(Don't) Feed the Mouth that Bites: Trade Credit Spillover through Common Suppliers

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Abstract

Product market rivals often source upstream inputs from common suppliers. Because these inputs are typically sold on credit, sharing a supplier could create incentives for customers to strategically demand trade credit in order to prevent the supplier from providing liquidity to rivals – to avoid "feeding the mouth that bites." We develop a theoretical model to illustrate that when government policies strengthen certain customers' product market position, such strategic incentives become aggravated, leading to a spillover effect of these policies. We empirically test the model implications using manually collected pair-level trade credit data. Using the U.S. government's *QuickPay* reform as an identification strategy, we show that customers extract more trade credit from common suppliers in an effort to pull away these suppliers' liquidity from the rivals that already benefit from *QuickPay*. We also provide suggestive evidence that the presence of common suppliers can act as a moderator on firm-specific shocks and level the playing field in the downstream market.

Keywords: Trade Credit, Policy Spillover, Supply Chains, Common Supplier, QuickPay Reform

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1 Introduction

In 2001, Home Depot sharply changed its policies on trade credit payment to suppliers, after noting a gap between the company's days payable and that of its competitors. The then-CFO Carol Tomé explained:

> *"We used to pay our vendors faster than any other retail – and a lot faster than Lowe's... We really were the First National Bank of Home Depot. And I'm sorry, but we were subsidizing Lowe's [growth]. Our days payable is now 50, and before it was less than 30. Some of our vendors said to us, 'You know, we always wondered how long before you changed your policy.'"*[1]

This case depicts a competitive incentive among product market rivals when they source upstream inputs from common suppliers, as illustrated by the following figure.

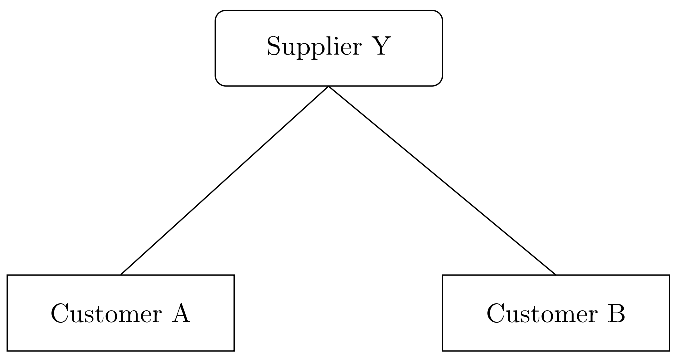

Illustration 1

Rival customers A and B acquire inputs and obtain trade credit from a common supplier (Y). Trade credit is among the most important sources of short-term financing for firms in the United States, and even the largest companies request generous payable terms from suppliers (Petersen and Rajan, 1997; Strom, 2015; Murfin and Njoroge, 2015; Giannetti, 2024). By prolonging payment to suppliers, companies can grow working capital and maximize their use of cash flows in exchange for higher returns. Suppliers, on the other hand, often face liquidity constraints and are limited in their ability to extend trade credit. Therefore, when one customer (e.g., customer B in Illustration 1) makes a speedy payment,

[1] Lloyd (2001). "Home Depot CEO: CEO won't accept sales cannibalization", *Dow Jones Newswires*.

it unlocks the supplier's liquidity tied up with receivables, and allows the supplier to increase trade credit to the rival customer A. In such a case, firm B becomes a "shadow financier" of firm A, effectively subsidizing the rival's growth. Recognizing this threat, firm B may deliberately prolong its payable days to delay cash flows received by the common supplier – and in turn, by the rival firm A. The incentive here is clear: to avoid "feeding the mouth that bites." This incentive is the underlying spirit of the beginning quote from Home Depot's CFO.

Notably, such an incentive becomes aggravated when there is a shift in the rival customers' relative competitiveness. To see this, consider a case when customer A receives an unexpected cash flow influx (e.g., from government subsidies) strengthening its market position over rival B. Facing this turn of events, B's concern of feeding the mouth that bites is heightened: it will become more aggressive in bargaining for trade credit from the common supplier – so as to pull the supplier's liquidity away from A and accordingly, keep A from obtaining more trade credit on top of the government subsidies it already enjoys. As such, although the government benefit is placed on customer A, it spills over to affect the trade credit received by customer B – and this spillover is passed through the shared supplier.

