credit card pass-through rate and the significantly higher consumer loan pass-through rate provides evidence against the assumption of competitive credit card lending. The combination of Figure 2, Figure 3, and Table 4 are strong evidence that (1) interest rate caps do not explain the lack of pass-through, (2) banks had the technology to better price discriminate in the credit card market, and (3) the differing duration of lender-borrower relationships do not explain the lack of pass-through.

Figure 3: Interest rate behavior: credit cards versus consumer loans (24mo) and auto loans (36mo)



(a) Credit card vs. consumer loan rate dispersion conditional on r_t^{high} <15% & r_t^{low} <15%

(b) Credit card vs. consumer loan lowest rate kernel density conditional on r_t^{low} <15%

Reforms. Finally, we discuss legal scrutiny over non-competitive behavior that led to a number of reforms. These court cases contain some of the most informative data about the market structure of the credit card industry in the 1970s and 1980s. While many of these cases pertain to networks, the degree of competition among issuing banks was inherently tied to the payment networks and their rules (and the banks owned the networks, making any dichotomy between the two entities artificial). We discuss three landmark court cases regarding (i) the lack of competition of networks across regions and banks' inability to issue competing network cards (*Worthen*); (ii) network rules preventing competitive new-entrant credit cards from being issued within particular regions (*MountainWest*); (iii) the *Marquette* decision which generated further inter-regional competition.

Our analysis is largely based on Wildfang and Marth (2005), to whom we direct the more interested reader. In 1970, Worthen Bank was a member of Visa (previously the National BankAmericard network). Worthen wanted to issue Mastercard (previously the Interbank Card Association network) credit cards.

Visa rules prohibited Worthen from doing so. Worthen sued over this *exclusivity* rule (the prohibition of issuing both networks' cards), and this eventually led to the abandonment of exclusivity rules in 1976.

The *MountainWest* concerns Sears' attempt to enter the credit card market in the 1980s. The company wanted to issue an aggressive *Prime Option* card on the Visa network. The Sears card would have no annual fee, thus a lower implicit interest rate and potentially higher total credit limits. Although Sears owned MountainWest Financial, a Visa member bank, Visa prohibited Sears from issuing the card. Visa adopted a new rule banning Visa membership to any institution that was "deemed competitive." While legal scrutiny over the case persisted, Sears created the Discover network in response.

Lastly, the Supreme Court's *Marquette* decision in 1978 unanimously determined that state-level usury laws (interest rate caps) were not legally binding for nationally chartered banks. Before the *Marquette* decision, states with relatively tight usury laws faced limited competition. Afterwards, these credit card markets became nationally contested. In our main counterfactuals that follow, we interpret the *Marquette* decision, as well as reforms spurred by the *Worthen* and *MountainWest* cases, as increased competition from lender entry.

Model market structure for the 1980s. The aforementioned lawsuits established non-competitive behavior in a court of law. In addition, we show that zero pass-through across the interest rate distribution and low interest rate dispersion are unique features of credit cards and not present in more competitive loan markets with similar borrower-lender relationships. The lack of responsiveness to marginal costs, the extreme bunching of rates, allegations of collusion (Knittel and Stango (2003) and the California Attorney General), and the blocking of lower priced competitors motivate our particular deviation from competitive markets. In particular, we treat the market structure of the 1980s as an oligopoly in which banks collude on interest rates and compete on quantities.[19] We refer to this form of competition as *collusive-Cournot* competition. In addition to the historic narrative, in Section 6, we show that collusive-Cournot competition generates the observed joint dynamics of credit to income, bankruptcies, chargeoffs, credit among bankrupts, and interest rate dispersion. In the later part of the paper, we also drop the collusion assumption and consider a perfectly competitive lending market in the post-reform 1980s. This provides an upper bound on potential welfare gains.

We briefly discuss how our empirical evidence relates to three other market structures: (1) perfect competition with one-period loans (e.g., Livshits et al. (2007) among others), (2) perfect competition with private information and lender fixed costs of contract design (e.g., Livshits et al. (2016)), and (3) a leader-competitive fringe market structure (e.g., Shimomura and Thisse (2012)).

First, in the standard competitive calibration of individually priced defaultable debt, there is typically a group of households who face near-zero default risk $D \approx 0$. This group of households receive the *lowest* offered interest rate in the economy, e.g. their cost of funds is approximately the risk free rate r_f plus

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[19] Through the end of the 1970s, member banks were divided into two classes. Stearns (2007) describes how regionally dominant licensee banks would sign up *agent banks* to attract merchants, and that these agent banks could only 'compete' on the quantity of issued cards: "the licensee banks contracted with these agent banks to sign up additional merchants and process their transactions. Many licensee banks also allowed non-competing agents to 're-issue' their cards to the agent's depositors, but the licensee held the receivables and thus enjoyed all the interest revenues" (p. 123).

an exogenous spread τ (i.e., the discount on the face value of debt is $q = \frac{E[1-D]}{1+r_f+\tau} \approx \frac{1}{1+r_f+\tau}$). In standard calibrations, this group of households has approximately full pass-through from the risk free rate into their costs of borrowing.[20] Thus pass-through from the cost of funds to the *lowest* offered interest rate in the economy is approximately 100%.

Second, even though the focus of Livshits et al. (2016) is on technological adoption, they show that a competitive equilibrium with private information and fixed costs for lender entry can rationalize the lack of dispersion in interest rates, lack of pass through to the *average* interest rate, interest rate clumping, and spreads that exceed zero-profit interest rates. However, in the context of our paper, such an environment predicts full pass-through from the cost of funds to the *lowest* offered interest rate (Figure 5C in Livshits et al. (2016)).[21]

Third, the canonical leader-competitive fringe market structure (see the modern treatment by Shimomura and Thisse (2012)) is arguably at odds with the *widespread* profitability among the top 25 credit card issuing banks (see e.g., Ausubel (1991) and Grodzicki (2019)).

3 Model

We use our empirical analysis to justify our departure from standard competitive models of the consumer credit market and, instead, model a finite number of non-atomistic credit card firms that issue non-exclusive credit lines. We use the model to quantify the welfare gains and losses from competitive reforms in the credit card industry.

3.1 Environment

Time is discrete and runs forever ($t = 0, 1, \ldots$). We assume a small open economy with risk-free rate r_f.[22] For ease of exposition, we focus on a recursive exposition of the steady state, omitting time subscripts. However, when we compute transition paths in later sections of this paper, the value functions, policy functions, and profits are time dependent. The economy is populated by a unit measure of infinitely-lived heterogeneous consumers and N credit card firms (which we will also refer to as *lenders*). Consumers differ ex-ante with respect to their permanent earnings ability. They face idiosyncratic earnings shocks as well as taste shocks over their decision to default/repay. They make savings/borrowing and default/repayment decisions to maximize utility. Lenders imperfectly compete to issue non-exclusive credit lines. Further, lenders commit to their interest rates and limits. Motivated by the limited disper-

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[20] In fact non-responsiveness of default risk to moderate movements in the risk-free rate is a common problem in the existing literature.

[21] To be clear, one of the main findings in Livshits et al. (2016) is that declining fixed costs of contract design in a competitive environment with incomplete information rationalizes several prominent time trends in the credit market. Our data sheds no light on whether contract design costs have fallen over time. In reality, some combination of greater competition and lower fixed costs of contract design likely contributed to the observed time trends discussed in this paper.

[22] In a previous version of this paper (`https://www.nber.org/system/files/working_papers/w26604/w26604.pdf`), we analyzed implications under general equilibrium. The general equilibrium effects were minimal. Hence, we assume a small open economy in this version.

sion in rates in the 1970s and mass solicitations of credit offers, we assume lenders' contracts to only be a function of the low-dimensional permanent earnings ability of an individual.[23] This implies that all interest rates, limits, and lender profit functions are indexed by permanent earnings ability. Allowing for some interest rate heterogeneity lets us test various market structure predictions for interest rate dispersion.

3.2 Consumers

Consumers have discount factor $\beta \in (0,1)$. They make savings/borrowing and default/repayment decisions to maximize the present value of their flow utility over consumption, $U(c)$, as well as any utility gain or loss associated with default. There are three preference parameters associated with default. Consumers have independent and identically distributed Gumbel taste shocks over default and repayment, $\zeta_D \sim^{iid} F(\zeta_D) = e^{-e^{-\kappa\zeta_D}}$ and $\zeta_R \sim^{iid} F(\zeta_R) = e^{-e^{-\kappa\zeta_R}}$, respectively (e.g., Auclert and Mitman (2018) and Chatterjee, Corbae, Dempsey, and Rios-Rull (2020)). The Gumbel scaling parameter κ is common for both shocks. We view these taste shocks as unmodeled sources of default such as divorce, health costs, and other lawsuits (Chakravarty and Rhee (1999)).[24] If the consumer chooses to default, they incur an additional one-time utility penalty of χ (stigma).

The consumer's idiosyncratic state is given by their credit standing $i \in \{g, b\}$, permanent earnings ability $\theta \in \{\theta_L, \theta_H\} \equiv \Theta \subset \mathbb{R}_+$, a persistent earnings shock $\eta \in \mathbb{R}_+$, an iid earnings shock $\epsilon \in \mathbb{R}_+$, and net assets $a \in \mathbb{R}$. If a consumer defaults, then they are in bad credit standing $(i = b)$; they may regain good credit standing $(i = g)$ with probability ϕ. A consumer in good credit standing maintains it as long as they repay. A consumer in good credit standing may borrow, whereas a consumer in bad credit standing cannot borrow. Permanent earnings ability θ is fixed, and thus we refer to *type-θ consumers* when referencing permanent earnings ability. The earnings shock η is persistent and follows a Markov chain, whereas ϵ is perfectly transitory. Positive values of a indicate saving, whereas negative values of a indicate borrowing. The state of a consumer is therefore given by the tuple $(i, \theta, \eta, \epsilon, a)$. We define the distribution of consumers across states as $\Omega(i, \theta, \eta, \epsilon, a)$, where $\Omega : \{g, b\} \times \Theta \times \mathbb{R}_+ \times \mathbb{R}_+ \times \mathbb{R} \to [0, 1]$.

To exposit the consumer's problem, we must briefly discuss the credit card market (more details about the formation of the credit lines appear in Section 3.3). As discussed above, we assume lender contracts are a function solely of type-θ, implying that all type-θ consumers in good credit standing have access to the same set of credit lines.[25] A credit line is a long-term defaultable debt contract that

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[23] One may interpret this restriction as a pure technological constraint on lenders (lenders have full information, but it is too costly to customize contracts), or one may motivate this restriction with incomplete information plus costly monitoring. We do not micro-found this restriction; however, we view the assumption warranted based on historic narrative evidence in Section 2.

[24] The taste shocks make default a probability function rather than a discrete choice function. This adds smoothness to the lender's profit function. In other related settings such as the monopsony literature, multiplicative Frechet or Gumbel yields similar results across models.

[25] This assumption makes the model tractable because it makes the lender's profits a function of one limit and one spread per type-θ consumer, which greatly simplifies the lender's problem . It also implies that we do not have to keep track of the terms of the credit card contract as an idiosyncratic state in the consumer's problem. If the lender is allowed to condition the contract on other consumer characteristics, the lender's profit function will be a function of a limit and a spread for each observable

specifies an interest rate $r \in \mathbb{R}_+$ and a borrowing limit $\bar{l} \in \mathbb{R}_+$. Further, we assume that credit lines are non-exclusive. Consequently, if there are N credit lines available in equilibrium, the consumer will first borrow from the cheapest credit line, independent of the lender that issues it. That is, consumers will first borrow from the lowest rate card until reaching the limit, and then they will borrow from the next lowest rate card, and so on. While credit reports do not keep track of rates, this type of interest rate 'pecking order' is observed across debt products. For example, Bhutta, Skiba, and Tobacman (2015) show that consumers first borrow from credit card lenders before turning to payday loans with higher rates.[26]

Let j denote the credit card interest rate ranking of a credit line, where $j = 1$ is the lowest interest rate credit card and $j = N$ is the highest interest rate credit card. As far as the consumer is concerned, the credit lines can be sorted in ascending order with respect to the interest rate $(r_1(\theta) \leq r_2(\theta) \leq \ldots r_j(\theta) \leq \ldots \leq r_N(\theta))$ and the corresponding borrowing limits $(\bar{l}_1(\theta), \bar{l}_2(\theta), \ldots, \bar{l}_N(\theta))$, ignoring the issuing credit card firm's identity. With this notation, the set of credit lines available to type-θ consumers is $S_\theta = \{(r_1(\theta), \bar{l}_1(\theta)), \ldots, (r_N(\theta), \bar{l}_N(\theta))\} \in (\mathbb{R}_+, \mathbb{R}_+)^N$.

Our model assumes that (1) consumers rationally allocate debts by interest rate ranking and (2) all type-θ consumers in good credit standing have access to the same set of credit lines reduce the state space significantly and allow us to compute balances allocated to each credit line with a function $a_j(\cdot) : \mathbb{R}_- \to \mathbb{R}_-^N$. For any net asset level a (recall $a < 0$ implies debt), let $a_j(a, \theta) \leq 0$ denote the balance on the credit line with credit card interest rate ranking $j \in \{1, ..., N\}$ for a type-θ consumer:

$$a_j(a,\theta) = \begin{cases} -\bar{l}_j(\theta) & \text{if} \quad a \leq -\sum_{k=1}^{j} \bar{l}_k(\theta) \\ \min\{a + \sum_{k=1}^{j} \bar{l}_k(\theta) - \bar{l}_j(\theta), 0\} & \text{if} \quad a > -\sum_{k=1}^{j} \bar{l}_k(\theta). \end{cases}$$

If net assets are less than or equal to the sum of the borrowing limits on credit lines $\{1, ..., j\}$, then the consumer has reached the limit on credit line j. Otherwise, if net assets are greater than the sum of the borrowing limits on credit lines $\{1, ..., j-1\}$ and net assets are negative, then the balance on credit line j is $a + \sum_{k=1}^{j} \bar{l}_k(\theta) - \bar{l}_j(\theta)$. Figure 4 provides an example of the interest rates and limits consumers face with three lenders, $N = 3$. They borrow from the lowest interest rate first, $r_1(\theta)$, then the next lowest, $r_2(\theta)$, and lastly $r_3(\theta)$. The total principal and interest expense incurred on the lowest interest rate credit card is $(1 + r_1(\theta))a_1(a, \theta)$, the next lowest interest rate card is $(1 + r_2(\theta))a_2(a, \theta)$, and lastly, $(1 + r_3(\theta))a_3(a, \theta)$.[27] More generally, since $\sum_{j=1}^{N} a_j(a, \theta) = a$, the principal and interest expense of a household can be written as $(1 + r_f)a + \sum_{j=1}^{N}(r_j(\theta) - r_f)a_j(a, \theta)$. When making contact with the data, it will be useful to define lender j's *spread*:

$$\tau_j(\theta) \equiv r_j(\theta) - r_f.$$

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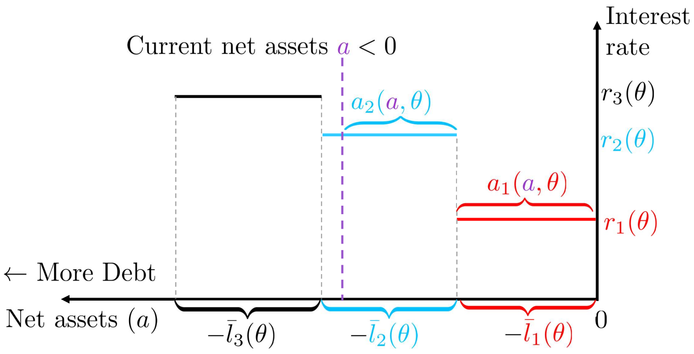
characteristic, and we would have to keep track of the credit card contract as an idiosyncratic state for the consumer.

[26] The pecking order is an equilibrium outcome in our model because there are no switching costs. This keeps the model tractable because we only need to keep track of total net assets and not the balance on each credit line.

[27] In Online Appendix J, we compare the interest rates from the credit lines in our quantitative model to implied interest rates from the standard consumer credit model with a bond price schedule.

Figure 4: Example of credit lines available to consumer with three lenders, $N = 3$.



Notes: *Non-calibrated example with three lenders and three credit lines. More negative net asset positions imply greater debt. The function $a_j(a, \theta)$ allocates net assets a most efficiently across the credit lines ordered by interest rates $r_j(\theta)$. Consumers first max out credit card 1 with the lowest interest rate $r_1(\theta)$. If they borrow more than $\bar{l}_1(\theta)$, they then begin borrowing from the credit card with the second lowest interest rate, $r_2(\theta)$, and so on.*

Using this notation for credit lines, we now describe the consumer's value functions. Let $V(i, \theta, \eta, \epsilon, a)$ denote the consumer's continuation value at the start of the period. Let $V^D(\theta, \eta, \epsilon)$ be the value of default and $V^R(i, \theta, \eta, \epsilon, a)$ be the value of repayment. The first choice the consumer makes is between default and repayment:

$$V(i, \theta, \eta, \epsilon, a) = E_{\zeta_D, \zeta_R} \max\{V^D(\theta, \eta, \epsilon) + \zeta_D, V^R(i, \theta, \eta, \epsilon, a) + \zeta_R\}. \tag{3}$$

Since ζ_D and ζ_R were assumed to be Gumbel with a common inverse scaling parameter κ, we can express the default probability as follows:

$$p(i, \theta, \eta, \epsilon, a) = \frac{exp(\kappa V^D(\theta, \eta, \epsilon))}{\exp(\kappa V^D(\theta, \eta, \epsilon)) + \exp(\kappa V^R(i, \theta, \eta, \epsilon, a))}. \tag{4}$$

Given our assumptions about default penalties, default is universal. That is, the consumer repays credit card debt on all credit lines or defaults on all credit lines. This is a close approximation of bankruptcy in which accounts typically cannot be selectively excluded from discharge, and ultimately we map our model to bankruptcies in the calibration section below. The policy functions for repayment/default, consumption, and savings/borrowing — $p(\cdot), c(\cdot), a'(\cdot)$ — are functions of $(i, \theta, \eta, \epsilon, a)$. However, for ease of exposition, we omit this state dependence of policy functions.

A consumer who defaults consumes labor earnings and profits, $\theta\eta\epsilon + \Pi(\theta\eta\epsilon)$, where $\Pi(\theta\eta\epsilon)$ refers to the profits transferred to consumers from credit card firms. Our baseline assumption is that profits are distributed uniformly *among* the top 0.1 percentile of earners, and in Section 7, we consider alternate distributions of profits including uniform across all income levels. Further, the consumer cannot save or borrow ($a' = 0$) and incurs a one-time disutility cost (stigma χ) only during the default period. In the next period, the consumer may regain good credit standing with probability ϕ or stay in bad credit standing with probability $1-\phi$. The continuation value of defaulting is given by

$$V^D(\theta,\eta,\epsilon) = U\big(\theta\eta\epsilon + \Pi(\theta\eta\epsilon)\big) - \chi + \beta E_{\epsilon',\eta'|\eta}\big[\phi V(g,\theta,\eta',\epsilon',0) + (1-\phi)V(b,\theta,\eta',\epsilon',0)\big].$$

Note that in our model, because of the taste shock for default, consumers in bad standing $(i=b)$ may redefault, a common occurrence in the data (Athreya, Mustre-del Río, and Sánchez (2019)). Further, defaults may occur with a balance of zero net assets or greater. We interpret the data analogue of these defaults to be shocks that are not modeled explicitly in our framework, such as divorce, health shocks, or lawsuits.

A type-θ consumer who chooses to repay and is in good credit standing $(i=g)$ may borrow from the set of credit lines or save $(a' \geq -\sum_{j=1}^{N}\bar{l}_j(\theta))$. Further, this consumer retains good credit standing for the next period. The value of repayment when $i=g$ is given by

$$\begin{aligned} V^R(g,\theta,\eta,\epsilon,a) = &\max_{a' \geq -\sum_{j=1}^{N}\bar{l}_j(\theta)} \quad U(c) + \beta E_{\epsilon'\eta'|\eta}V(g,\theta,\eta',\epsilon',a') \\ s.t. \qquad c + a' =& \theta\eta\epsilon + (1+r_f)a + \sum_{j=1}^{N}(r_j(\theta)-r_f)a_j(a,\theta) + \Pi(\theta\eta\epsilon). \end{aligned} \tag{5}$$

A consumer who chooses to repay and is in bad credit standing can only save $(a' \geq 0)$. This consumer regains good credit standing in the next period with probability ϕ and stays in bad credit standing with probability $1-\phi$. The value of repayment when $i=b$ is given by

$$\begin{aligned} V^R(b,\theta,\eta,\epsilon,a) =& \max_{a' \geq 0} \quad U(c) + \beta E_{\epsilon',\eta'|\eta}\big[\phi V(g,\theta,\eta',\epsilon',a') + (1-\phi)V(b,\theta,\eta',\epsilon',a')\big] \\ s.t. \qquad c + a' =& \theta\eta\epsilon + (1+r_f)a + \Pi(\theta\eta\epsilon). \end{aligned} \tag{6}$$

Compared with the problem for the consumer in good standing (5), the budget constraint for those in bad standing drops the term $\sum_{j=1}^{N}(r_j(\theta)-r_f)a_j(a,\theta)$ because the consumer in bad credit standing will not hold debt in equilibrium, regardless of the repayment choice.

3.3 Lenders

There are N lenders in the economy. We assume that lenders price discriminate across type-θ consumers. Further, lenders observe the default status of individuals, $i \in \{g,b\}$, and they only issue credit lines to those in good standing. Each lender may issue one credit line to each type-θ consumer. Therefore there are N credit lines for each consumer. We assume lenders commit to the terms of their lines of credit, consistent with the simple, non-dynamic credit contracts observed during this time period (see Section 2 and discussion below).

Consider lender $k \in \{1,\ldots,N\}$. We will use the convention that superscripted k refers to a lender's identity and does *not* reflect any ranking of lenders, and subscripted j refers to the lenders' credit card interest rate ranking. For a type-θ consumer, lender k's objective is to choose the terms of their credit line, $(r^k(\theta), \bar{l}^k(\theta))$, to maximize their net present value of profits, $\pi_t^k(\theta)$, discounted at rate β_L:

$$\sum_{t=0}^{\infty} \beta_L^t \pi_t^k(\theta). \tag{7}$$

A lender's credit card interest rate ranking is denoted by j, where $j = 1$ is the lowest credit card interest rate and $j = N$ is the highest one. Let $r_j(\theta)$ and $\bar{l}_j(\theta)$ denote the interest rate and borrowing limit of the lender offering the j^{th} highest credit card interest rate. The flow profits resulting from offering the j^{th} highest credit card interest rate are given by $\Pi_j(\theta)$:

$$\Pi_j(\theta) = \int \left[-(1 - p(g, \theta, \eta, \epsilon, a))(r_j(\theta) - r_f)a_j(a, \theta) + p(g, \theta, \eta, \epsilon, a)(1 + r_f)a_j(a, \theta) \right] d\Omega(g, \theta, \eta, \epsilon, a). \tag{8}$$

Lenders borrow from households and since households can costlessly access capital markets, the lenders must offer a riskless savings rate r_f. The resulting profits consist of two components: the first term, $-(r_j(\theta) - r_f)a_j(a, \theta) > 0$, captures the gains from repayment; the second term, $(1 + r_f)a_j(a, \theta) < 0$, captures the losses from default (lenders must repay their depositors). Total profits are computed as $\Pi = \sum_{\theta \in \Theta} \sum_{j=1}^{N} \Pi_j(\theta)$. As mentioned above, these are uniformly transferred to consumers in the top 0.1 percentile of earnings (an assumption relaxed in Section 7).

Suppose lender $k \in \{1, 2, ..., N\}$ chooses interest rate $r^k(\theta)$ and borrowing limit $\bar{l}^k(\theta)$. Let $j(r^k(\theta), r^{-k}(\theta))$ be a function that maps a lender's own interest rate $r^k(\theta)$ and the interest rates of their competitors $r^{-k}(\theta) \equiv (r^1(\theta), ..., r^{k-1}(\theta), r^{k+1}(\theta), ..., r^N(\theta))$ to the rank of $r^k(\theta)$ when the interest rates are sorted in ascending order, $j : \mathbb{R}_+ \times \mathbb{R}_+^{N-1} \rightarrow \{1, \ldots, N\}$. Then, the set of credit lines can be written $S_\theta = \{(r_{j(r^k(\theta), r^{-k}(\theta))}, \bar{l}_{j(r^k(\theta), r^{-k}(\theta))})\}_{k=1}^{N}$, and the profits to credit card firm k are given by

$$\pi^k = \Pi_{j(r^k(\theta), r^{-k}(\theta))}. \tag{9}$$

For example, if there is one firm (monopolist), then the monopolist chooses the interest rate $r^1(\theta)$ and the borrowing limit $\bar{l}^1(\theta)$ to maximize total profits, $\pi^1(r^1(\theta), \bar{l}^1(\theta)) = \Pi_1(r_1(\theta), \bar{l}_1(\theta))$, where the first expression refers to profits by the lender's identity and the second expression refers to profits using the (degenerate) credit card interest rate ranking.

Forms of lender competition. Our benchmark 1960s/1970s economy begins in a state of *monopoly* based on the empirical evidence and the historic narrative in Section 2.

Post-reform, we consider two forms of competition. We first compute the transition path to *collusive-Cournot* competition, as motivated in Section 2. Collusive-Cournot competition is a two-stage game where lenders collude on interest rates in the first stage and then Cournot compete on limits in the second stage.[28]

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[28] Since actions are observed and there are few players, Ivaldi, Jullien, Rey, Seabright, and Tirole (2003) provide assumptions under which tacit collusion or outright collusion is sustainable. If deviations trigger a future price war with certainty and lenders place enough value on future profits, a collusive equilibrium can exist. We do not micro-found our collusion assumption; however, we believe it is justified based on legal and academic evidence and matches the data well (see Table 12).

Our second post-reform economy drops our assumption of collusion and computes a perfectly competitive benchmark in which the lender chooses a zero-profit contract that maximizes newborn consumer welfare from behind the veil. We believe this definition of competitive equilibrium is quite natural in most settings: one would trace out the set of zero-profit contracts and then choose the one that is tangent to the household's utility maximizing indifference curves. Because we do not have a theory of credit card acquisition, our competitive equilibrium implements the household's optimal choice. Lenders offer the set of zero-profit contracts to newborns, behind the veil. The newborn household chooses the utility maximizing contract.

In Online Appendix E and F, we provide additional discussion of alternate market structures.

Lender commitment and optimization. When computing steady states, we assume that the monopolist maximizes steady state profits in addition to fully committing to the terms of the credit line. This assumption is equivalent to taking the limit of the discount factor of the lender to one, $\beta_L \to 1$, implying that the lender places equal weight on profits today and in the infinite future. Researchers appeal to both (1) commitment and (2) $\beta_L \to 1$ in a broad class of dynamic monopsony models beginning with Burdett and Mortensen (1998) (for recent examples, see e.g., Engbom and Moser (2022) among others). These assumptions greatly simplify the computation of the model to one in which the monopolist maximizes steady state flow profits. In practice, because our quantitative exercises rely on the net-present-value of lender profits (which is infinite when $\beta_L = 1$), we assume (1) that lenders discount the future at a finite rate, $\beta_L = \frac{1}{1+r_f}$, while (2) maintaining the simplifying assumption that the monopolist maximizes steady state profits.

When analyzing transition paths, we assume lenders maximize their net present value of profits along the transition path and commit to the terms of their credit lines at the date of shock ($t = 1$). To assess robustness to this assumption, Online Appendix I shows that allowing lenders to re-optimize and commit to a new strategy from date $t > 1$ onwards yields very small deviations from the original rate and limit. An alternative is to compute a Markov Perfect equilibrium and relax commitment for new credit card issuances. This poses two problems. First, the underlying model would require a theory of new issuances. Households would have to keep track of heterogeneous terms of credit, and lenders would have to keep track of the vintages of issuances and their associated terms of credit. Second, computing a Markov Perfect equilibrium (MPE) is not practically feasible in such a setting. Lenders would have to keep track of the joint distribution of interest rates and limits at all competitors (in addition to $\Omega(\cdot)$), and policy functions would be contingent on those distributions in a MPE. Moreover, the more tractable oblivious equilibrium concept in Weintraub, Benkard, and Van Roy (2008) does not resolve these technical issues and is a poor approximation for the MPE in highly concentrated markets, such as those considered in this paper.

Lender entry costs. When we consider the transition path, we must make assumptions regarding lender entry costs. Our benchmark reform assumes zero lender entry costs. However, in Section 7, we impose up front lender entry costs equal to the net present value of profits. Since there was profitable lender entry in the 1970s and 1980s, we view this robustness exercise as providing an upper bound on lender entry costs. We show that these costs have second-order effects on welfare, compared with the gains from increased competition.

Equilibrium. Appendix A defines the stationary recursive equilibrium, and Appendix B describes how we compute it.

4 Calibration

Our goal is to characterize the distribution of welfare gains when the U.S. credit card industry became more competitive. With our model environment in hand, we develop a calibration of the early years of the U.S. credit card industry. Based on the narrative evidence of non-competitive, regionally dominant credit card issuers in Section 2, we approximate 1970s market conditions with *pure monopoly* ($N = 1$). Given the computationally demanding nature of the model, we take as many standard parameters as possible from the literature, and then we calibrate the remaining parameters to target 1971-75 moments.

We assume that each period corresponds to one year. Table 6 presents the parameters determined outside of the model equilibrium. We use a standard estimate for the risk aversion ($\sigma = 2$). We set the risk-free savings rate equal to 1.27%, which is the average real interest rate from 1971 to 1975.[29] As discussed above, we assume lenders discount at the risk-free rate, $\beta_L = \frac{1}{1+r_f}$. The re-entry probability of good credit standing $\phi = .1$ is chosen so that it takes the average consumer 10 years to re-enter the credit card market upon default. The earnings process is taken from Storesletten, Telmer, and Yaron (2000) (Table 1, Panel D).[30] We assume that permanent types are distributed so that $\ln(\theta) \sim^{idd} N(0, \sigma_\theta^2)$. We approximate this on a symmetric two-point distribution, yielding equal masses of agents at $\theta_H = 1.12$ and $\theta_L = 0.88$. We assume that the persistent component of income η follows an AR(1), $\ln(\eta') = \rho \log(\eta) + u$, where $u \sim^{idd} N(0, \sigma_\eta^2)$. Lastly, the perfectly transitory component is log normally distributed, $\ln(\epsilon) \sim^{idd} N(0, \sigma_\epsilon^2)$.

Profits are distributed uniformly to the top 0.1 percentile of earners, thus $\Pi(\theta\eta\epsilon) = 1_{\{\theta\eta\epsilon \geq P99.9\}}\Pi/(0.001)$ where $1_{\{\theta\eta\epsilon \geq P99.9\}}$ is an indicator function equal to 1 if total earnings $\theta\eta\epsilon$ is greater or equal to the 99.9th percentile of the earnings distribution ($P99.9$) and 0 otherwise. In Section 7, we consider alternate distributions of profits.

The remaining parameters $\{\beta, \chi, \kappa\}$ are estimated jointly to target moments between 1971 and 1975. We estimate $\beta = 0.959$ to match average credit to income of 1.04% from 1971 to 1975. We calibrate stigma $\chi = 4.293$ to match the average bankruptcy rate of 0.06% from 1971 to 1975. Since there are taste shocks, defaults may occur even when the Bellman value of repayment is greater than the Bellman value of default. We attribute these defaults to *unmodeled shocks*. We interpret the data analogue of defaults attributable to *unmodeled shocks* as the share of bankruptcies due to divorce, health costs, or lawsuits

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[29] We measure this as the Moody's Aaa rate less inflation implied by the NIPA GDP Deflator.

[30] We base our estimates on the working paper version of Storesletten, Telmer, and Yaron (2004), since the working paper reports the relevant income process for our exercise.

Table 6: Parameters determined outside the model equilibrium

Parameter	**Description**	**Value**
σ	Risk aversion	2
r	Risk-free rate	1.265
ϕ	Re-entry prob. good credit standing (10 year exclusion)	0.1
σ^2_θ	Variance permanent component θ	0.244
σ^2_η	Variance of innovation to AR(1) component η	0.024
σ^2_ϵ	Variance transitory component ϵ	0.063
ρ	Persistence of AR(1) component η	0.977
$1_{\{\theta\eta\epsilon \geq P99.9\}} \frac{\Pi}{0.001}$	Profits uniform among top earnings decile	$P99.9_{\text{earnings}}$

reported by Chakravarty and Rhee (1999). We therefore set $\kappa = 3.582$ so that the share of unmodeled defaults in the model coincides with the share of these bankruptcies.

Table 7: Parameters determined jointly in equilibrium

	Parameter	**Value**	**Target**	**Data**	**Model**
β	Discount rate	0.959	Credit to income	1.04	1.01
χ	Stigma	4.293	Bankruptcy rate	0.06	0.06
κ	Scaling parameter	3.582	Fraction of bankruptcy due to divorce, health, lawsuits	44.81	45.40

Notes: Credit data are from the Federal Reserve Board G.19 series. The bankruptcy rate is Chapter 7 flings per capita computed using data from the Historical Statistics of the U.S. Millennial Edition. The fraction of bankruptcy due to divorce, health costs and lawsuits is taken from Chakravarty and Rhee (1999) who compute these statistics in the PSID. The fraction of bankruptcy due to divorce, health costs and lawsuits within model is the fraction of defaults that occur when the continuation value of repayment is greater than the Bellman value of default. See text for more discussion.

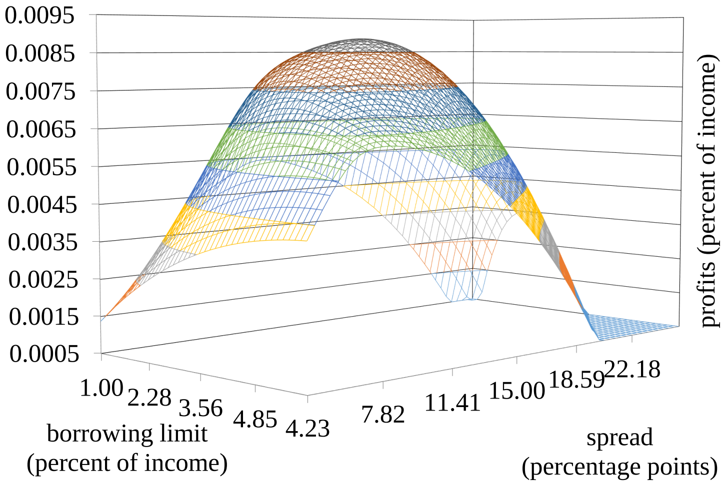
5 Characterization and validation of monopolist's problem

We first numerically explore the properties of the monopolist's problem. As a validation exercise, we then compare the model's performance relative to non-targeted moments including spreads, credit access by income, and pass-through rates.

5.1 Characterization of the monopolist's problem

We begin by analyzing the monopolist's profit maximizing choices of limits and interest rates. Figure 5 plots profits to the monopolist $(\pi^1(r^1(\theta), \bar{l}^1(\theta)) = \Pi_1(r_1(\theta), \bar{l}_1(\theta)))$ as a function of the spread $(\tau^1(\theta) = r^1(\theta) - r_f)$ and the borrowing limit $(\bar{l}^1(\theta))$ for the consumer with the high permanent earnings component. The monopolist maximizes profits at an interior spread and an interior borrowing limit. This is because if the monopolist chooses a low spread, then the profit margin is low, and hence, profits are low. If the monopolist chooses a high spread, then consumers will borrow less, leading to low profits. A high spread also increases default risk as the composition of borrowers changes. The same is true for the extremes of borrowing limits. By definition, near-zero limits restrict profits, while limits that are too generous result in negative profits due to more defaults. The profit function for the consumer with low permanent earnings is qualitatively similar with lower total profits.

Figure 5: Monopolist profit function for high-earning consumer $(\theta = \theta_H)$



Notes: *borrowing limits are expressed as a percentage of income per capita. Spreads are expressed as percentage points over the savings interest rate. Profits are expressed as a percentage of income.*

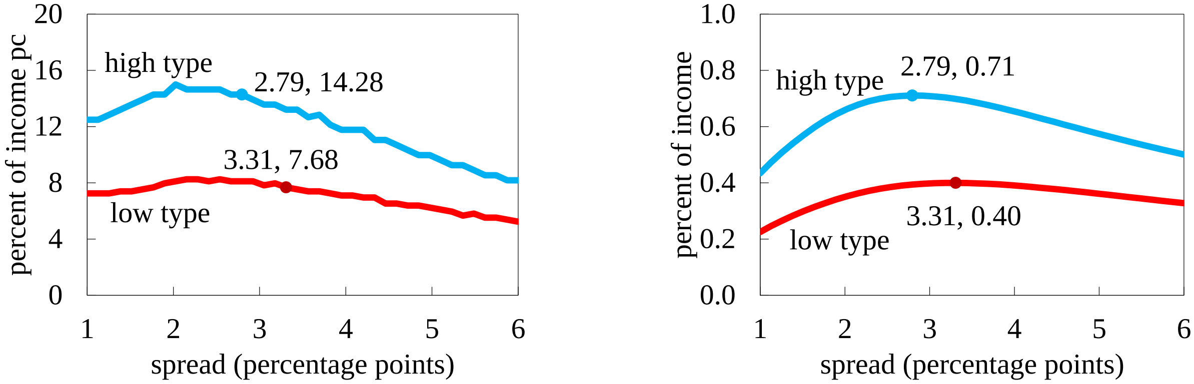
To further understand why the profit function is single-peaked and admits an interior solution, Figure 6 plots the monopolist's optimal policy functions and corresponding profits for both the high-type (blue) and low-type (red). Panels (a) and (b) plot the limits that maximize profits and the corresponding profits as a function of the spread. Hence, the spreads that maximize profits in Panel (b) are the optimal contracts for each type. We see that optimal limits are hump shaped with respect to the spreads for both types. That is, for both very low and very high values of the spread, the monopolist restricts the amount that can be borrowed by cutting limits. A low spread reduces the profit margin for each dollar of borrowing. This restricts the ability of the monopolist to take on more default risk. For high values of the spread, the only agents who borrow are those who have realized extremely low persistent and transitory earnings shocks. These agents default at a very high rate, which again incentivizes the monopolist to restrict lending.

Panels (c) and (d) plot the spreads that maximize profits and the corresponding profits as a function of the limit for both types. Hence, analogous to Panel (b), the limits that maximize profits in Panel (d) are the optimal contracts for each type. In Panel (c), spreads increase for both types as the credit limit declines. This feature is consistent with neoclassical models of monopoly where quantity restrictions raise prices.