In this study, we theoretically and empirically examine such a spillover through trade credit. Our analysis builds on a Nash bargaining model featuring two rival customers (A and B) that source inputs from and bargain for trade credit with a common supplier (Y). Customer A experiences an exogenous reduction in the production cost (due to, e.g., granted government benefits). We show that as customer A's market position strengthens, customer B optimally demands more trade credit from supplier Y; doing so allows B to stay competitive and fend off the growing threat from A. Supplier Y, however, faces a trade off. On the one hand, accommodating such demand allows the supplier to maintain business with B, who would otherwise be out-competed by A thus shutting down part of Y's sales. On the other hand, providing extra trade credit is costly for the supplier's profit. Nevertheless, we find that in equilibrium, the supplier can afford to generously accommodate B's demand for extra trade credit, and the intuition is as follows.

As a common supplier, Y has the ability to *cross-subsidize* trade credit among its customers. In particular, when B requests extra trade credit, the common supplier Y can accommodate it to a large extent by trimming the trade credit allocated to customer A in the meantime. This is a sustainable strategy because as we show, A's profit becomes less dependent on the trade credit from Y once it begins to enjoy the reduced production costs (due to government subsidies) – and thus becomes less demanding with Y in term of trade credit. Put differently, because the common supplier's cost of granting trade credit to B is partially offset by the tightening credit to A, customer B is able to bargain for extra trade credit. This spillover of A's government benefits to B's trade credit is achieved *as if* customer B pulls the trade credit away from rival A via their common supplier – i.e., the act of avoiding feeding the mouth that bites.

In contrast, we remove the common supplier from our model and examine a case in which the two customers A and B deal with their respective suppliers – Y_A and Y_B. We find that a reduction in A's production cost (following government benefits) only *marginally* increases rival B's trade credit from Y_B. In this case, although customer B still intends to demand extra trade credit upon A's threat, supplier Y_B – the non-common supplier – is now more restrained from accommodating such requests. Without the ability to cross-subsidize trade credit between A and B, supplier Y_B bears all the cost of trade credit provision, which in turn curbs its incentive to do so. Y_B cannot simply pull trade credit from any other customers either: Absent government benefits, other customers are unwilling to give up their trade credit to Y_B (as customer A does) – making the cross-subsidization infeasible.

Likewise, we examine the case in which the competition between customers A and B is muted. We find that as the lower competition suppresses customer B's urge to stop empowering the rivals, its trade credit from common supplier Y does not increase significantly upon A's threat. Therefore, our model highlights the two cornerstones underlying the spillover effect of government benefits on trade credit: (1) common suppliers who have the ability to internalize the allocation of trade credit across customers, and (2) competing customers who have incentives to avoid feeding the mouth that bites. In our empirical analyses, we provide evidence in accordance with these two aspects.

To set up our empirical framework, we leverage the setting of the *QuickPay* reform initiated by the U.S. federal government in 2011 – which allows us to mimic the exogenous reduction in customer A's production cost in the model. Illustration 2 demonstrates this setting. This illustration is an expansion of the original Illustration 1: The right half of Illustration 2 corresponds to Illustration 1, and the added left half depicts how we use *QuickPay* to set up the empirical analyses.