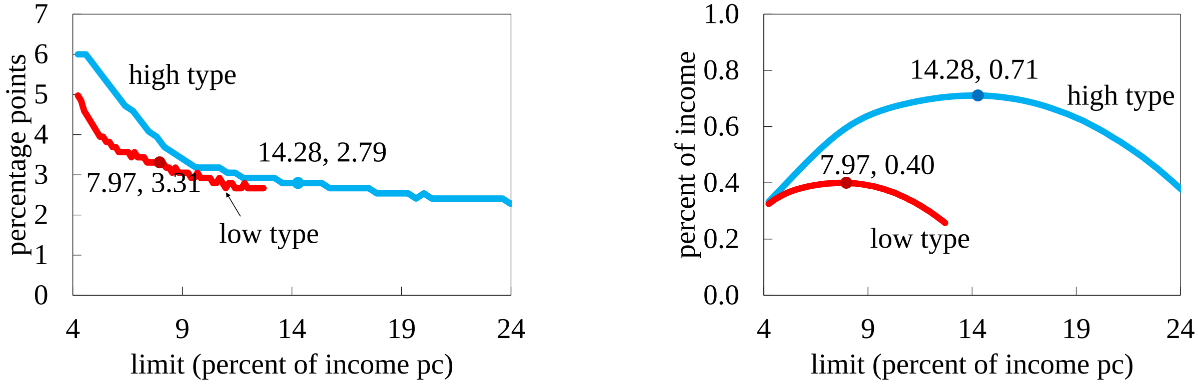
Comparing the high-type to the low-type, we see that the policy functions are qualitatively similar except that total profits are lower for the low-type. Further, the monopolist chooses a lower limit and a higher spread for the low-type.

Figure 6: Monopolist policy functions for both types ($\theta \in \{\theta_H, \theta_L\}$)

(a) Limit (b) Profits (NPV)



(c) Spread (d) Profits (NPV)



Notes: *Panel (A) plots the lender's optimal limit when their spread is fixed at the value on the x-axis (blue denoting the high-type and red denoting the low-type). Panel (B) plots the lender's NPV profits as a percentage of income when their spread is fixed at the value on the x-axis and the limit is allowed to freely adjust. Panel (C) plots the lender's optimal spread when their limit is fixed at the value on the x-axis. Panel (D) plots the lender's NPV profits as a percentage of income when their limit is fixed at the value on the x-axis and the spread is allowed to freely adjust. Borrowing limits are expressed as a percentage of income per capita. Spreads are expressed as percentage points over the savings interest rate.*

5.2 Non-targeted moments: Spreads, credit access by income, and pass-through rates

As a validation exercise, we next compare the monopoly model with three non-targeted moments: spreads, relative limits among high and low earners, and pass-through rates.

Spreads. While our calibration uses targets from 1971 to 1975, we can only measure spreads starting in 1974. Table 8 shows that the model generates an average spread of 3.05 percentage points, accounting for roughly 40% of the observed spreads in the data. The model generates an excess spread (the spread over and above the break even spread) of 2.07 percentage points, similarly accounting for roughly 40% of the data.

Relative credit limits. We also measure the relative credit limits of high and low earners in the data. Unfortunately, the first micro data available with both credit limits and income is the 1989 Survey of Con-

Table 8: Spreads and Excess Spreads, Benchmark Monopoly Calibration vs. Data

Variable (unit=percent)	**Monopoly**	**Data**	**Source**
Spread	3.05	8.48	Board of Governors & Author's Calc.(1974-1975)
Excess spread: actual - zero-profit	2.07	5.69	Board of Governors & Author's Calc. (1974-1975)

Notes: *See Section 2 for details on construction of the excess spread in the data. The excess spread in model is defined as* $\tau_{avg} - \tau_{zero}$ *where* $\tau_{avg} = (\tau(\theta_H) + \tau(\theta_L))/2$ *and* $\tau_{zero} = D(1+r)/(1-D)$ *where D is the economy-wide charge-off rate.*

sumer Finances (SCF). We proxy the high and low permanent earnings groups using college- and non-college-educated workers, respectively. We further restrict the SCF data to employed heads of household between the ages of 24 and 65.[31] While the 1989 *levels* of limit to income are non-comparable with our calibration, as a plausibility check, we compare credit limits in the model with those observed between both types of workers in the data. Table 9 shows that the relative limits of high and low-earning households in our 1970s monopoly calibration is 1.86, whereas the ratio is 2.69 in the 1989 SCF. In our 1970s monopoly calibration, the credit limit to income ratio between high earners and low earners is 1.46, whereas this ratio is 1.21 in the 1989 SCF. Since low-income households default at a higher rate, the monopolist optimally extends lower limits to low-income households. As a result, our model produces disparate access to credit among rich and poor households.

Table 9: Relative Limits of High and Low Permanent Earners, Benchmark Monopoly Calibration vs. Data

Variable (unit=ratio)	**Monopoly**	**Data**	**Source**
High earner limit over low earner limit	1.86	2.69	SCF & Author's Calc. (1989)
High earner limit to income over low earner limit to income	1.46	1.21	SCF & Author's Calc. (1989)

Notes: *Model column of "High earner limit over low earner limit" corresponds to* $l_1(\theta_H)/l_1(\theta_L)$*. Data column of "High earner limit over low earner limit" corresponds to the ratio of average credit limits of college-educated prime-age heads in the SCF relative to non-college-educated heads. Model column of "High earner limit to income over low earner limit to income" corresponds to the average credit limit to contemporaneous income ratio of high-types to low-types. Data column of "High earner limit to income over low earner limit to income" corresponds to the credit limit to gross family income ratio of college-educated prime-age heads in the SCF relative to non-college-educated heads. We require all SCF heads of household to be employed and thus have well defined limit to income ratios. We further winsorize the data at the 1% level to remove outliers.*

Pass-through rates. Our last validation exercise for the pure monopoly market structure is measuring its ability to generate the pass-through rates from 1975 to 1982 reported in Section 2. To formally test across market structures, we estimate pass-through on model simulated data and then compare those estimates to Table 4. To make our model estimates comparable to the data, we simulate the same size shocks to the risk-free rate (the federal funds rate), with the same persistence, observed in our sample period (1975-1982). We estimate an AR(1) and find an autocorrelation coefficient of 0.778 and a standard deviation of innovations to the federal funds rate of 0.70 (70 basis points).

Our experiment is to compute pass-through to the lowest offered rate (the type-θ_H rate) following an unexpected one standard deviation reduction in the risk-free rate that then decays according to the AR(1)

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[31] We require employment in order to remove income values of zero, and thus undefined limit to income ratios.

autocorrelation coefficient. We focus on the lowest offered rate in the model because we measure pass-through to the lowest offered rate in the data. Since our model has no credit card acquisition decision, we compute the pass-through rates in an initial economy populated by zero-net-worth individuals, in good credit standing, with the ergodic distribution of earnings. Zero-net-worth individuals (i) are not yet borrowing and (ii) are most likely to borrow in the next period, therefore they provide a good proxy for new issuances in our model. At the onset of the shock, lenders optimize and commit to their strategies, which are restricted to be constant over the transition path. We restrict strategies to be constant for two reasons: (1) solving for an unrestricted path of rates and limits ignores the commitment inherent in credit line contracts and (2) it would be computationally infeasible. Nonetheless, computing transition paths remains very computationally intensive, since for each set of strategies, we must solve the entire transition path forward to compute profits. To estimate the pass-through, we compare the interest rate chosen by the lender when there is a shock to the case when there is no shock.

Panel I of Table 10 reports the baseline monopoly pass-through rate of 0.41% and the competitive benchmark pass-through rate of 14.05%.[32] Panel 1 also reports pass-through rates for alternative forms of competition that we consider in Online Appendix E such as competitive pricing only on rates (i.e., the limit is exogenous) as analyzed in Athreya (2002).

Panel II of Table 10 compares our model to pass-through rates estimated from the federal funds rate to the lowest offered credit card interest rates in the data.[33] In 3 out of 5 specifications in the credit card data, the baseline monopoly model predicts pass-through rates within the 95% confidence interval. As expected, it falls outside of the confidence interval for the data specifications with severely negative pass-through rates. However, the upper bound of the 95% confidence interval is extremely close to zero in those instances, and so we view the pass-through rate of 0.41% as quantitatively consistent with the credit card data. Our benchmark competitive model as well as the one with competitive pricing only on rates generate pass-through rates that lie outside of all confidence intervals based on credit card data.

Panel III of Table 10 compares the model to pass-through rates for consumer loans. We treat consumer loans as the empirical ‘competitive benchmark’ since consumer loans could be issued outside of credit card licensing agreements. Reversing the patterns in the credit card market, we find that the monopoly model lies outside of the confidence interval for consumer loan pass-through rates in all but one of the specifications. In contrast, our competitive benchmark model lies within the confidence interval in every specification; competitive pricing only on rates lies within the confidence interval in 3 out of 5 specifications.

In summary, the monopoly economy does well at replicating the credit card pass-through rate, unlike the competitive model; the competitive economy does well at replicating the consumer loan pass-through rate, unlike the monopoly model. This gives us confidence that our monopoly market structure is consistent with credit card pass-through rates observed in Section 2, whereas the competitive model

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[32] The relatively low pass-through rates for both monopoly and the competitive benchmark are also driven by the fact that the lender commits to the contract (i.e., fixed interest rate credit cards). In Online Appendix K, we show that in a simplified two-period model (i.e., an abstraction from fixed rate credit cards with many periods), the pass-through rate under pure monopoly is 50%, whereas it is 100% under perfect competition.

[33] Online Appendix 18 repeats this exercise for the Romer and Romer shocks.

is not.

Table 10: Pass-through rates

Panel I: Model	
Pure monopoly pass-through rate to r_t^{low} :	0.0041
Competitive benchmark pass-through rate to r_t^{low} :	0.1405
Competitive rate-only pass-through rate to r_t^{low} :	0.0661

Panel II: Pass-through from federal funds to credit cards					
Source: Panel A, Table 5 Column No.	(1)	(2)	(3)	(4)	(5)
$FF_t - FF_{t-1}$ pass-through rate to $r_t^{low,cons}$	-0.00657	-0.00783	-0.0322**	-0.0589	-0.168**
Upper bound of 95% Confidence interval	0.0203	0.0164	-0.0081	0.032	-0.0215
Lower bound of 95% Confidence interval	-0.0334	-0.0321	-0.0563	-0.15	-0.315
Pure monopoly within 95% CI?	Y	Y	N	Y	N
Competitive benchmark within 95% CI?	N	N	N	N	N
Competitive rate-only within 95% CI?	N	N	N	N	N

Panel III: Pass-through from federal funds to consumer loans					
Source: Online Appendix, Table 19 Column No.	(1)	(2)	(3)	(4)	(5)
$FF_t - FF_{t-1}$ pass-through rate to $r_t^{low,cons}$	0.212***	0.211***	0.193**	0.203*	0.253**
Upper bound of 95% Confidence interval	0.319	0.318	0.363	0.407	0.481
Lower bound of 95% Confidence interval	0.106	0.104	0.0239	-0.00089	0.0247
Pure monopoly within 95% CI?	N	N	N	Y	N
Competitive benchmark within 95% CI?	Y	Y	Y	Y	Y
Competitive rate-only within 95% CI?	N	N	Y	Y	Y

6 Gains from competition

The 1970s credit card market was characterized by regional monopolies. However, many landmark cases such as the *Marquette* decision and other cases discussed in Section 2 contributed to greater, yet still limited, national competition. We map these reforms into two market structures. First, in Section 6.1, we solve the transition from monopoly to collusive-Cournot oligopoly. Second, in Section 6.2, we drop the assumption of oligopoly and compute the transition from monopoly to our competitive benchmark. This provides an upper bound on the gains from the reforms.

6.1 Experiment 1: Monopoly to collusive-Cournot oligopoly

Based on evidence in Section 2.2, our first experiment models the U.S. credit card industry's transition to greater competition during the 1970s and 1980s by replacing a monopoly lender with a collusive-Cournot oligopoly. In particular, we replace the monopoly lender with a collusive-Cournot oligopoly of twenty lenders ($N = 20$), in which the number of lenders is motivated by the inverse Herfindahl in the late 1980s (see Table 2). In the first stage, forward-looking lenders collude to set an interest rate ($r(\theta)$)

for each type $\theta \in \{\theta_L, \theta_H\}$; in the second stage, the lenders Cournot compete on limits in a simultaneous move game for each type, and we analyze the symmetric Nash equilibrium of that game.

Experiment details. We assume there is a one-time, unexpected, and permanent change from monopoly to collusive-Cournot oligopoly at date $t = 1$. As discussed in the pass-through exercise in Section 2.2, to maintain a well-defined notion of credit lines, we assume that at date $t = 1$, forward-looking lenders compete as collusive-Cournot oligopolists and commit to new, constant strategies. This still involves solving the entire transition path for thousands of strategies to compute lender profits. We assess robustness to the constancy of strategies in Online Appendix I.[34]

Policy functions. To better understand the results that follow, we first characterize the collusive-Cournot policy functions. Figure 7 illustrates lender policy functions for credit limits. At date $t = 1$, taking the spread from the first stage as given, lenders simultaneously compete over borrowing limits in stage 2. Panel (a) plots the Nash equilibrium limit in stage 2 as a function of the spread for type-θ_H consumers (see Online Appendix G for the policy functions for type-θ_L consumers). In the first stage, lenders collude on a spread of 2.55 percentage points to maximize their total second stage profits. When the twenty lenders collude on a spread of 2.55 percentage points, the sum of the Nash equilibrium limits on all credit lines is 38.16% of income per capita. Panel (b) plots the best response function of the lenders in the second stage for the case where the spread is 2.55 percentage points. The best response in limits is downward sloping, reflecting the fact that limits are strategic substitutes. This is because when one lender increases their limit, they increase total borrowing and total default risk. Hence, the other lenders are forced to tighten their limit. The symmetric Nash equilibrium is determined by the point where the best response function crosses the 45 degree line.[35]

Transition path. Figure 8 illustrates that the optimal spreads and credit limits for both the high-type and low-type consumers along the transition path to a collusive-Cournot oligopoly. Panel (a) shows the paths for spreads for the low-type (θ_L) and high-type (θ_H) decline slightly once the lenders begin to Cournot-compete. Combined limits increase significantly for both the low-type (θ_L) and high-type (θ_H).

Panels (a) through (d) of Figure 9 plot key variables along the transition path from monopoly to collusive-Cournot oligopoly. Since total borrowing limits increase and spreads decrease, individuals borrow more. As a result, credit rises monotonically in Panel (a) of Figure 9. Borrowing limits increase discontinuously at $t = 1$; however, consumers slowly adjust their savings and borrowing. As a result, the credit utilization rate (credit/limit) falls, and consumers initially have extra slack on their credit lines. This generates the sharp drop in defaults shown in Panel (b). In the long run, however, consumers dissave and borrow more, which causes defaults to rise in the cross-section. Panel (c) plots the resulting

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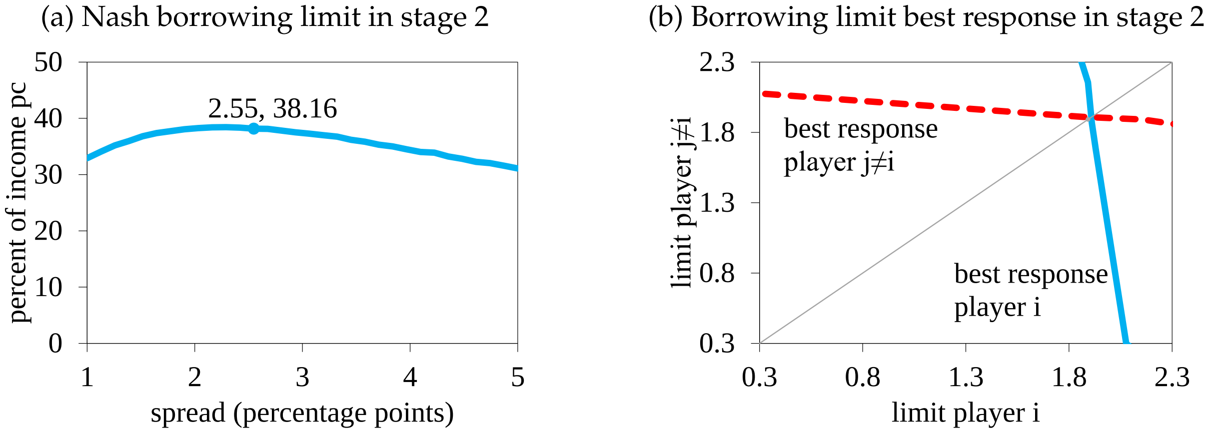
[34] To address concerns about the constancy of strategies, Online Appendix I conducts two exercises. We show optimization across steady states yields similar strategies which suggests there are small gains from re-optimization later in the transition. Second, we show that allowing for re-optimization at a later period ($t = 5$) yields similar strategies.

[35] We cannot theoretically establish that the symmetric Nash equilibrium is unique. In our numerical exercise, however, we verify that the best response functions in limits are weakly downward sloping. This ensures that the symmetric Nash equilibrium in limits is unique (numerically).