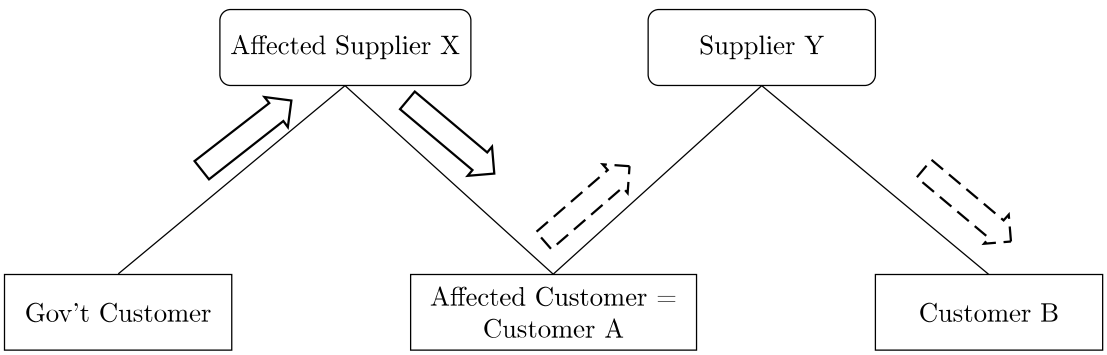

Illustration 2

The *QuickPay* reform mandated federal government agents to pay their small business contractors within 15 days of the receipt of invoice, a significant acceleration from the previous 30-day maximum. Barrot and Nanda (2020) document that *QuickPay* affected a total of $70 billion in annual contract value and impacted almost every industry sector due to the massive footprint of federal government procurement.[2] We conjecture (and verify) that the acceleration in payment creates a liquidity influx to suppliers of government agents (Supplier X) – and in turn, allows these suppliers to re-distribute the freed-up liquidity to its non-government customers in the form of trade credit – effectively reducing these customers' input cost. This effect of *QuickPay* is shown by the solid arrows in Illustration 2.

[2] Barrot and Nanda (2020) document that loosened financial constraints from *QuickPay* increase treated suppliers' employment growth. Moreover, these suppliers begin to pay their own suppliers in a more timely manner, pointing to *QuickPay*'s upstream effects. Complementing their findings, our results document a downstream effect on the customers of the treated suppliers.

As such, the affected customers resemble customer A in the original Illustration 1, which experiences an exogenous reduction in production costs, posing greater threat to the competitors. This setting in turn provides a testing ground for our model: By identifying customer A's product market rivals – i.e., customer B sharing a common supplier Y – we can empirically examine how rival B's trade credit responds to the growing threat from A, test whether B attempts to pull extra trade credit from common suppliers (i.e., the dashed arrows) and lastly, estimate the magnitude of *QuickPay*'s spillover effect from A to B.[3]

More specifically, our empirical analyses consist of two stages. We first validate the exogenous reduction in customer A's production costs following *QuickPay* (the left half of Illustration 2), and then study rival B's tactical response in terms of trade credit (the right half). In stage one, we use a difference-in-differences setting to analyze how suppliers distribute the unlocked liquidity following an acceleration of government payment, akin to the identification strategy in Barrot and Sauvagnat (2016). An affected supplier (X) is a small business that has outstanding contracts with federal government agents at the time of *QuickPay*; an affected customer (A) is a non-government customer served by at least one affected supplier. We compare how the amount of trade credit between the affected customer (A) and the affected supplier (X) changes around *QuickPay* (the first difference) with the trade credit change between the affected customer (A) and a control supplier – one that is unaffected by *QuickPay* (the second difference). While the first difference may capture a general time trend in trade credit provisions, the second difference nets it out.

To implement this analysis, we manually collect the amount of pair-level trade credit that each supplier extends to its customers. Our sample includes 2,229 supplier-customer-year observations (representing 831 unique customer-supplier pairs) between 2008 and 2013, a window containing three years prior to the *QuickPay* reform and three years after. In our estimation, we include supplier-customer pair fixed effects to absorb time-invariant char-

[3]The phenomenon of common suppliers serving same-industry rivals has become increasingly prominent in recent years. For example, the average number of rivals that share at least one supplier increases from 0.53 in 1980 to 1.57 in 2017. See Section 3.5 for more details.

acteristics that lead to the match between the two parties, and to isolate the time-series variation in pairwise trade credit surrounding the reform.

In this first stage, we show that the government payment acceleration leads suppliers to extend more trade credit to their non-government customers. These affected customers, on average, receive about 4.5% more payables relative to sales (benchmarked against the control). This effect is both statistically and economically significant; it remains so after we control for a battery of factors, including the relationship between suppliers and customers in business duration and intensity, as well as supplier and customer firm characteristics. This result is interesting in its own right: Distinct from the literature showing that *suppliers'* liquidity shocks can transmit down the supply chain via trade credit (e.g., Garcia-Appendini and Montoriol-Garriga, 2013; Costello, 2020; Adelino et al., 2023), our result shows that liquidity influx from *one customer* can be transferred to the supplier's other customers.

The extra trade credit extended to *QuickPay*-affected customers reduces their input cost, making them akin to customer A in Illustration 2. In the stage-two analysis, we identify customer A's product market rival firms sharing the same suppliers (i.e., customer B) and study whether the *QuickPay* effect spreads further along to customer B. We consider several aspects of product market competition to identify rivals, including whether customer B operates in the same industry as A, whether the two have a high level of product similarity, whether they have comparable market dominance, and whether they are geographically close.

Corresponding to the model, we consider two cases: (1) when customers A and B share a common supplier Y, and (2) a placebo case, in which customers A and B deal with respective non-common suppliers – i.e., $\mathrm{Y_A}$ and $\mathrm{Y_B}$. We find that in the common-supplier case, customer B's trade credit from Y significantly increases following the *QuickPay*, relative to a control group selected to capture Y's overall trade credit provisions over time. This increase is economically sizable and amounts to up to 10% of customer B's sales. Combining this estimate with that obtained from stage one, we can derive the magnitude of the *QuickPay* spillover in terms of dollar amount of trade credit: For each dollar increase in customer A's trade credit from supplier X due to *QuickPay*, customer B's trade credit from the common supplier Y also increases by approximately one dollar.

In stark contrast, we find that customer B's trade credit from a non-common supplier (Y_B) does not exhibit a significant increase, either statistically or economically. This placebo case echoes our model prediction, and shows that the presence of common suppliers is important in carrying through the spillover effect of government benefits from customers A to B – owing to the suppliers' ability to cross-subsidize trade credit.

We perform another placebo test on customers' competitive incentives. That is, we identify customer C – which shares a common supplier with customer A but does not compete with customer A in the product market. In other words, customer C is the placebo of B absent the competition. We show that, unlike the case of customer B, there is no significant increase in C's trade credit following *QuickPay*. Taken together, these placebo tests demonstrate the two cornerstones underlying our model mechanism: the presence of common suppliers and competing customers' incentive to stop empowering the rivals.[4]

Finally, we examine the implications of our findings for the real economy, at both firm and industry levels. At the firm level, we find that customer B, by obtaining additional trade credit from the common supplier after the policy shock, performs better in the product market (in terms of sales growth and market value) than peers without common suppliers. At the industry level, we find that customer firms in industries with more frequent common suppliers see less cross-sectional dispersion in product market performance, suggesting that the presence of common suppliers can act as a moderator on firm-specific shocks and level the playing field in the customer industry. Such a shock-absorbing effect complements prior studies documenting that supply chain instability can intensify customers' operational risks

[4]The importance of common suppliers in our setting relates our study to the literature examining firms' behavior and interactions in the presence of common shareholders. This literature examines settings of mergers and acquisitions (e.g., Matvos and Ostrovsky (2008); Harford et al. (2011)), product markets (e.g., He and Huang (2017); Azar et al. (2018); Freeman (2023b); Dennis et al. (2022); Koch et al. (2021)), corporate governance and compensation (e.g., Kwon (2016); Liang (2016); Kang et al. (2018); He et al. (2019); Edmans et al. (2019); Antón et al. (2023)), managerial incentives (e.g., Gilje et al. (2020)), financial reporting (e.g., Jung (2013); Park et al. (2019); He et al. (2020)), and cost of capital (He et al. (2024)).

and amplify downstream market shocks.

Related Literature

Our study contributes to the existing theoretical and empirical literature in several dimensions. Recent theoretical studies explore the strategic interactions between customers and suppliers in the context of trade credit. For example, Chod et al. (2019) show that trade credit allows cash-constrained retailers to increase purchases from competing suppliers, leading to a free rider problem. Suppliers – especially those serving a common customer – extend less trade credit in equilibrium to combat this problem. The authors find support for the model predictions using simulated and observational data. Different from their context, we examine strategic interactions when customers share a common supplier. Our setting is more similar to that of Giannetti et al. (2021), who show that suppliers utilize trade credit to ease competition among customers, especially when customers deal with a common supplier. In their setting, trade credit allows the supplier to implement a de facto increasing price schedule, without rendering excessive market power to high-bargaining-power customers that could cause sales cannibalization. Complementing their paper's focus on the *supplier*'s motives to limit competition among customers, we focus on the motives of *customers*. We show that when one customer (customer B) faces growing threat from rivals (customer A), the concern of feeding the mouth that bites prompts it to more aggressively request trade credit, and this behavior is accommodated in equilibrium owing to the common supplier's ability to cross-subsidize trade credit.