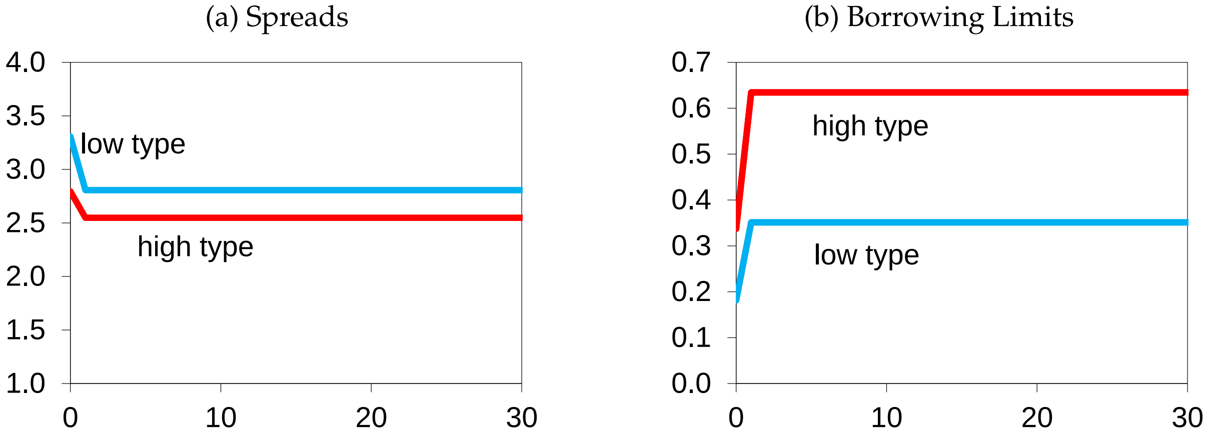
Figure 7: Collusive-Cournot oligopoly (N=20) policy functions ($\theta = \theta_H$)


(a) Nash borrowing limit in stage 2

(b) Borrowing limit best response in stage 2

Notes: *Panel (a) plots the stage 2 Nash equilibrium limit as a function of the spread. Panel (b) plots the lenders' best response functions the spread that maximizes profits in the first stage. The symmetric Nash equilibrium is the point where the limits cross the 45 degree line.*

Figure 8: Transition from monopoly to collusive-Cournot oligopoly


(a) Spreads

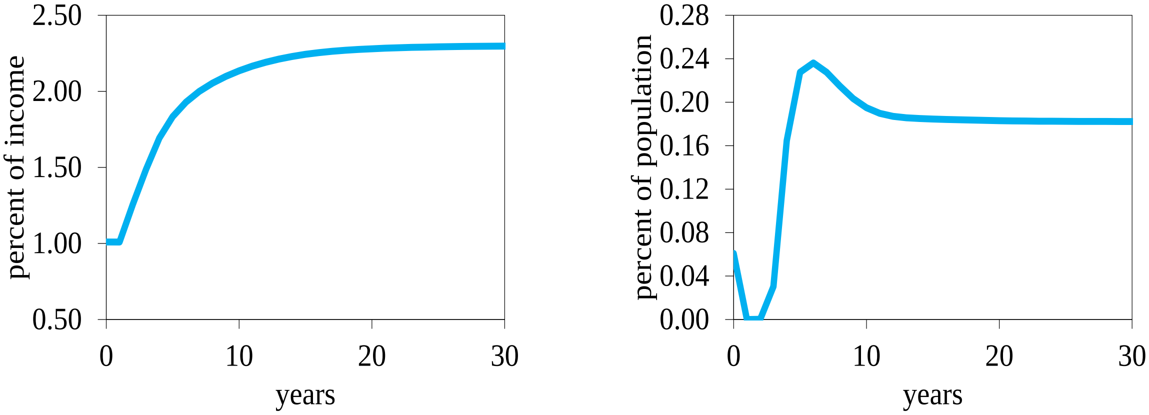
(b) Borrowing Limits

Notes: *The initial steady state (t=0) is a monopoly. At date $t = 1$, the economy unexpectedly transitions to a collusive-Cournot oligopoly (N=20). We assume perfect foresight for subsequent periods. Panel (a) plots the optimal spread of the high-type and low-type. Panel (b) plots the optimal limit of the high-type and low-type.*

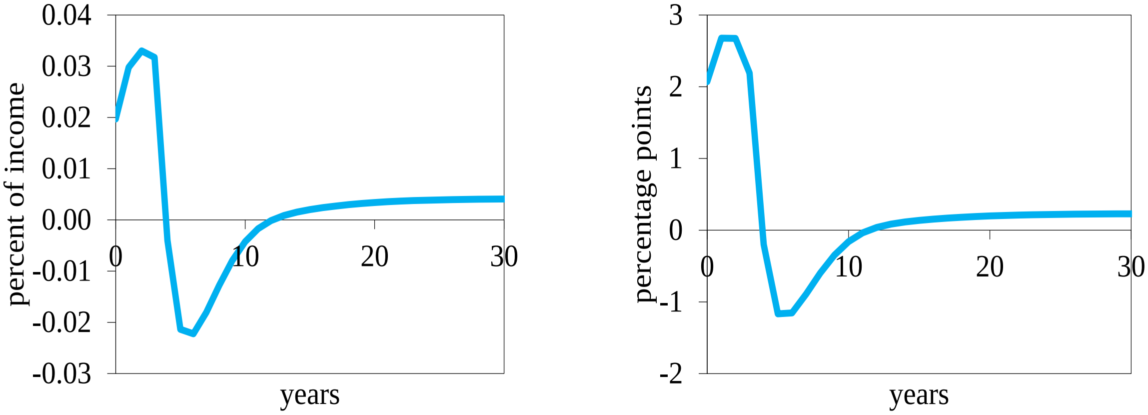
path for aggregate lender profits. The discontinuous decline in defaults generates an initial positive spike in profits. Eventually competition sets in and profits decline. It is important to note, however, that although profits are negative for some of the periods along the transition path, the net present value of profits for both high and low-types is positive, implying the transition path would not result in lender exit. Qualitatively, a similar pattern emerges in Panel (d) for the excess spread.

Initial steady state ($t = 0$) to terminal steady state ($t = \infty$). Table 11 compares credit market outcomes across the initial steady state (Column (1), Monopoly at $t = 0$) and the terminal steady state (Column (2), collusive-Cournot (N=20) at $t = \infty$). Table 11 reports limits and spreads for both consumer types and

Figure 9: Transition from monopoly to collusive-Cournot oligopoly


(a) Credit

(b) Default Rate


(c) Profits

(d) Excess Spread

Notes: *The initial steady state (t=0) is a monopoly. At date $t = 1$, the economy unexpectedly transitions to a collusive-Cournot oligopoly (N=20). We assume perfect foresight for subsequent periods.*

other credit-related summary statistics. From monopoly to collusive-Cournot oligopoly, total borrowing limits increase by almost 90% for both the high-type and low-type (20.29% to 38.16% of income per capita for the high-type and 10.91% to 21.13% of income per capita for the low-type). However, the fall in spreads is small (2.79 to 2.55 percentage points for the high-type and 3.31 to 2.81 percentage points for the low-type). This is not surprising because lenders collude on rates and compete on limits.

A side effect of greater competition is a significant expansion of the credit market. Total credit increases by 128% from 1.01% of income to 2.31% of income; the share of population revolving a positive balance increases by 25% from 12.69% to 15.83%. Further, the default rate, charge-off rate, and credit among bankrupts increase significantly. Defaults triple, rising from a default rate of 0.06% per annum per capita to 0.18% per annum per capita. Likewise, charge-offs increase by 145%, from 0.96% to 2.35%. Moreover, the ratio of credit to income among bankrupts increases from 1.50 to 2.19.[36] An implication of (1) roughly constant spreads for both the high and low-type and (2) increasing charge-offs is that the

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[36] Table 11 reports these credit statistics by low/high-type as well, and they follow a similar pattern.

Table 11: Comparison of initial ($t = 0$) to terminal steady state ($t = \infty$).

Summary Statistics	**(1)** Monopoly $t = 0$	**(2)** collusive-Cournot (N=20) $t = \infty$	**(3)** Competitive Pricing $t = \infty$
High-type			
Borrowing limit to initial income pc	20.29	38.16	37.52
Spread	2.79	2.55	1.35
Credit to income	1.25	2.80	4.00
Share revolving	13.87	16.99	21.00
Bankruptcy rate	0.07	0.19	0.16
Charge-off rate	0.95	2.29	1.30
Credit to income: bankrupts	1.69	2.46	2.58
Low-type			
Borrowing limit to initial income pc	10.91	21.13	21.41
Spread	3.31	2.81	1.58
Credit to income	0.70	1.69	2.44
Share revolving	11.52	14.67	18.10
Bankruptcy rate	0.06	0.18	0.15
Charge-off rate	0.97	2.48	1.51
Credit to income: bankrupts	1.21	1.81	1.91
Aggregate			
Credit to income	*1.01*	2.31	3.31
Share revolving	12.69	15.83	19.55
Bankruptcy rate	*0.06*	0.18	0.15
Charge-off rate	0.96	2.35	1.37
Credit to income: bankrupts	1.50	2.19	2.29
Excess spread: actual - zero-profit	2.07	0.24	0.06**
Interest rate dispersion (CV)	0.06	0.03	0.04

Notes: *Table 11 reports credit-related summary statistics for the initial monopoly steady state at $t = 0$ (Column (1)) and the steady-states at the end of the transition path after each competitive reform. Column (2) is a collusive-Cournot oligopoly with twenty lenders, in which lenders collude in the first stage on interest rates and then compete on limits in the second stage. Column (3) is perfectly competitive pricing. We define the competitive pricing equilibrium to be the limit and interest that maximize welfare of an unborn agent (given their permanent earning ability), subject to weakly positive profits. ** note that integrating over the entire transition path yields a zero excess spread for the competitive pricing economy. At the final terminal steady state, excess spreads are slightly positive so as to cover initial losses along the transition path to competitive pricing.*

excess spread decreases from 2.07 percentage points to 0.24 percentage points. The interest rate dispersion measured by the coefficient of variation decreases slightly from 0.06 to 0.03.

Model versus data time trends. Table 12 compares empirical time trends in credit-related variables with their model counterparts. We observe the following patterns in the data from the early 1970s to the mid-late 1980s: (a) credit to income increased in the aggregate and among both high- and low-earners, (b) the share of population that is revolving a positive credit balance increased in the aggregate and among both high- and low-earners, (c) bankruptcies increased, (d) charge-offs increased, (e) credit to income among bankrupts increased, and (f) interest rate dispersion measured by the coefficient of variation was low initially and decreased slightly.[37]

Table 12 shows that the transition to collusive-Cournot equilibrium is both quantitatively and qualitatively consistent with facts (a) through (f). The model explains roughly one-third of the rise in credit and roughly one-fifth of the rise in the share of population that is revolving a positive balance; further, the model explains most of the increase in bankruptcies and charge-offs, and a significant share of the increase in credit to income among bankrupts.[38] The model also explains the low level of interest rate dispersion (measured by the coefficient of variation) in the 1970s as well as the slight decrease in dispersion.[39]

Table 12: Credit-related statistics: model vs data

Summary Statistics	**Data**		**Model**		**Change**	
	1971-75	1986-1990	Monopoly	Oligopoly	Data	Model
Aggregate						
Credit to income	1.02	4.64	1.01	2.31	3.62	1.30
Share revolving	11.71	25.79	12.69	15.83	14.08	3.14
Bankruptcy rate	0.06	0.16	0.06	0.18	0.10	0.12
Charge-off rate	2.57	3.84	0.96	2.35	1.27	1.39
Credit to income: bankrupts	1.71	2.72	1.50	2.19	1.01	0.69
Interest rate dispersion (CV)	0.11**	0.09**	0.06	0.03	-0.02	-0.03
High-type						
Credit to income	0.30	0.96	1.25	2.80	0.66	1.55
Share revolving	21.24	37.11	13.87	16.99	15.87	3.12
Low-type						
Credit to income	0.22	1.07	0.70	1.69	0.85	0.98
Share revolving	9.84	22.04	11.52	14.67	12.19	3.16

*Notes: Aggregate credit data are from the Federal Reserve Board G.19 series. Share revolving and credit by earnings type data are from the Survey of Consumer Finances (average of 1970 and 1977 and average of 1983 and 1989; high earner and low earner correspond to college-educated and non-college-educated heads). The bankruptcy rate is Chapter 7 filings per capita computed using data from the Historical Statistics of the U.S. Millennial Edition. Charge-off data are from Ausubel (1991). Credit to income of bankrupts data are from Livshits et al. (2010), who collected data from various sources including Domowitz and Eovaldi (1993) and Sullivan, Warren, and Westbrook (2000) (averages from 1978/79-80 and 1991). ** denotes that interest rate dispersion data are from LIRS FR2835 in 1975 and 1982, respectively. We used averages from 1971-75 and 1986-90 unless otherwise noted. Monopoly is* $N = 1$*, Oligopoly is* $N = 20$ *with collusive-Cournot competition.*

We view the model's ability to generate the observed time trends, especially the low level of dispersion in interest rates along with a slight decrease, as an important validation exercise for collusive-

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[37] Earnings type-specific credit related variables other than credit to income and share revolving are not available for this time period.

[38] To compare the oligopoly credit statistics in the model to data, we computed averages from 1986 to 1990 in the data to the extent possible. See table notes for specific years and sources. We picked this period because the model completes most of the transition in the first fifteen years. Further, this period is a snapshot of the credit card market before the significant expansion due to the impact of the IT revolution.

[39] The slight decrease in interest rate dispersion during this time period is a pattern that is at odds with prior narratives, *prima facie*. But this time period (1975-1982) predates the typical surveys used to document credit dispersion in the existing literature. In subsequent periods, interest rate dispersion increased and credit scoring and/or other factors not present in our analysis likely contributed to the observed time trends (e.g., Livshits et al. (2010), Athreya et al. (2012), Livshits et al. (2016), Sánchez (2018), and Raveendranathan (2020)). We provide a complementary rationale for rising credit and bankruptcies in the 1970s and 1980s.

Cournot. While we are computationally limited in the market structures we can consider, in Online Appendix E, we show that an alternative market structure that relaxes interest rate collusion is unable to generate these time trends, in particular, the level of dispersion in interest rates.

Distributional consequences of collusive-Cournot oligopoly. We now quantify the *distribution* of welfare gains along the transition path. We use three measures of welfare: (1) consumption equivalent variation (CEV), (2) wealth equivalent variation (WEV), and (3) share of population that is better off. Consumption equivalent variation is a standard measure that calculates the lifetime increase of consumption in the initial monopoly steady state such that a consumer is indifferent between the economy with a monopolist and an economy with an oligopoly. In our model, we compute CEV numerically, taking into account default costs and taste shocks.

Wealth equivalent variation is the one-time transfer that the consumer requires in the initial monopoly steady state to be just as well off with an oligopoly. Wealth equivalent variation is our preferred measure because (1) it allows for aggregation across heterogeneous consumers and (2) it takes into account that consumers re-optimize on their decisions given the one-time transfer. Following Conesa, Costa, Kamali, Kehoe, Nygard, Raveendranathan, and Saxena (2018), it is calculated as follows:

$$
\begin{aligned}
& \min \ WEV && (10)\\
s.t. \quad & V_0(i,\theta,\eta,\epsilon,z,a+WEV) \geq V_t(i,\theta,\eta,\epsilon,z,a) && \\
& a+WEV \geq -\bar{l}^1(\theta) \qquad \text{if } \ i=g && \\
& a+WEV \geq 0 \qquad \text{if } \ i=b, &&
\end{aligned}
$$

where $V_0(i,\theta,\eta,\epsilon,z,a+WEV)$ refers to the value at the initial steady state (monopolist) given a one-time transfer of WEV, $V_t(i,\theta,\eta,\epsilon,z,a)$ refers to the value in period t along the transition path, and $\bar{l}^1(\theta)$ refers to the borrowing limit in the initial steady state. The last two inequalities ensure that the minimization problem is well defined. When computing $V_0(i,\theta,\eta,\epsilon,z,a+WEV)$, the consumer takes into account profit changes resulting from the reform. When measuring welfare for unborn agents, we assume agents enter in good standing with zero assets and that they draw their earnings states from the ergodic earnings distribution. When aggregating wealth equivalent variation over living cohorts, we use the initial steady state distribution of agents.

Column (2) of Table 13 provides both consumption and wealth equivalent gains from collusive-Cournot oligopoly. At the date of the transition experiment ($t=1$), an unborn agent requires an increase in lifetime consumption of 0.73% to be as well off living in an economy with a single monopoly lender rather than a collusive-Cournot oligopoly. Equivalently, an unborn agent requires a one-time transfer at birth worth 6.38% of initial income per capita to be as well off living in an economy with a single monopoly lender rather than a collusive-Cournot oligopoly.[40] Among those that are alive at the date

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[40] WEV unborn = $E_{\theta,\eta,\epsilon}\text{WEV}(g,\theta,\eta,\epsilon,0)$. WEV unborn (θ) = $E_{\eta,\epsilon}\text{WEV}(g,\theta,\eta,\epsilon,0)$. Aggregate wealth equivalent variation $=\int \text{WEV}(i,\theta,\eta,\epsilon,a)d\Omega(i,\theta,\eta,\epsilon,a)$. Total income $=\int[\theta\eta\epsilon + r\max(0,a)+\Pi(\theta\eta\epsilon)]d\Omega(i,\theta,\eta,\epsilon,a)$. Population better off = $\int 1_{\{V_t(i,\theta,\eta,\epsilon,z,a)\geq V_0(i,\theta,\eta,\epsilon,z,a)\}}d\Omega(i,\theta,\eta,\epsilon,a)$.

Table 13: Welfare gains from monopoly to different forms of competition.

Welfare gains: Monopoly to...	**(2)** collusive-Cournot (N=20)	**(3)** Competitive Pricing
CEV unborn at $t = 1$ (% of lifetime consumption)	0.73	1.02
WEV unborn at $t = 1$ (% of initial income pc)	6.38	9.12
WEV low-unborn at $t = 1$ (% of initial income pc)	5.13	7.32
WEV high-unborn at $t = 1$ (% of initial income pc)	8.54	12.08
WEV alive at $t = 1$ (% of initial income)	4.77	6.86
Population better off (% of population)	99.66	99.88
High-type WEV alive at $t = 1$ (% of initial income group)		
AR(1) earnings tercile 1	13.41	19.23
AR(1) earnings tercile 2	4.41	6.41
AR(1) earnings tercile 3	1.15	1.62
Low-type WEV alive at $t = 1$ (% of initial income group)		
AR(1) earnings tercile 1	10.16	14.69
AR(1) earnings tercile 2	3.38	4.93
AR(1) earnings tercile 3	0.92	1.29

Notes: *This table reports welfare gains along the transition path relative to monopoly steady state. When measuring wealth or consumption equivalent variation for unborn agents, we assume agents enter in good standing with zero assets and they draw their earnings states from the ergodic earnings distribution. When aggregating wealth equivalent variation over living cohorts, we use the initial steady state distribution of agents. Welfare is measured as either (a) consumption equivalent variation (CEV) for an unborn agent at the date of the transition $t = 1$, (b) the wealth equivalent variation (WEV) using equation (10) for unborn agents and unborn agents given their low- or high-earnings-type, (c) WEV for the cohort that is alive at the date of the transition $t = 1$, (d) Share of population that is better off with the transition, and (e) WEV for the cohort that is alive at the date of the transition $t = 1$ given their low- or high-earnings type and AR(1) earnings tercile.*

of the transition experiment ($t = 1$), the aggregate sum of wealth equivalent variation across consumers equals 4.77% of income. As we discuss below, these initial gains are a large fraction of gains from competitive pricing. Lastly, almost all consumers are better off from a new lender entrant; some consumers are worse off because total profits transferred to consumers fall. Given permanent earnings type, consumers in lower terciles of earnings experience larger gains.

Panel (a) of Figure 10 plots wealth equivalent variation by earnings decile. Individuals in the lowest earnings decile require a transfer worth $3,600 (in 2016 dollars) to be indifferent between the status quo and transitioning to collusive-Cournot oligopoly. Individuals in the highest earnings decile require a transfer worth $1,200. Panel (b) of Figure 10 expresses the WEV as a ratio of contemporaneous earnings in each decile. Individuals in the lowest decile of earnings would require a transfer worth more than 50% of their annual earnings to be indifferent between the status quo and transitioning to collusive-Cournot oligopoly. Individuals in the highest deciles would require transfers worth very little of their annual earnings (1.2 percent). This reflects the disproportionate burden of monopoly power borne by low-income households.[41]

To understand what drives the welfare gains among low-earning individuals, we study implications for average consumption, variance of consumption, average net assets, and default probabilities

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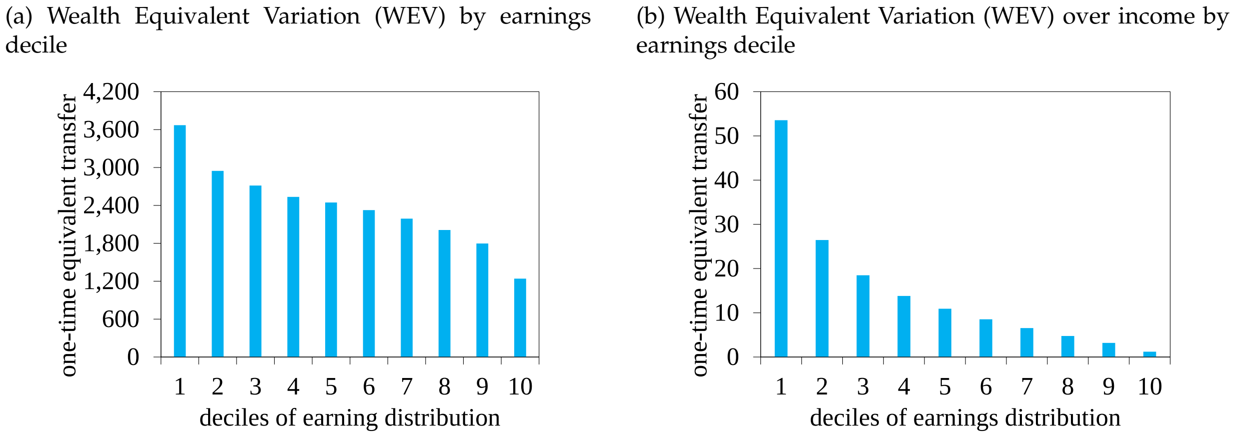
[41] In the bottom decile, 64% of consumers are type-θ_L consumers and 36% are type-θ_H consumers.