To this extent, our model is related to the ones in Wilner (2000) and Cuñat (2007), who theoretically show that firms undergoing a liquidity shock often resort to suppliers as temporary liquidity providers. They do so by raising the amount of accounts payables, which effectively serves as short-term cash reserves that help offset the negative effects of the shock. In equilibrium, suppliers are willing to grant such trade credit because it allows them to maintain a mutually beneficial supplier-customer relationship. In our Nash bargaining model, splitting the surplus from an ongoing relationship similarly motivates the supplier to accommodate customer B's request for extra trade credit, particularly when B faces growing threat from customer A. We add to this mechanism by considering the presence of common suppliers, who reallocate liquidity from the less demanding customer A (already enjoying policy benefits) to the more demanding customer B. This reallocation reduces the cost of trade credit concession, and affords the common supplier to be especially accommodating in trade credit policies – as demonstrated by the cases with vs. without the common supplier. The re-allocation mechanism in turn allows the policy effect to spread along the supply chain.

This mechanism is therefore related to studies documenting the resource re-allocation within inter-firm networks and how these networks spread economic shocks. For instance, Indest and Mueller (2003) show that financially constrained firms mitigate liquidity shocks to individual business units by withdrawing resources from others. Giroud and Mueller (2019) find that firms' incentive to equate marginal revenue products lead to the propagation of local economic conditions across regions. This re-allocation mechanism also connects our study to the literature examining liquidity redistribution via trade credit adjustments. For example, Bakke and Whited (2012) find that firms significantly reduce accounts receivables when facing liquidity shortfalls due to mandatory pension contributions. Garcia-Appendini and Montoriol-Garriga (2013) find that firms facing greater liquidity constraints issue less trade credit amidst tightening bank credit than firms with fewer constraints. Restrepo et al. (2019) show that firms' credit reliance shifts from short-term loans to trade credit out of liquidity management concerns amid rising costs of bank credit.

Our model is also related to the theoretical framework examining the transmission of economic shocks in production networks (see, e.g., Acemoglu et al., 2012; Carvalho, 2014). Carvalho and Tahbaz-Salehi (2019) provide a review of this literature. These studies find that economic shocks can travel downstream or upstream via input-output linkages, depending on whether the shocks originate from the supply side or the demand side. Consistent with this framework, our stage-one result shows that the cash influx due to accelerated payment from government customers – akin to a positive shock to the government suppliers – can transmit downstream in the form of additional trade credit to their other customers (i.e., customer A). In stage two, we further show that this vertical transmission extends to a horizontal transmission, affecting the trade credit to the peers of customer A (i.e., customer B). This result is in a similar spirit of Hertzel et al. (2008), who find that economic shocks can spread beyond reliant suppliers and customers to peers in their respective industries. In our model, the horizontal transmission originates from the competitive incentives of customers and is carried out through an under-explored channel: common suppliers. We show that firms' incentive to avoid empowering the rivals is reinforced by common suppliers' ability to internally reallocate short-term funding. Such a force of the horizontal transmission answers the call of Giannetti (2024) for a more thorough investigation of suppliers' "*ability of extending funding to customers on static and dynamic competition*" (p.32).[5]

Further, the documented transmission of the *QuickPay* effect adds to the growing empirical literature studying how policy interventions can spill over to firms not directly targeted by the policy. Adelino et al. (2023) show that through trade credit, the benefits of unconventional monetary policies can reach financially constrained firms, and this supply-chain channel operates independently from the effects of monetary policies on bank lending. Other studies examine the transmission of conventional monetary policies through trade credit, including Gertler and Gilchrist (1993), Nilsen (2002), and Love et al. (2007). The *QuickPay* spillover effect is also related to the well-documented peer effects in corporate policies and household decisions. In our context, the peer effect arises from firms' (customer B's) incentives to fend off the growing threat from peers (customer A), thus driving them to request extra trade credit through the common supplier.[6]