Figure 10: Welfare gains by earnings decile along transition path from monopoly to collusive-Cournot oligopoly (N=20)


(a) Wealth Equivalent Variation (WEV) by earnings decile

(b) Wealth Equivalent Variation (WEV) over income by earnings decile

Notes: *Welfare gains from the transition are measured using wealth equivalent variation in Panel (a). Panel (b) takes the ratio of the wealth equivalent variation to earnings in each decile.*

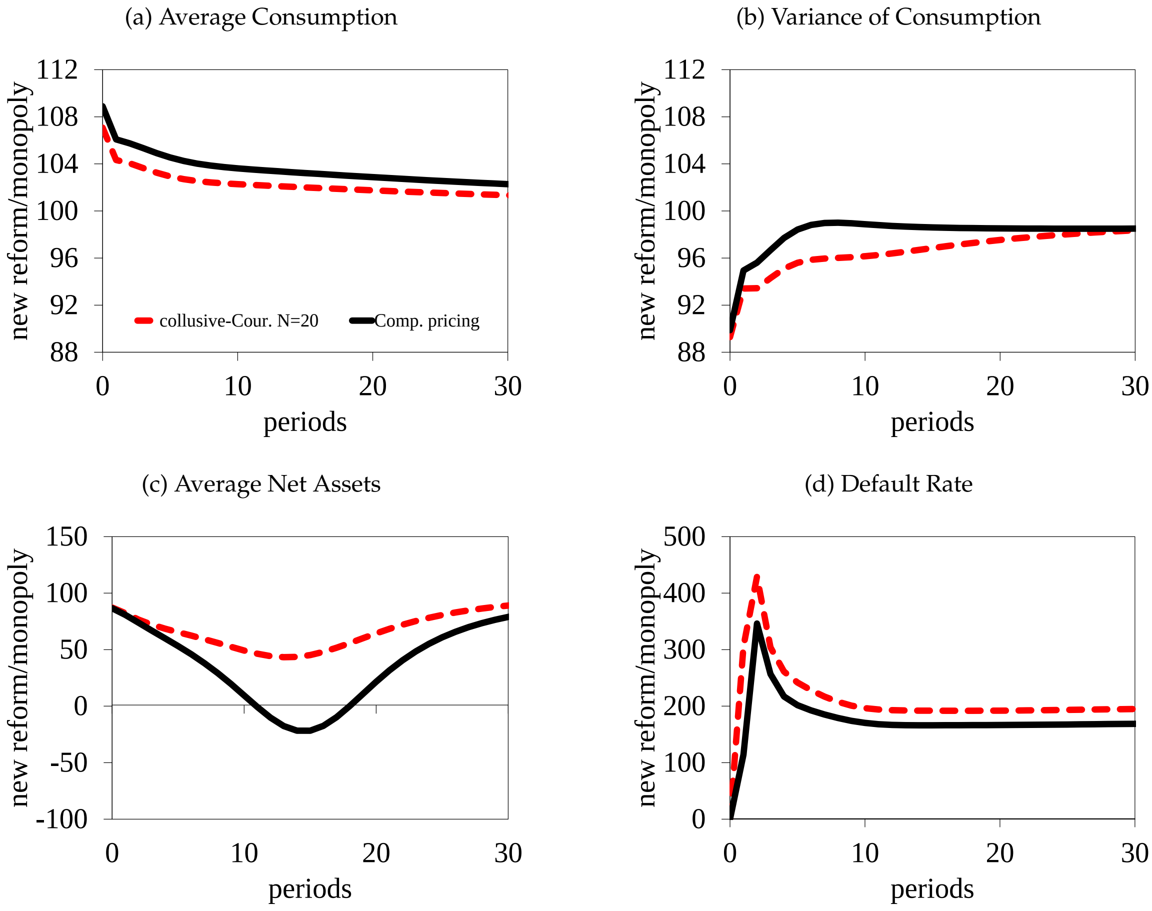
of consumers in the lowest decile of earnings at the start of the transition experiment ($t = 1$). We compare implications between remaining in the monopoly economy and transitioning to collusive-Cournot oligopoly and competitive pricing (we discuss the latter below in Section 6.2). We find that low-earning individuals benefit from higher average consumption, lower variance of consumption, and lower default rates along the transition path.

Panel (a) of Figure 11 plots the relative average consumption profile of agents in the bottom decile of earnings at the time of the transition ($t = 1$). More specifically, Panel (a) plots the ratio of average consumption along the transition path divided by the *status quo* average consumption if the agents remained in the monopoly economy. Agents consume roughly 6% more along the collusive-Cournot oligopoly transition path relative to remaining in steady state with a single monopoly lender (henceforth, *status quo*). In terms of consumption volatility, increased lender competition allows agents to better smooth consumption. Panel (b) shows that the variance of consumption decreases by 11% along the transition path to collusive-Cournot with twenty lenders relative to status quo. Panel (c) shows that low-earning individuals are able to dis-save relatively more with greater lender competition. Because credit limits expand, default rates initially decline in Panel (d). In the long run, however, default rates rise above the monopoly case because agents accumulate more debt.

In Online Appendix Figure 14, we show that the top 10% of earners also gain from greater competition mainly through lower consumption variance. However, since the highest earners less frequently rely on credit to smooth consumption, their welfare gains are an order of magnitude smaller.

In summary, even with interest rate collusion, increased lender entry leads to large welfare gains due to a large expansion in credit limits. Further, the welfare costs of monopoly in the lending market are borne primarily by low-earning individuals.

Figure 11: Average consumption, asset, and default profiles of a low-earning consumer



Notes: *Panels (a) through (d) are derived from simulating agents in the bottom-decile of earnings at date* $t = 1$ *on the transition path to (1) collusive-Cournot (N=20) and (2) single-lender competitive pricing. Panel (a) plots the average consumption path along the transition path expressed as a ratio to average consumption if the agent remained in a world with a single-lender monopoly. Panel (b) plots the variance of consumption along the transition path expressed as a ratio to the variance of consumption if the agent remains in a world with a single-lender monopoly. Panels (c) and (d) repeat the same exercise for net assets and defaults, respectively.*

6.2 Experiment 2: Monopoly to competitive pricing

Our second experiment assumes that lenders behave perfectly competitively in the post-reform 1980s. This exercise provides an upper bound for the welfare costs borne by households and acts as a benchmark against which we can measure the relative effectiveness of alternative competitive reforms. We solve for the zero-profit contract that maximizes welfare of newborns behind the veil at date $t = 1$. As we discuss in Section 3, we view this as a natural competitive benchmark: given the set of feasible zero-profit contracts, the household chooses the contract that maximizes utility. The household's choice is made behind the veil because we do not model credit card acquisition by the household.

Unlike the prior experiments, there is no lender entry in this section. Rather, we assume that there is a single lender that unexpectedly and permanently changes from monopoly pricing to competitive pricing at $t = 1$. We must define what competitive pricing means in this context. Our first condition for competitive pricing is zero expected profits. However, this condition alone is not sufficient to uniquely determine the equilibrium. For any given limit, Figure 5 shows that there is a zero-profit spread. Likewise, for any given spread, there is a zero-profit credit limit.[42]

The way we resolve this issue is to define competitive pricing to be the combination of interest rates and limits that maximizes the expected utility of an unborn agent in good standing with zero assets and permanent earnings component θ, subject to weakly positive lender profits:

$$\begin{aligned} \max_{r(\theta),\bar{l}(\theta)} \quad & E_{\eta,\epsilon} V_0(g,\theta,\eta,\epsilon,0) \\ s.t. \quad & \sum_{t=0}^{\infty} \left(\frac{1}{1+r_f}\right)^t \pi_t(\theta) \geq 0. \end{aligned}$$

Column (3) of Table 11 describes the competitive pricing in the terminal steady state ($t = \infty$) of the transition experiment. Compared with monopoly pricing, the credit limits are nearly twice as large (37.52% versus 20.29% for the high-type and 21.41% versus 10.91% for the low-type). Likewise, spreads fall by 50% (2.79 versus 1.35 percentage points for the high-type and 3.31 versus 1.58 percentage points for the low-type), and credit to income more than triples, increasing from 1.01 to 3.31 percent. A side effect of increased borrowing is that the default rate more than doubles, rising from 0.06 to 0.15 percent. With competitive pricing, excess spreads are effectively zero in the $t = \infty$ terminal steady state (note that when computed over the entire transition path, excess spreads are exactly zero).

The large reduction in spreads and increase in limits generate considerable welfare gains. Column (3) of Table 13 shows that an unborn agent would require an increase in lifetime consumption of 1.02% to be as well off living in an economy with a single lender that behaves monopolistically rather than a single lender that behaves competitively. The wealth equivalent gain to the same consumer, expressed as a one-time transfer, is equal to 9.12% of initial income per capita. The aggregate wealth equivalent variation across workers who are alive at the date of the transition equals 6.86% of initial income. We also find much larger distributional welfare gains. Panel (a) of Figure 12 shows that the lowest earning individuals would require a one-time transfer worth \$5,000 to be indifferent between a single lender that prices monopolistically and a single lender that prices competitively. Individuals in the highest earnings decile would require a transfer worth \$1,800. Expressing the wealth equivalent variation as a ratio of earnings in Panel (b), we find that individuals in the lowest decile of earnings would require a transfer worth more than 70% of their annual earnings to be indifferent between a single lender that prices monopolistically and a single lender that prices competitively. Higher mean consumption, lower consumption variance, and lower default rates drive these gains. Panel (a) of Figure 11 shows that with competitive pricing, agents on average consume roughly 9% more during the transition than they do in the status quo monopoly steady state. Panel (b) shows that consumption variance falls by approximately 10% with competitive pricing relative to status quo.

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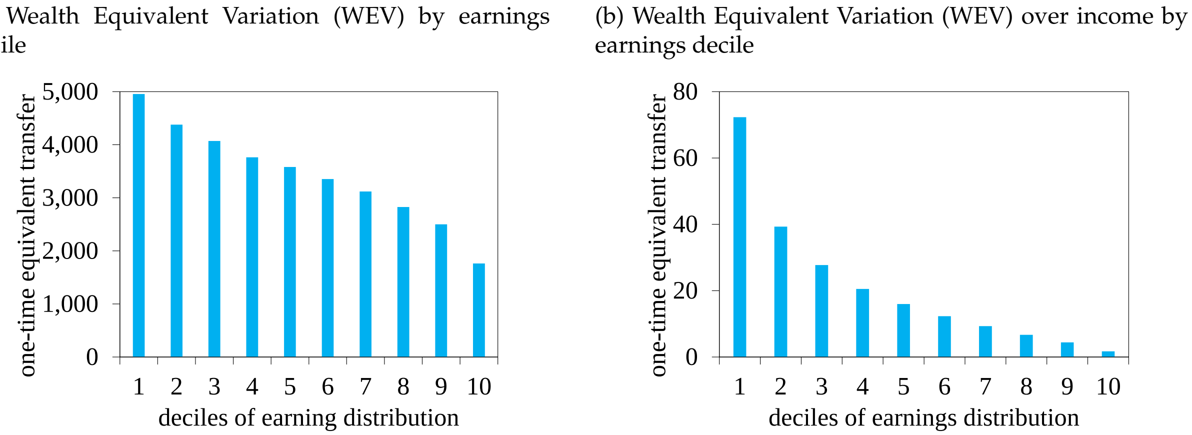
[42] This indeterminacy does not exist in Livshits, MacGee, and Tertilt (2007, 2010) and Chatterjee, Corbae, Nakajima, and Ríos-Rull (2007) because in their models, a credit card contract is not a credit line with both a limit and interest rate. Instead, the contract is a bond price schedule that maps quantities borrowed into interest rates.

Figure 12: Welfare gains by earnings decile along transition path from monopolistic single lender to a perfectly competitive single lender.


(a) Wealth Equivalent Variation (WEV) by earnings decile

(b) Wealth Equivalent Variation (WEV) over income by earnings decile

Notes: *Welfare gains from the transition are measured using wealth equivalent variation in Panel (a). Panel (b) takes the ratio of the wealth equivalent variation to earnings in each decile.*

When we compare collusive-Cournot oligopoly with competitive pricing, we find that the gains from perfect competition are 40% larger (6.86/4.77) than collusive-Cournot; equivalently, collusive-Cournot oligopoly generates 70% of the gains from competitive pricing. Hence, the transition to collusive-Cournot oligopoly with twenty lenders generates a large fraction of competitive pricing welfare gains. This is because the credit limits in both collusive-Cournot oligopoly with twenty lenders and competitive pricing are roughly the same. Hence, increased lender entry and the expansion in credit limits are important to account for the welfare gains from competitive reforms in the credit card industry.[43] Further, the main difference between collusive-Cournot oligopoly with twenty lenders and competitive pricing is that competitive pricing leads to significantly lower spreads. This also shows that of the aggregate welfare gains from competitive pricing, roughly 70% is explained by higher limits (4.77/6.86) and 30% is explained by lower spreads.

Alternatives for competitive benchmark. In Online Appendix F, we consider two alternatives to our competitive benchmark. First, we consider the competitive benchmark analogous to Athreya (2002) in which limits are held fixed exogenously (at the monopoly level in our case); and then we solve for the zero-profit interest rate. We find that this generates gains that are in fact smaller than the gains from collusive-Cournot with twenty lenders. This is because this form of competition abstracts from competition on limits. This further illustrates the importance of credit lines for our welfare gains. Second, we consider the limit as $N \to \infty$ (although computationally we are limited to N=50) in the collusive-Cournot case. Even with a large N, collusion on rates implies positive profits, introducing a persistent wedge between rates faced in any limiting case of collusive-Cournot and the various definitions of per-

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[43] In Online Appendix D, we analyze a transition from monopoly to collusive-Cournot duopoly to show that the drastic increase in the number of lenders is important to generate the large increase in limits and large welfare gains.

fect competition considered in this text and existing literature.

7 Robustness

In this section, we discuss two robustness exercises. We consider (1) fixed costs of lender entry, and (2) alternate redistributions of lender profits to households.

First, we assess the role of lender entry costs for our welfare analysis. We use our simulated lender profits and our aggregate wealth equivalent variation to provide bounds on what private parties and/or society would be willing to pay for a new entrant. Our first exercise recomputes household welfare if there is a fixed lender cost equal to the net present value of lender profits that must be paid up front. The net present value of profits is the maximum amount a lender would be willing to pay to enter the market. The initial fixed cost is subtracted from total profits in the period of the transition. We know that there was lender entry in the 1970s, and so the fixed cost must be weakly lower than the discounted stream of profits.[44]

Table 14 reports our results for collusive-Cournot with twenty lenders. We measure welfare among the cohort that is alive at the date of the transition. If we assume that the entry cost of the new lender is equal to the discounted flow profits of the lender (row (2) in Table 14), then the aggregate wealth equivalent variation as a percentage of income falls from 4.77 to 4.64. Given that there was profitable lender entry in the 1970s, we view an entry cost equal to the net present value of lender profits as an upper bound, and thus our reported welfare gains in Table 14 can be viewed as lower bounds.

Table 14: Welfare along transition path under alternative assumption for lender fixed costs and profit distribution

Welfare gains of alive at t=1: Monopoly to...	collusive-Cournot (N=20) (unit = % of initial income)
(1) Benchmark, WEV	4.77
(2) Fixed cost equal to NPV lender profits, WEV	4.64
(3) Profits distributed uniformly, WEV	4.10
(4) Profits not distributed, WEV	4.82

Notes: *(1) "Benchmark, WEV" taken from Table 13, expresses aggregate WEV of the cohort alive at the time of the transition over income in the initial equilibrium. (2) "Fixed cost equal to NPV lender profits, WEV" assumes new lenders initially make a loss equal to the NPV of future profits and the loss is equally distributed among households. (3) "Profits distributed uniformly, WEV" computes aggregate WEV assuming that lender profits are uniformly distributed to all households. (4) "Profits not distributed, WEV" computes aggregate WEV assuming that lender profits are not distributed to households.*

Our second robustness check is to consider alternative distributions of lender profits. Rows (3) and (4) of Table 14 report welfare when profits are distributed uniformly across all households and when profits are not distributed to any of the households, respectively. Welfare gains are slightly lower in the economy where profits are distributed uniformly to all households because lower income households disproportionately suffer from lost lender profits. Individuals alive at the date of the transition

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[44] Online Appendix H presents the modifications made to the baseline model for these robustness exercises.

from monopoly to collusive-Cournot oligopoly would require a transfer worth 4.10% of initial income compared with 4.77% in the benchmark reform. Analogously, Welfare gains are slightly higher in the economy where profits are not distributed. This is because households no longer face welfare losses resulting from lower profits in a competitive reform.

8 Conclusion

During the 1960s, 1970s, and 1980s, the U.S. credit card industry engaged in various forms of non-competitive behavior. The industry repeatedly faced – and repeatedly lost – lawsuits brought by the Justice Department, Federal Trade Commission, and private parties. We provide additional suggestive evidence of non-competitive behavior by developing an empirical method to measure pass-through in the presence of interest rate caps. Our method relies on pass-through rates from large, unexpected rate cuts to the lowest offered interest rate. We show that the lowest offered rate on all other forms of consumer credit (subject to the same rate caps and regulations as credit cards) move in lockstep with both expected and unexpected movements in interest rates. Credit cards are uniquely unresponsive, yielding precisely zero pass-through from unexpected rate cuts to the lowest offered interest rate, which is anomalous when viewed through the lens of standard competitive frameworks. To speak to these new facts and study the consequences of the competitive reforms brought on by landmark antitrust cases, we relax the assumption of atomistic zero-profit lenders in workhorse consumer credit models. We propose a new model that incorporates oligopoly in the consumer credit market.

Motivated by historic narrative and novel empirics, we use our estimated model to measure the gains from greater competition in the 1970s and 1980s. We conduct two experiments. In our first experiment, based on our synthesis of various narratives, court cases, and data on lender concentration and pricing, we model the competitive reforms in the 1970s as a transition from monopoly to a collusive twenty lender oligopoly. We find that this transition yields significant welfare gains, especially among low-income households. In the bottom decile of earnings, welfare gains from greater lender entry are equivalent to a one-time transfer worth $3,600 (in 2016 dollars), or roughly 50% of their annual income. These gains are driven primarily by increased borrowing limits, leading to increased consumption as well as lower consumption volatility along the transition path. Transitioning to an oligopoly is worth three times less to the top decile of earners. We also find that the model's transition path explains a large fraction of the rise in bankruptcies, chargeoffs, and credit to income ratios, while being consistent with observed changes in interest rate dispersion.

In our second experiment, we drop our assumption of collusion and entertain a perfectly competitive market structure. This acts to establish an upper bound on the potential losses from non-competitive pricing in the credit card market. While the overall welfare gains are roughly 40% larger than our first experiment, we find similar distributional consequences. In the bottom decile of earnings, welfare gains from greater lender entry are equivalent to a one-time transfer worth $5,000 (in 2016 dollars), or roughly 70% of their annual earnings. Moreover, spreads fall by 50% and credit to income more than triples.

We contribute a new theory – and quantification of that theory – to the mounting evidence that monopolies inflict great harm on low-income households (see, e.g., Schmitz (2016)). Despite its relatively small ex-ante size in the U.S. economy, we show that the welfare costs of monopoly in the U.S. credit card industry are large and disproportionately borne by low-income households.

While our article tackles several important issues, many questions remain. Does lender market power inhibit innovation and the adoption of new lending technologies? Are non-competitive credit card lenders limiting pass-through of monetary policy to households? We believe that our framework is tractable enough for future researchers to make progress on these questions as well as other important unanswered questions in the consumer credit literature.

9 Data Availability

The data availability statement and replication package are available on Zenodo: `https://dx.doi.org/10.5281/zenodo.11034739`

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Appendix

A Equilibrium definition

Given a risk-free rate r_f, a stationary recursive equilibrium is given by a set of credit lines $S_\theta = \{(r_1(\theta), \bar{l}_1(\theta)), \ldots, (r_N(\theta), \bar{l}_N(\theta))\}$, a stationary distribution over idiosyncratic states $\Omega\,(i, \theta, \eta, \epsilon, a)$, total profits Π, a repayment/default policy function $p(i, \theta, \eta, \epsilon, a)$, a consumption policy function $c(i, \theta, \eta, \epsilon, a)$, a savings/borrowing policy function $a'(i, \theta, \eta, \epsilon, a)$, and a set of credit card firms' best response functions $\{r^k(\theta), \bar{l}^k(\theta)\}_{k=1}^N$ such that

(i) given r_f, S_θ, and Π, the allocations $p(i, \theta, \eta, \epsilon, a)$, $c(i, \theta, \eta, \epsilon, a)$, and $a'(i, \theta, \eta, \epsilon, a)$ solve the consumer's problem in (3), (5), and (6);

(ii) for $k \in \{1, 2, ..., N\}$, $\{r^k(\theta), \bar{l}^k(\theta)\}_{k=1}^N$ maximizes each credit card firm's profits in (9);

(iii) the distribution of consumers $\Omega(i, \theta, \eta, \epsilon, a)$ is consistent with the policy functions $p(i, \theta, \eta, \epsilon, a)$ and $a'(i, \theta, \eta, \epsilon, a)$ and the exogenous process for earnings and re-entry into credit markets.

B Computational Algorithm

- Algorithm for steady state given set of credit lines $S_\theta = \{(\tau_1(\theta), \bar{l}_1(\theta)), \ldots, (\tau_N(\theta), \bar{l}_N(\theta))\}$
    1. Guess total profits $\Pi(S)$
    2. Given set of credit lines and total profits, solve consumer's problem through value function iteration
    3. Given policy functions, simulate economy and solve for terminal stationary distribution of $\Omega(i, \theta, \eta, \epsilon, a; S)$ where $\Omega : \{g, b\} \times \mathbb{R}_+ \times \mathbb{R}_+ \times \mathbb{R}_+ \times \mathbb{R} \to [0, 1]$
    4. Given stationary distribution, update total profits
    5. Repeat 2.-4.until convergence
- Algorithm for transition given set of credit lines from $t = 1, ...T$ where T refers to the period for the terminal steady state.
    1. Solve for initial steady state given set of credit lines in $t = 1$
    2. Solve for terminal steady state given set of credit lines in $t = T$
    3. Guess sequence of aggregate total profits $\Pi(S)$ for transition path
    4. Given set of credit lines and sequence of total profits, solve consumer's problem in each period through backward induction starting from $T - 1$
    5. Given policy functions from previous step and distribution of consumers from initial steady state, simulate economy and solve for new sequence of aggregate profits
    6. Update guess for sequence of total profits

    7. Repeat 3.-6. until convergence

- Solve for monopoly, collusive-Cournot, Stackelberg-Cournot, and perfectly competitive pricing
  - Monopoly:
    1. Define grid on spreads and borrowing limits: $(\tau_1(\theta), \bar{l}_1(\theta)), \ldots, (\tau_N(\theta), \bar{l}_N(\theta)) \in (\mathbb{R}_+, \mathbb{R}_+)^N$
    2. For each point on grid for spreads and borrowing limits, solve for steady state
    3. Pick spreads and borrowing limits that maximize total profits across steady states
  - Collusive-Cournot
    1. Define grid on spreads for each type θ
    2. Given number of lenders N and spread $\tau(\theta)$, solve for best response limit function
       * Define grid on limits for every θ. Let each limit on this grid denote the identical limit of players $\{1, 2, ..., N-1\}$
       * For each spread and grid point on limits, solve for profit maximizing limit of player N given $\tau(\theta)$ and sum of limits of players $\{1, 2, ..., N-1\}$. For this step, the lenders internalize the transition path for each set of credit lines. The initial steady state is the equilibrium outcome from the monopolist problem.
    3. For every spread $\tau(\theta)$, using best response limit function from previous step, use Bisection to solve for the symmetric Nash equilibrium limit (stage 2 outcome). This is the point where the best response function intersects the 45 degree line.
    4. Given stage 2 outcomes, pick the spreads that maximize profits in stage 1 for every θ
  - Stackelberg-Cournot duopoly
    1. Define grid on spreads for both players for each type θ
    2. For every spread of first mover $\tau^1(\theta)$ and spread of second mover $\tau^2(\theta)$, solve for stage 2 best response limit function of both the players
       * Define grid on limits for every θ for first mover
       * For each spread combination and grid point on limits from previous step, solve for profit maximizing limit of the second mover. This gives the best response limit function of the second mover. For this step, both lenders internalize the transition path for each set of credit lines. The initial steady state is the equilibrium outcome from the monopolist problem. The best response limit function for the first player is analogous.
    3. For every spread $\tau^1(\theta)$ and $\tau^2(\theta)$, given best response limit functions from previous step, solve for the Nash equilibrium limit (stage 2 outcome)
    4. Given stage 2 outcomes and $\tau^1(\theta)$, second mover picks the spread that maximizes their net present value of profits in stage 1
    5. First mover picks spread that maximizes their net present value of profits given second mover's spread best response function and Nash equilibrium limits

- Perfectly competitive pricing
  1. Define grid on spreads and borrowing limits: $(\tau_1(\theta), \bar{l}_1(\theta)), \ldots, (\tau_N(\theta), \bar{l}_N(\theta)) \in (\mathbb{R}_+, \mathbb{R}_+)^N$
  2. Solve for spreads and borrowing limits that maximize the welfare of unborn agent (given θ) subject to weakly positive profits

Online appendix: Who Bears the Welfare Costs of Monopoly? The Case of the Credit Card Industry

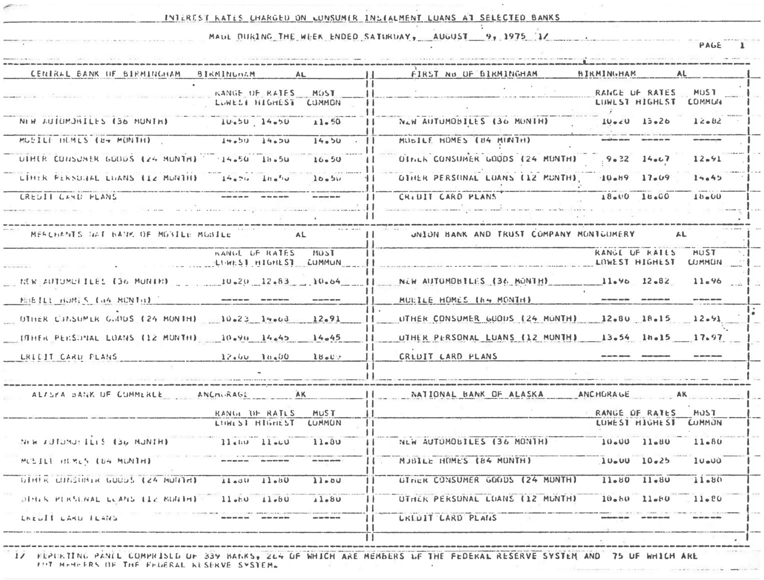
Kyle F. Herkenhoff and Gajendran Raveendranathan

October 4, 2024

A Data

Our regression analysis in Section 2 is based on digitized archives of *Interest Rates Charged on Selected Types of Loans* (Form *FR 2835* and its variants), created and hosted at the Board of Governors. The micro-data is not readily available to the public. Therefore, we provide detailed summary statistics in this appendix. Table 15 describes the main variables in our analysis.[45] Tables 16 and 17 provide information on interest rates and interest rate dispersion from 1975 to 1982. These data can be used to inform theories of credit scoring and rate dispersion in the early years of the credit card industry. The panel is quarterly and unbalanced. The data include roughly 200 banks per year. The data set records the lowest, highest, and most common charged interest rates on each bank's newly issued credit card plans in the week prior to the survey date (see Table 15). A copy of the original survey, for which we thank the Federal Reserve Bank of Minneapolis' librarians, is included in Figure 13. The form clearly details the requirement that only new loans made during the week preceding the survey should be tabulated, a requirement which is still present for consumer installment loans on FR2835 and its associated instructions.[46]

Figure 13: LIRS data description from Board of Governor's data dictionary



INTEREST RATES CHARGED ON CONSUMER INSTALMENT LOANS AT SELECTED BANKS

MADE DURING THE WEEK ENDED SATURDAY, AUGUST 9, 1975 1/

PAGE 1

CENTRAL BANK OF BIRMINGHAM BIRMINGHAM AL

	RANGE OF RATES		MOST
	LOWEST	HIGHEST	COMMON
NEW AUTOMOBILES (36 MONTH)	10.50	14.50	11.50
MOBILE HOMES (84 MONTH)	14.50	14.50	14.50
OTHER CONSUMER GOODS (24 MONTH)	14.50	18.50	16.50
OTHER PERSONAL LOANS (12 MONTH)	14.50	18.50	16.50
CREDIT CARD PLANS	-----	-----	-----

FIRST NB OF BIRMINGHAM BIRMINGHAM AL

	RANGE OF RATES		MOST
	LOWEST	HIGHEST	COMMON
NEW AUTOMOBILES (36 MONTH)	10.20	13.26	12.82
MOBILE HOMES (84 MONTH)	-----	-----	-----
OTHER CONSUMER GOODS (24 MONTH)	9.32	14.67	12.91
OTHER PERSONAL LOANS (12 MONTH)	10.89	17.09	14.45
CREDIT CARD PLANS	18.00	18.00	18.00

MERCHANTS NAT BANK OF MOBILE MOBILE AL

	RANGE OF RATES		MOST
	LOWEST	HIGHEST	COMMON
NEW AUTOMOBILES (36 MONTH)	10.20	12.83	10.64
MOBILE HOMES (84 MONTH)	-----	-----	-----
OTHER CONSUMER GOODS (24 MONTH)	10.23	14.68	12.91
OTHER PERSONAL LOANS (12 MONTH)	10.90	14.45	14.45
CREDIT CARD PLANS	12.60	18.00	18.00

UNION BANK AND TRUST COMPANY MONTGOMERY AL

	RANGE OF RATES		MOST
	LOWEST	HIGHEST	COMMON
NEW AUTOMOBILES (36 MONTH)	11.96	12.82	11.96
MOBILE HOMES (84 MONTH)	-----	-----	-----
OTHER CONSUMER GOODS (24 MONTH)	12.80	18.15	12.91
OTHER PERSONAL LOANS (12 MONTH)	13.54	18.15	17.97
CREDIT CARD PLANS	-----	-----	-----

ALASKA BANK OF COMMERCE ANCHORAGE AK

	RANGE OF RATES		MOST
	LOWEST	HIGHEST	COMMON
NEW AUTOMOBILES (36 MONTH)	11.80	11.80	11.80
MOBILE HOMES (84 MONTH)	-----	-----	-----
OTHER CONSUMER GOODS (24 MONTH)	11.80	11.80	11.80
OTHER PERSONAL LOANS (12 MONTH)	11.80	11.80	11.80
CREDIT CARD PLANS	-----	-----	-----

NATIONAL BANK OF ALASKA ANCHORAGE AK

	RANGE OF RATES		MOST
	LOWEST	HIGHEST	COMMON
NEW AUTOMOBILES (36 MONTH)	10.00	11.80	11.80
MOBILE HOMES (84 MONTH)	10.00	10.25	10.00
OTHER CONSUMER GOODS (24 MONTH)	11.80	11.80	11.80
OTHER PERSONAL LOANS (12 MONTH)	10.80	11.80	11.80
CREDIT CARD PLANS	-----	-----	-----

1/ REPORTING PANEL COMPRISED OF 339 BANKS, 264 OF WHICH ARE MEMBERS OF THE FEDERAL RESERVE SYSTEM AND 75 OF WHICH ARE NOT MEMBERS OF THE FEDERAL RESERVE SYSTEM.

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[45] This is provided by the Board of Governor's Micro Data Reference Manual `https://www.federalreserve.gov/apps/mdrm/`

[46] `https://www.federalreserve.gov/apps/reportingforms/Report/Index/FR_2835`

Table 15: LIRS Variable Descriptions

Variable	Start date	End date	Description	Confidential?	Reporting Form
LIRS7812	2/12/1972	11/6/1982	LOWEST INTEREST RATE CHARGED FOR CREDIT CARD PLANS	No	FR 2835
LIRS7813	2/12/1972	11/6/1982	HIGHEST INTEREST RATE CHARGED FOR CREDIT CARD PLANS	No	FR 2835
LIRS7814	2/12/1983	8/6/1994	MOST COMMON INTEREST RATE CHARGED FOR CREDIT CARD PLANS	No	FR 2835

Table 16: Summary Statistics LIRS, 1975 to 1978

Variable	p25	p50	p75	Mean	Standard Deviation	Min	Max	Observations	Banks
1975									
Lowest Interest Rate Charged	12	16.5	18	15.25173	3.058655	6	18	330	217
Highest Interest Rate Charged	18	18	18	17.25482	1.862724	10	24	330	217
Most Common Interest Rate Charged	18	18	18	17.173	1.947327	10	24	330	217
Highest Minus Lowest Rate Charged	0	0	3	2.003091	2.896519	0	12	330	217
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.036364	0.187478	0	1	330	217
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.018182	0.133811	0	1	330	217
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.021212	0.14431	0	1	330	217
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.624242	0.485053	0	1	330	217
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	0.5	1	0.5	0.500759	0	1	330	217
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.048485	0.215115	0	1	330	217
1976									
Lowest Interest Rate Charged	12	16.48	18	15.29687	3.006702	6	18	584	176
Highest Interest Rate Charged	18	18	18	17.1907	1.797162	10	24	584	176
Most Common Interest Rate Charged	18	18	18	17.09481	1.893592	10	24	584	176
Highest Minus Lowest Rate Charged	0	0	3	1.893836	2.809243	0	12	584	176
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.054795	0.227774	0	1	584	176
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.017123	0.129842	0	1	584	176
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.023973	0.153095	0	1	584	176
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.638699	0.480789	0	1	584	176
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	0	1	0.498288	0.500426	0	1	584	176
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.059932	0.237563	0	1	584	176
1977									
Lowest Interest Rate Charged	12	15	18	15.16965	3.043804	6	18	601	169
Highest Interest Rate Charged	18	18	18	17.03484	1.960559	10	18	601	169
Most Common Interest Rate Charged	18	18	18	16.96058	2.031148	9	18	601	169
Highest Minus Lowest Rate Charged	0	0	3	1.865191	2.746045	0	12	601	169
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.071547	0.257952	0	1	601	169
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.021631	0.145595	0	1	601	169
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.036606	0.187948	0	1	601	169
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.63228	0.482586	0	1	601	169
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	0	1	0.477537	0.499911	0	1	601	169
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.049917	0.217954	0	1	601	169
1978									
Lowest Interest Rate Charged	12	18	18	15.28005	3.105733	6	18	637	177
Highest Interest Rate Charged	18	18	18	17.14498	1.876022	10	18	637	177
Most Common Interest Rate Charged	18	18	18	17.04292	1.954877	10	18	637	177
Highest Minus Lowest Rate Charged	0	0	3	1.864929	2.82426	0	12	637	177
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.073783	0.261623	0	1	637	177
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.017268	0.130372	0	1	637	177
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.032967	0.178691	0	1	637	177
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.643642	0.479299	0	1	637	177
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	1	1	0.514914	0.50017	0	1	637	177
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.036107	0.186702	0	1	637	177

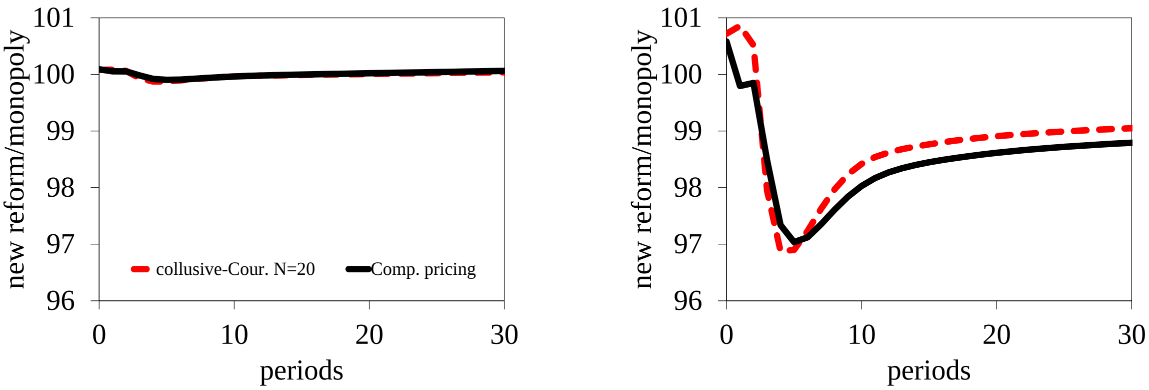
Table 17: Summary Statistics LIRS, 1979 to 1982

Variable	p25	p50	p75	Mean	Standard Deviation	Min	Max	Observations	Banks
1979									
Lowest Interest Rate Charged	12	18	18	15.6337	2.949441	8	18	644	181
Highest Interest Rate Charged	18	18	18	17.27981	1.74522	10	18	644	181
Most Common Interest Rate Charged	18	18	18	17.12764	1.867032	10	18	644	181
Highest Minus Lowest Rate Charged	0	0	3	1.646118	2.633292	0	10	644	181
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.069876	0.255136	0	1	644	181
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.017081	0.129673	0	1	644	181
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.026398	0.160439	0	1	644	181
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.680124	0.466791	0	1	644	181
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	1	1	0.569876	0.495478	0	1	644	181
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.029503	0.169343	0	1	644	181
1980									
Lowest Interest Rate Charged	12	18	18	15.99783	2.838035	8	22	636	182
Highest Interest Rate Charged	18	18	18	17.53349	1.709019	11	24	636	182
Most Common Interest Rate Charged	18	18	18	17.36969	1.825551	11	24	636	182
Highest Minus Lowest Rate Charged	0	0	3	1.53566	2.664269	0	13	636	182
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.121069	0.326464	0	1	636	182
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.051887	0.221973	0	1	636	182
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.073899	0.261813	0	1	636	182
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.709119	0.454526	0	1	636	182
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	1	1	0.578616	0.494169	0	1	636	182
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.050314	0.218765	0	1	636	182
1981									
Lowest Interest Rate Charged	15	18	18	16.62226	2.601491	10	22	614	170
Highest Interest Rate Charged	18	18	18	17.94324	1.593033	12	30	614	170
Most Common Interest Rate Charged	18	18	18	17.76094	1.553755	12	24	614	170
Highest Minus Lowest Rate Charged	0	0	1.84	1.320977	2.483644	0	12	614	170
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.112378	0.316088	0	1	614	170
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.07329	0.260824	0	1	614	170
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.076547	0.266088	0	1	614	170
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.734528	0.441944	0	1	614	170
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	1	1	0.600977	0.490097	0	1	614	170
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.04886	0.215751	0	1	614	170
1982									
Lowest Interest Rate Charged	18	18	18	17.3569	2.598594	10	25.92	583	159
Highest Interest Rate Charged	18	18	19.5	18.61828	1.691271	10.5	25.92	583	159
Most Common Interest Rate Charged	18	18	19	18.5076	1.67938	10.5	25.92	583	159
Highest Minus Lowest Rate Charged	0	0	1.8	1.261389	2.498304	0	12	583	159
Quarterly Probability That Lowest Charged Rate Changes	0	0	0	0.149228	0.356619	0	1	583	159
Quarterly Probability That Highest Charged Rate Changes	0	0	0	0.128645	0.335094	0	1	583	159
Quarterly Probability That Most Common Charged Rate Changes	0	0	0	0.125214	0.331246	0	1	583	159
Fraction of Banks Reported No Difference Between Highest and Lowest Charged Rate	0	1	1	0.737564	0.440336	0	1	583	159
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 18%	0	1	1	0.538593	0.498936	0	1	583	159
Fraction of Banks Reporting Highest and Lowest Charged Rate Equal to 15%	0	0	0	0.010292	0.101011	0	1	583	159

B High-earner consumption variance

Figure 14 plots average consumption and the variance of consumption for collusive-Cournot (N=20) in the main text.

Figure 14: Average consumption and variance of consumption profiles of a high-earning consumer (collusive-Cournot (N=20))


(a) Average Consumption

(b) Variance of Consumption

Notes: *Panels (a) through (b) are derived from simulating agents in the top-decile of earnings at date $t = 1$ on the transition path to (1) collusive-Cournot (N=20) and (2) single-lender competitive pricing. Panel (a) plots the average consumption path along the transition path expressed as a ratio to average consumption if the agent remained in a world with a single-lender monopoly. Panel (b) plots the variance of consumption along the transition path expressed as a ratio to the variance of consumption if the agent remains in a world with a single-lender monopoly.*

C Additional pass-through rates

Table 18 repeats the exercise of comparing model vs. data pass-through rates based on the Romer and Romer shocks. This parallels Table 10 in the main text. Table 19 provides the pass-through rate from changes in the federal funds rate to the lowest offered rate for 24mo consumer loans.

Table 18: Pass-through rates, Romer and Romer

Panel I: Model	
Pure monopoly pass-through rate to r_t^{low} :	0.0041
Competitive benchmark pass-through rate to r_t^{low} :	0.1405
Competitive rate-only pass-through rate to r_t^{low} :	0.0661

Panel II: Pass-through from Romer and Romer to credit cards					
Panel A, Table 4 Column No.	(1)	(2)	(3)	(4)	(5)
RR_t pass-through rate to r_t^{low}	0.00394	0.000650	-0.0486***	-0.101**	-0.0973**
Upper bound of 95% Confidence interval	0.0511	0.0436	-0.0222	-0.0286	-0.00707
Lower bound of 95% Confidence interval	-0.0432	-0.0423	-0.075	-0.173	-0.188
Pure monopoly within 95% CI?	Y	Y	N	N	N
Competitive benchmark within 95% CI?	N	N	N	N	N
Competitive rate-only within 95% CI?	N	N	N	N	N

Panel III: Pass-through from Romer and Romer to consumer loans					
Panel B, Table 4 Column No.	(1)	(2)	(3)	(4)	(5)
RR_t pass-through rate to $r_t^{low,cons}$	0.459***	0.457***	0.286***	0.296***	0.308***
Upper bound of 95% Confidence interval	0.631	0.627	0.338	0.344	0.349
Lower bound of 95% Confidence interval	0.288	0.287	0.234	0.248	0.266
Pure monopoly within 95% CI?	N	N	N	N	N
Competitive benchmark within 95% CI?	N	N	N	N	N
Competitive rate-only within 95% CI?	N	N	N	N	N

Table 19: Pass-through from federal funds rate to consumer loans (24mo)

	(1)	(2)	(3)	(4)	(5)
	Dependent variable is $\Delta r_{it}^{low,cons} = r_{it+1}^{low,cons} - r_{it}^{low,cons}$				
$FF_t - FF_{t-1}$	0.212*** (0.0543)	0.211*** (0.0546)	0.193** (0.0865)	0.203* (0.104)	0.253** (0.116)
Sample	Full	Full	$RR_t < 0$	$RR_t < 0$ & $r_{it-1}^{low,cons}$ <18%	$RR_t < 0$ & $r_{it-1}^{low,cons}$ <15%
Lender Fixed Effect	N	Y	Y	Y	Y
Observations	3,782	3,776	2,632	2,233	1,903
R-squared	0.049	0.065	0.06	0.069	0.09
UB 95pct CI	0.319	0.318	0.363	0.407	0.481
LB 95pct CI	0.106	0.104	0.0239	-0.00089	0.0247

D Monopoly to collusive-Cournot duopoly

In Section 6.2, we found that collusive-Cournot oligopoly with 20 lenders generates 70 percent of the gains from that of competitive pricing due to a significant expansion in credit limits. In this section, we analyze a reform from monopoly to Collusive-Cournot duopoly. This exercise illustrates that the significant increase in the number of lenders is important to generate the large increase in credit limits and the large welfare gains.

Column (2) of Table 20 reports the spreads and limits for both consumer types and various credit related statistics. When the number of lenders increases from one to two, we observe an increase in limits of almost 30% for both types. Recall that in the reform from monopoly to collusive-Cournot oligopoly, the increase was roughly 90% for both types.

When we compare the welfare implications of the two collusive-Cournot reforms with competitive pricing (Table 21), we find that collusive-Cournot duopoly generates 22% of total gains from competitive pricing (aggregate WEV as a percentage of income equals 1.48 for collusive-Cournot duopoly and 6.86 for competitive pricing).

Table 20: Comparison of initial ($t = 0$) to terminal steady state ($t = \infty$).

Summary Statistics	**(1)** Monopoly $t = 0$	**(2)** collusive-Cournot (N=2) $t = \infty$	**(3)** collusive-Cournot (N=20) $t = \infty$	**(4)** Stackelberg-Cournot (N=2) $t = \infty$	**(5)** Competitive Pricing $t = \infty$	**(6)** Competitive Rate-only $t = \infty$	**(7)** collusive-Cournot (N=50) $t = \infty$
High-type							
Line 1: Borrowing limit to initial income pc	20.29	26.16	38.16	4.93	37.52	20.29	39.43
Line 1: Spread	2.79	2.68	2.55	0.64	1.35	0.10	2.29
Line 2: Borrowing limit to initial income pc	_	_	_	16.87	_	_	_
Line 2: Spread	_	_	_	2.96	_	_	_
Low-type							
Line 1: Borrowing limit to initial income pc	10.91	14.38	21.13	4.87	21.41	10.91	21.92
Line 1: Spread	3.31	3.06	2.81	0.91	1.58	0.07	2.16
Line 2: Borrowing limit to initial income pc	_	_	_	8.28	_	_	_
Line 2: Spread	_	_	_	3.48	_	_	_
Aggregate							
Credit to income	*1.01*	1.41	2.31	1.33	3.31	1.96	2.71
Share revolving	12.69	13.93	15.83	15.17	19.55	19.13	17.26
Bankruptcy rate	*0.06*	0.10	0.18	0.07	0.15	0.01	0.18
Charge-off rate	0.96	1.46	2.35	0.92	1.37	0.10	2.09
Credit to income: bankrupts	1.50	1.76	2.19	1.62	2.29	1.69	2.28
Excess spread: actual - zero-profit	2.07	1.37	0.24	1.06	0.06**	-0.01**	0.06
Interest rate dispersion (CV)	0.06	0.05	0.03	0.38	0.04	0.01	0.02

Notes: *This table reports credit-related summary statistics for the initial monopoly steady state at $t = 0$ (Column (1)) and the steady-states at the end of the transition path after each competitive reform. Column (2) is a collusive-Cournot duopoly, in which lenders collude in the first stage on interest rates and then compete on limits in the second stage. Column (3) is a collusive-Cournot oligopoly with twenty lenders. Column (4) is a Stackelberg-Cournot duopoly, where lenders Stackelberg compete on interest rates in the first stage and Cournot compete on limits in the second stage. Column (5) is our benchmark competitive pricing. We define the competitive pricing equilibrium to be the limit and interest that maximize welfare of an unborn agent (given their permanent earning ability), subject to weakly positive profits. Column (6) is a form of perfect competition considered in Athreya (2002), where the limit is exogenous (in our case, the one from the monopoly case), and the interest rate is such that the lender makes zero-profits (given permanent earnings ability). Column (7) is collusive-Cournot with fifty lenders. ** excess spreads are measured in the $t = \infty$ terminal steady state, and thus deviate from zero. Along the entire transition path, excess spreads are zero in both columns (5) and (6).*

Table 21: Welfare gains from monopoly to different forms of competition

Welfare gains: Monopoly to...	**(2)** collusive-Cournot (N=2)	**(3)** collusive-Cournot (N=20)	**(4)** Stackelberg-Cournot (N=2)	**(5)** Competitive Pricing	**(6)** Competitive Rate-only	**(7)** collusive-Cournot (N=50)
CEV unborn at $t = 1$ (% of lifetime consumption)	0.23	0.73	0.24	1.02	0.50	0.88
WEV unborn at $t = 1$ (% of initial income pc)	1.98	6.38	2.04	9.12	4.33	7.82
WEV low-unborn at $t = 1$ (% of initial income pc)	1.61	5.13	2.15	7.32	3.42	6.54
WEV high-unborn at $t = 1$ (% of initial income pc)	2.61	8.54	1.85	12.08	5.84	9.95
WEV alive at $t = 1$ (% of initial income)	1.48	4.77	1.37	6.86	3.22	5.79
Population better off (% of population)	99.94	99.66	99.49	99.88	99.60	99.66
High-type WEV alive at $t = 1$ (% of initial income | group)						
AR(1) earnings tercile 1	4.12	13.41	2.88	19.23	9.33	15.66
AR(1) earnings tercile 2	1.34	4.41	0.98	6.41	3.19	5.16
AR(1) earnings tercile 3	0.36	1.15	0.20	1.62	0.66	1.34
Low-type WEV alive at $t = 1$ (% of initial income | group)						
AR(1) earnings tercile 1	3.19	10.16	4.28	14.69	6.90	13.09
AR(1) earnings tercile 2	1.05	3.38	1.45	4.93	2.36	4.37
AR(1) earnings tercile 3	0.29	0.92	0.36	1.29	0.56	1.17

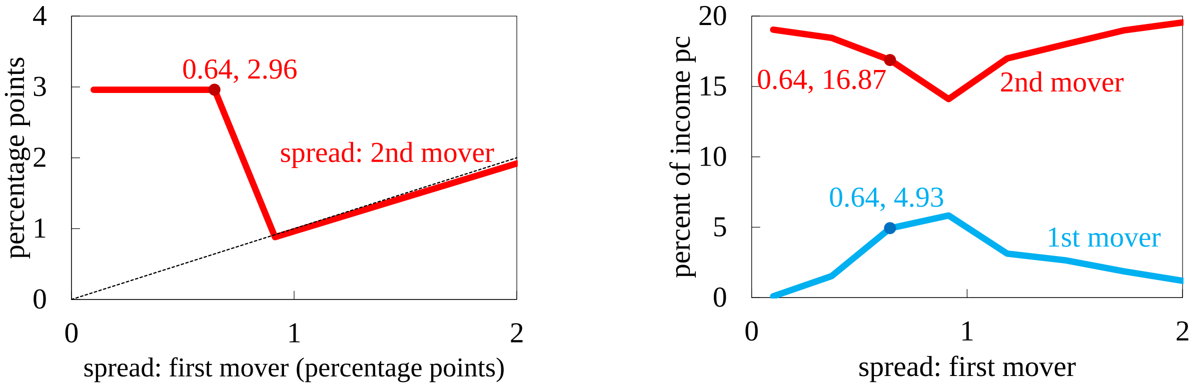
Notes: *This table reports welfare gains along the transition path relative to monopoly steady state. When measuring wealth or consumption equivalent variation for unborn agents, we assume agents enter in good standing with zero assets and they draw their earnings states from the ergodic earnings distribution. When aggregating wealth equivalent variation over living cohorts, we use the initial steady state distribution of agents. Welfare is measured as either (a) consumption equivalent variation (CEV) for an unborn agent at the date of the transition $t = 1$, (b) the wealth equivalent variation (WEV) using equation (10) for unborn agents and unborn agents given their low- or high-earnings-type, (c) WEV for the cohort that is alive at the date of the transition $t = 1$, (d) Share of population that is better off with the transition, and (e) WEV for the cohort that is alive at the date of the transition $t = 1$ given their low- or high-earnings type and AR(1) earnings tercile.*

E Monopoly to Stackelberg-Cournot

In this section, we study a limited form of price competition by analyzing a transition from monopoly to *Stackelberg-Cournot* competition. The lenders Stackelberg compete on interest rates in the first stage and Nash compete on limits in the second stage. We assume Stackelberg competition on interest rates because a pure strategy Nash equilibrium does not exist, and solving for a mixed strategy Nash equilibrium is not tractable. In contrast to collusive-Cournot, there is now price competition in the first stage. In stage 1, the second mover chooses a profit maximizing interest rate given the first mover's interest rate. The first mover chooses a profit maximizing interest rate internalizing the second mover's best response. The stage 2 competition on limits is the same as collusive-Cournot, except the Nash equilibrium for limits may no longer be symmetric because the lenders can choose different spreads. The main takeaway from this analysis is that Stackelberg-Cournot duopoly generates inconsistent time trends for both charge-offs and interest rate dispersion compared to the data making collusive-Cournot our preferred competitive reform. Nevertheless, the gains from Stackelberg-Cournot duopoly is comparable to that from a collusive-Cournot duopoly.

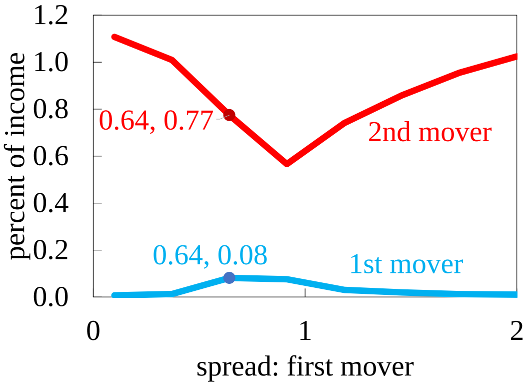
To maintain tractability, we assume there are two lenders. We assume the incumbent lender (the monopolist) is the first mover and the new entrant is the second mover. In the period of the transition, the profits or losses on the existing credit line are borne by the monopolist. In principle, the new interest rate and new limit chosen by the monopolist as a first mover or second mover could affect profits on their existing credit line in the period of the transition. However, numerically, the assumption that the monopolist moves first has no significant impact on the equilibrium interest rates and limits. To understand the transition path from monopoly to Stackelberg-Cournot duopoly, we first characterize each Stackelberg-Cournot duopolist's policy functions.

Figure 15: Stackelberg policy functions given 1st mover spread ($\theta = \theta_H$)


(a) 2nd mover spread in stage 1

(b) Nash borrowing limits in stage 2

(c) Net present value of profits



Notes: *Panel (a) plots the second mover's best response in spreads in stage 1 as a function of the first mover's spread. Panel (b) plots the stage 2 Nash borrowing limits for both lenders given the first mover's spread and the second mover's best response in spreads. Panel (c) plots the net present value of profits for both lenders given the first mover's spread, the second mover's best response in spreads, and Nash borrowing limits for both lenders given their respective spreads. Spreads are expressed as percentage point deviations over the risk-free rate. Borrowing limits are expressed as a percentage of income per capita. Net present value of profits are expressed as a percentage of income.*

For ease of exposition, we assume Lender 1 is the first mover, and Lender 2 is the second mover. Let τ^1 denote the first mover's spread. In Figure 15, panel (a) plots the second mover's best response in spreads $\tau^2(\tau^1)$ in stage 1. Panel (a) shows that if the first mover commits to a large spread in the first stage ($\tau^1 > 0.64\%$), the second mover will undercut the first mover and set τ^2 just below τ^1; that is, $\tau^2 = \tau^1 - \epsilon$ for arbitrarily small ϵ. In this region ($\tau^1 > 0.64\%$), spreads are strategic complements; that is, $\frac{d\tau^2(\tau^1)}{d\tau^1} \geq 0$. If the first mover increases their spread, the second mover also increases their spread and undercuts the first mover. This is typical in Stackelberg-Bertrand games. However, strategic complementarity of spreads does not hold for all first-mover spreads. There is a threshold at which the second mover's undercutting strategy is no longer profitable relative to the alternate strategy of charging a higher spread and becoming the second-ranked lender. For extremely low spreads, the second mover is made strictly better off by setting a high spread ($\tau^1 \leq 0.64\%$ in panel (a)). The spread at which the second mover abandons their undercutting strategy is the equilibrium interest rate. In equilibrium, the first mover, Lender 1, sets a spread of 0.64%, and the second mover, Lender 2, sets a spread of 2.96%.

Panel (b) of Figure 15 plots the stage 2 Nash borrowing limits for both lenders given the first mover's spread and the second mover's best response in spreads (i.e., $\bar{l}^1(\tau^1, \tau^2(\tau^1))$, and $\bar{l}^2(\tau^1, \tau^2(\tau^1))$, respectively). In equilibrium, the first mover offers a limit equal to 4.93% of income per capita, three times less than the second mover's limit (16.87% of per capita income). The first mover picks a lower limit because, unlike the collusive-Cournot duopoly, with Stackelberg-Cournot competition consumers will first borrow from the first lender. This is because the first mover, Lender 1, offers a lower interest rate. Thus, there is stronger debt dilution for Lender 1. Lender 1 understands that some of its consumers will subsequently borrow from Lender 2, raising default risk on Lender 1's own loans. Ideally, Lender 1 would raise rates to reflect the default risk generated by the presence of Lender 2, but the threat of being undercut constrains Lender 1's ability to charge a higher rate. Thus, lender 1 picks a lower spread and restricts the amount of credit they extend to mitigate default risk.

Lastly, panel (c) of Figure 15 plots the net present value of profits for both lenders given the first mover's spread, the second mover's best response in spreads, and Nash borrowing limits for both lenders given their respective spreads $(\tau^1, \tau^2(\tau^1), \bar{l}^1(\tau^1, \tau^2(\tau^1)), \bar{l}^2(\tau^1, \tau^2(\tau^1)))$. The figure clearly illustrates Lender 2 has higher profits, reflecting the second mover advantage inherent in price competition. The equilibrium is determined by the spread at which the first mover maximizes profits ($\tau^1 = 0.64\%$), which is also the spread that induces the second mover to abandon undercutting and set their spread to 2.96%.[47]

Model versus data time trends. We assess the plausibility of the Stackelberg-Cournot market structure based on internal evidence. In the main text, Table 12 documents six key trends in aggregate credit data from the early 1970s to the mid-late 1980s: (a) credit to income increased, (b) the share of population that is revolving a positive credit balance increased, (c) bankruptcies increased, (d) charge-offs increased, (e) credit to income among bankrupts increased, and (f) interest rate dispersion measured by the coefficient of variation was low initially and decreased slightly. Table 22 compares the ability of Stackelberg-Cournot to simultaneously generate these facts. The table also presents results from collusive-Cournot with twenty lenders for comparison.

Notably, Stackelberg-Cournot competition implies the opposite time trend for chargeoffs, a feature of the data originally documented in Livshits et al. (2010). Chargeoffs fall as the economy transitions from Monopoly to Stackelberg-Cournot. What generates this fall in chargeoff rates is that consumers

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[47] This logic is also why a pure strategy Nash equilibrium does not exist. For low spreads, a profitable deviation is to set a high spread. However, if the competitor sets a high spread then a profitable deviation is to undercut, etc.

face much lower interest rates on the first line of credit, which also has a tighter limit. As a result, the amount borrowed on the cheaper line of credit is smaller as well as the interest rate is lower, so that the consumer's incentive to repay on the first line is higher. Further, the model significantly understates the rise in bankruptcies and the rise in credit to income among bankrupts.

Moreover, the Stackelberg-Cournot model produces a counterfactual level and increase in interest rate dispersion measured by the coefficient of variation. The interest rate dispersion in the data is 0.09, whereas it is 0.32 for collusive-Cournot. In fact, this level of dispersion is as high as the coefficient of variation for interest rates in 1998 in the SCF (documented in Livshits et al. (2016)), which is the period after the development of credit scoring and increased price discrimination. Further, Stackelberg-Cournot predicts a substantial increase in dispersion from monopoly, which is the opposite of what we see in the data from the 1970s to early 1980s.

Table 22: Credit-related statistics: model vs data

Summary Statistics	**Data**		**Model**		**Change**	
	1971-75	1986-1990	Monopoly	Oligopoly	Data	Model
Panel A: monopoly to Stackelberg-Cournot						
Credit to income	*1.02*	4.64	*1.01*	1.33	3.62	0.32
Share revolving	11.71	25.79	12.69	15.17	14.08	2.48
Bankruptcy rate	*0.06*	0.16	*0.06*	0.07	0.10	0.01
Charge-off rate	2.57	3.84	0.96	0.92	1.27	-0.04
Credit to income: bankrupts	1.71	2.72	1.50	1.62	1.01	0.12
Interest rate dispersion (CV)	0.11**	0.09**	0.06	0.38	-0.02	0.32
Panel B: monopoly to collusive-Cournot N=20						
Credit to income	*1.02*	4.64	*1.01*	2.31	3.62	1.30
Share revolving	11.71	25.79	12.69	15.83	14.08	3.14
Bankruptcy rate	*0.06*	0.16	*0.06*	0.18	0.10	0.12
Charge-off rate	2.57	3.84	0.96	2.35	1.27	1.39
Credit to income: bankrupts	1.71	2.72	1.50	2.19	1.01	0.69
Interest rate dispersion (CV)	0.11**	0.09**	0.06	0.03	-0.02	-0.03

Notes: Aggregate credit data are from the Federal Reserve Board G.19 series. Share revolving data are from the Survey of Consumer Finances (average of 1970 and 1977 and average of 1983 and 1989). The bankruptcy rate is Chapter 7 filings per capita computed using data from the Historical Statistics of the U.S. Millennial Edition. Charge-off data are from Ausubel (1991). Credit to income of bankrupts data are from Livshits et al. (2010), who collected data from various sources including Domowitz and Eovaldi (1993) and Sullivan et al. (2000) (averages from 1978/79-80 and 1991). ** *notes that interest rate dispersion data are from LIRS FR2835 in 1975 and 1982, respectively. We used averages from 1971-75 and 1986-90 unless specified otherwise. Monopoly is* $N = 1$*, Oligopoly is Stackelberg-Cournot duopoly in Panel A and collusive-Cournot with* $N = 20$ *in Panel B.*

Welfare. In Table 21, when we compare welfare outcomes from monopoly to collusive-Cournot duopoly vs. monopoly to Stackelberg-Cournot duopoly, we see that the low-type benefits more from price competition in Stackelberg-Cournot duopoly (a one-time transfer worth 2.15% of income in Stackelberg-Cournot and 1.61% of income in collusive-Cournot). The high-type does not benefit as much because of the lower total borrowing limit (a one-time transfer worth 1.85% of income in Stackelberg-Cournot and 2.61% of income in collusive-Cournot). In terms of aggregate welfare, Stackelberg-Cournot generates 20 percent of the gains from competitive pricing (1.37/6.86).

F Alternatives to competitive benchmarks

In this section, we consider two alternatives to our competitive benchmark. First, we consider the competitive benchmark analogous to Athreya (2002) in which limits are held fixed exogenously (at the monopoly level in our case); and then solve for the zero-profit interest rate. We refer to this case as competitive rate-only. Second, we consider the limit as $N \to \infty$ (although computationally we are limited to N=50) in the collusive-Cournot case. Columns (6) and (7) of Table 20 report credit-related statistics. With competition only on rates, the spread over the risk-free rate decreases significantly. Credit to income increases to 1.96%, but it does not increase as much as in the case of our benchmark competitive pricing (3.31%) or even collusive-Cournot with twenty lenders (2.31%). In the case of collusive-Cournot with fifty lenders, the limits increase slightly from the case of collusive-Cournot with twenty lenders while the spreads fall slightly.

In terms of welfare, competition only on rates leads to gains equivalent to a one-time transfer worth 3.22% of income compared to 6.86% in our benchmark competitive pricing case. The gains from collusive-Cournot with fifty lenders is 5.79% of income, which is substantially higher than the case with competition only on rates. This illustrates that competition on credit limits is an important source of welfare gains in our framework, which further substantiates the importance of modeling credit lines.

G Lender policy functions for the low type

This section presents lender policy functions for the low-type that are analogous to those presented in Figures 7 and 15, which were for the high-type. Figure 16 presents the policy functions in the case of collusive-Cournot oligopoly (N=20). Figure 17 presents the policy functions in the case of a Stackelberg-Cournot duopoly. In both cases, the policy functions are qualitatively similar to those of the high-type.

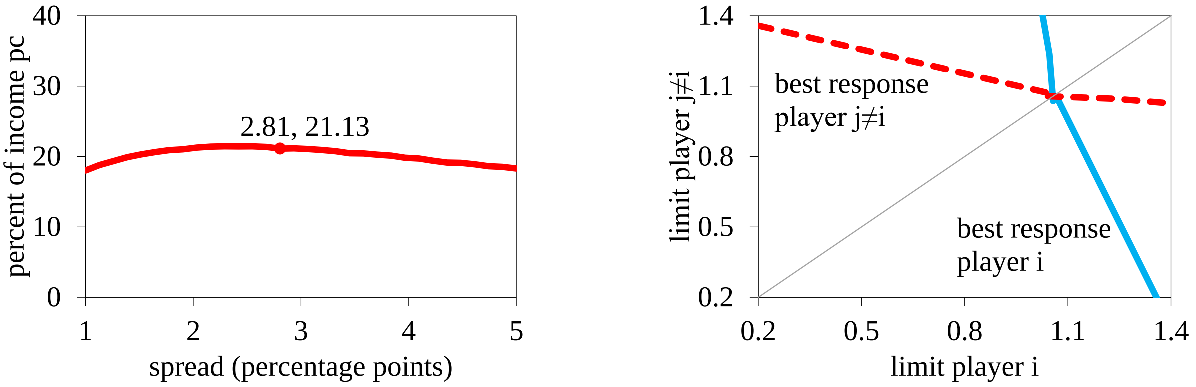
H Model economies for robustness exercises

This section presents the modifications made to the baseline model for the robustness exercises (Section 7). The first robustness exercise allows for fixed costs of lender entry. We compute the fixed cost as equal to the net present value of profits for lenders $k \in \{2, ..., N\}$, which serves as an upper bound. The total fixed cost is computed as follows:

$$F = \sum_{\theta \in \Theta} \sum_{k=2}^{N} \sum_{t=1}^{\infty} \left(\frac{1}{1+r_f} \right)^t \pi_t^k(\theta), \tag{11}$$

where F denotes the total fixed cost. F is subtracted from total profits in the first period of the transition. This leads to a change in the budget constraint of the household in the first period of the transition. For example, the budget constraint of the consumer in good standing who chooses to repay is given by the

Figure 16: collusive-Cournot policy functions ($\theta = \theta_L$)



(a) Nash borrowing limit in stage 2

(b) Borrowing limit best response in stage 2

(c)

Notes: *Panel (a) plots the stage 2 Nash equilibrium limit as a function of the spread in the first stage. Lenders collude in the first stage to set the spread that maximizes profits. Panel (b) plots the lenders' best response functions in the second stage for the spread that maximizes profits in the first stage. The symmetric Nash equilibrium is the point where the limits cross the 45 degree line.*

following equation:

$$c + a' = \theta\eta\epsilon + (1 + r_f)a + \sum_{j=1}^{N}(r_j(\theta) - r_f)a_j(a, \theta) + \Pi(\theta\eta\epsilon) - F(\theta\eta\epsilon). \tag{12}$$

The modifications to the budget constraints for consumers in good standing who default or consumers in bad standing are analogous. The rest of the baseline model remains unchanged.

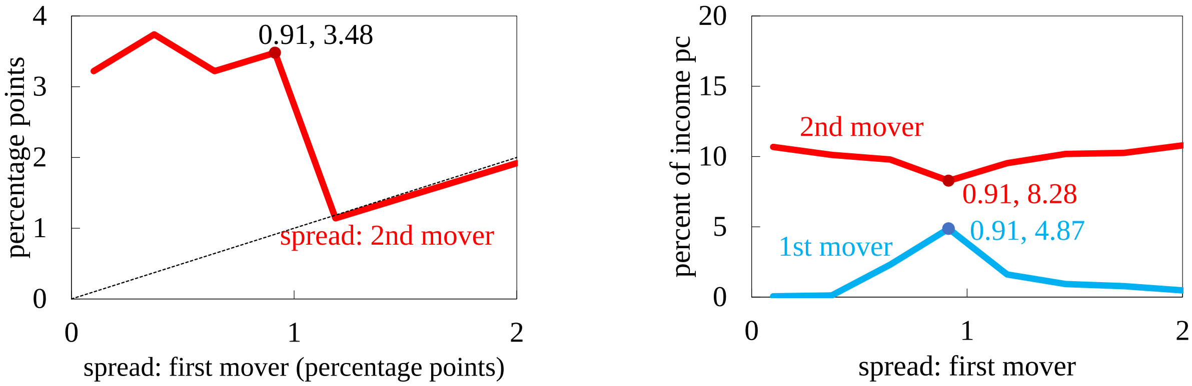
Our second robustness exercise allows for an alternate redistribution of lender profits uniformly across all households as well as zero redistribution of profits to households. In the case of the former, the budget constraint becomes:

$$c + a' = \theta\eta\epsilon + (1 + r_f)a + \sum_{j=1}^{N}(r_j(\theta) - r_f)a_j(a, \theta) + \Pi. \tag{13}$$

I Gains from re-optimization

In our benchmark competitive reform (monopoly to collusive-Cournot oligopoly with N=20), lenders commit to strategies at date 1 along the transition path, fully understanding the future movement of the distribution of agents across states. In this section, we conduct exercises that allow us to assess whether lenders would potentially gain from re-optimization. To measure the approximate gains from re-optimization, in column (2) of Table 23, we report the strategies lenders choose in steady state along with the baseline strategies we computed in column (1). In column (3), we report strategies lenders

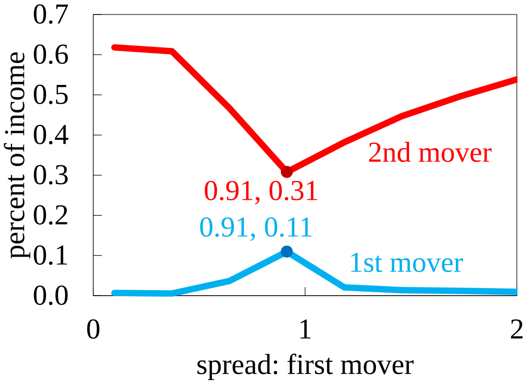
Figure 17: Stackelberg policy functions given 1st mover spread $(\theta = \theta_L)$



(a) 2nd mover spread in stage 1

(b) Nash borrowing limits in stage 2

(c) Net present value of profits



Notes: *Panel (a) plots the second mover's best response in spreads in stage 1 as a function of the first mover's spread. Panel (b) plots the stage 2 Nash borrowing limits for both lenders given the first mover's spread and the second mover's best response in spreads. Panel (c) plots the net present value of profits for both lenders given the first mover's spread, the second mover's best response in spreads, and Nash borrowing limits for both lenders given their respective spreads. Spreads are expressed as percentage point deviations over the risk-free rate. Borrowing limits are expressed as a percentage of income per capita. Net present value of profits are expressed as a percentage of income.*

would choose if they could unexpectedly re-optimize in the fifth period of the transition path given $t = 1$ strategies from column (1). Re-optimization yields similar strategies suggesting small gains from re-optimization, which are shown in the last two rows of Table 23.

J Comparison to standard bond price schedule

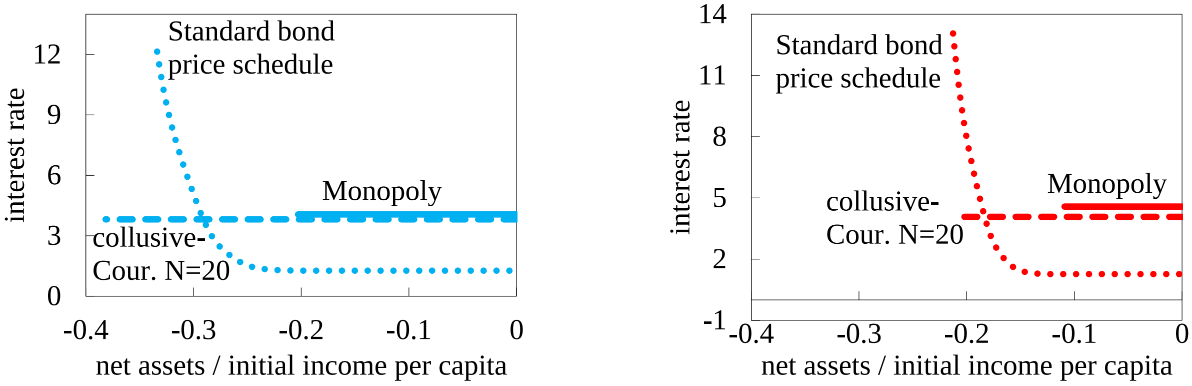
Figure 18 compares the credit card interest rates from our quantitative model with a pure monopoly and collusive-Cournot with twenty lenders to the interest rates the same consumer would face in the standard consumer credit model with a bond price schedule. We present the interest rates for both the

Table 23: Comparison of strategies and welfare from re-optimization: collusive-Cournot (N=20)

	(1) Transition	(2) Steady state	(3) Re-optimize $t = 5$
High-type			
Borrowing limit to initial income pc	38.16	38.51	37.69
Spread	2.55	2.42	2.29
Low-type			
Borrowing limit to initial income pc	21.13	21.55	20.95
Spread	2.81	2.42	2.16
Welfare gains: Monopoly to...			
CEV unborn at $t = 1$ (% of lifetime consumption)	0.73	0.81	0.81
WEV alive at $t = 1$ (% of initial income)	4.77	5.26	5.28

low- and high- permanent earnings types.[48] The main takeaway is that in our model, the interest rates are higher than that implied by the standard consumer credit model except for higher levels of debt. Figure 18 also illustrates another stark difference between a credit line and a bond price schedule. With the former, the rates do not increase with the level of borrowing for a given credit card, whereas with the latter, the interest rate increases with the level of borrowing.

Figure 18: Comparison of credit lines to standard bond price schedule



(a) High-type

(b) Low-type

K Pass-through in a two period model

In this section, we present a two-period deterministic model with an analytical solution to illustrate what to expect in terms of pass-through when there is market power in a credit market. Suppose there is one

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[48] In the case of the standard consumer credit model, the interest rate is a function of both the current realization of the AR(1) earnings component and a'. We present interest rates for a consumer with a median realization of the AR(1) earnings in the current period.

consumer and one lender. The consumer has endowment y in both periods, log preferences over consumption in the two periods, c_1 and c_2, and a discount factor β. The lender has all the market power and sets the lending rate r. The cost of funds to the lender is given by r_f. The consumer chooses consumption for the two periods and net assets a in the first period, where $a < 0$ indicates borrowing, to maximize lifetime utility. The principal along with the interest, $(1+r)a$, is repaid in the second period. We abstract from default to keep the model parsimonious. We view this as a reasonable abstraction because when we measure pass-through in the data and in the quantitative model, we focus on credit cards with the lowest offered interest rate (i.e., low default risk). The consumer problem is given by

$$\begin{aligned} &\max_{c_1 \geq 0, c_2 \geq 0, a} \quad \log(c_1) + \beta \log(c_2) \\ &s.t. \\ &c_1 + a = y \\ &c_2 = y + (1+r)a \\ &a \geq -\bar{A} \end{aligned} \tag{14}$$

where $\bar{A}$ is a borrowing limit that is large enough so that it does not bind in equilibrium. The lender's problem is given by

$$\begin{aligned} &\max_{r} -a(r)(r - r_f) \\ &s.t. \\ &a(r) = \frac{y(\beta(1+r)-1)}{(1+r)(1+\beta)} \end{aligned} \tag{15}$$

where r_f is the cost of funds and the lender chooses the lending rate r to maximize profits given the consumer's demand function $a(r)$. The consumer will borrow if $\beta(1+r) < 1$. Taking first order conditions, we can derive the solution to the lender's problem given by

$$r = \frac{\sqrt{1+r_f}}{\sqrt{\beta}} - 1 \tag{16}$$

This leads to a pass-through rate given by

$$\frac{\sqrt{1+r_{f,1}} - \sqrt{1+r_{f,0}}}{\sqrt{\beta}(r_{f,1} - r_{f,0})} \tag{17}$$

where $r_{f,1}$ and $r_{f,0}$ are the cost of funds with and without a shock. This equation illustrates that for a high enough β, the pass-through rate is low. Given our calibrated values for β, r_f, and the shock for measuring pass-through, the implied pass-through is 0.5082, i.e., 51 percent. If we assumed CRRA preferences with a risk aversion of 2 like in our quantitative model, the implied pass-through is 0.5079. Note that if the rates were set competitively, the pass-through would be 1. Therefore, when there is market power, we can expect a pass-through of less than 1 when there is a shock to the cost of funds. This two-period model abstracts from the notion of fixed rate credit cards, which will further reduce pass-through as long as shocks are not permanent. In our quantitative analysis of the model, we allow for multiple periods with fixed interest rate credit cards along with default (see Section 5).