[5]More generally, empirical studies find evidence supporting the theory on the transmission of shocks along supply chains. These shocks stem from bankruptcy risk (Jacobson and Von Schedvin, 2015), natural disasters (Barrot and Sauvagnat (2016)), bank liquidity expansion or contraction (Shenoy and Williams, 2017; Costello, 2020; Alfaro et al., 2021), and macro-economic conditions (Ozdagli and Weber, 2023). This literature also studies how the propagation of supply-chain shocks may be mitigated by the structure of the banking industry (Giannetti and Saidi, 2019), and how trade credit is provided or utilized to stabilize the supply chain in the presence of shocks (Gofman and Wu, 2022; Ersahin et al., 2024). Among international firms, Albuquerque et al. (2015) find that trade credit provides an important economic connection between firms across countries, generating cross-border return predictability.

[6]The peer effects are documented in the setting of capital structure (Leary and Roberts, 2014), cash and

Trade credit in the U.S. stands at $4.1 trillion as of 2020. Giannetti (2024) provides a comprehensive review of the literature examining this important source of financing.[7] Exploiting pair-wise granular trade credit data between suppliers and customers, we contribute to this literature by analyzing how customers' competitive incentives, in the presence of common suppliers, shape the allocation of trade credit. More broadly, our finding is related to the literature intersecting supply chain management with corporate finance. This literature has studied how supply chain relationships impact capital structure and loan terms (Kale and Shahrur, 2007; Campello and Gao, 2017; Hasan et al., 2020; Cen et al., 2016), innovation (e.g., Chu et al., 2019), mergers and acquisitions (Garfinkel and Hankins, 2011; Ahern and Harford, 2014; Fan and Goyal, 2006; Shahrur, 2005), tax policy (Cen et al., 2017), information diffusion and asset price comovement (Cen et al., 2023, 2024; Schiller, 2023), and corporate environmental and social policies (Schiller, 2018).[8]

2 Model

In this section, we develop a model of trade credit that features two rival firms sourcing input from suppliers. The model has two dates, $t = 0$ and $t = 1$. On date 1, customers A and B purchase inputs from suppliers on trade credit, and produce and engage in Cournot competition by choosing quantities. Customer A's product needs two inputs, X and Y. Customer B's product needs two inputs, Y and Z. Input Y is the common factor, and inputs X and Z are firm-specific factors. We consider these firm-specific factors in order to examine how changes in the input cost of non-common factors may spread along the supply chain

dividend policies (Hoberg et al., 2014; Grennan, 2019); investment (Foucault and Fresard, 2014; Dessaint et al., 2019), CSR/ESG engagement (Cao et al., 2019; Parsons et al., 2018), disclosure (Cao et al. (2021), and household refinancing decisions (Maturana and Nickerson, 2019).

[7]This literature explores the economic motivation for trade credit provision, including information asymmetry (Smith (1987); Biais and Gollier (1997)), implicit guarantee of product quality and commitment (Lee and Stowe (1993); Long et al. (1993); Petersen and Rajan (1997); Dass et al. (2015)), liquidity insurance (Ng et al. (1999); Wilner (2000); Cuñat (2007)), product characteristics and lender relationships (Giannetti et al. (2011)), and buyer opportunism (Burkart and Ellingsen (2004); Fabbri and Menichini (2010)). Trade credit provision can be found here: https://www.federalreserve.gov/releases/z1/20210923/html/b103.htm.

[8]See Cen and Dasgupta (2021) for a comprehensive survey of the supply chain literature.

– corresponding to the spillover effect of *QuickPay* in our empirical analyses. We label the suppliers of these three factors as suppliers X, Y, and Z, respectively. On date 0, trade credit is determined by the Nash bargaining between each customer-supplier pair. We consider a subgame perfect equilibrium and thus solve the model backwards. In the following, we start with describing the date-1 product market and solve its equilibrium; we then move on to date 0 to compute the trade credit equilibrium.

2.1 Product market

2.1.1 Production, demands, and trade credit

The production functions of customers A and B take the following Cobb-Douglas forms:

$$q_A = x^{1-\eta} y_A^{\eta}, \text{ and } q_B = z^{1-\eta} y_B^{\eta}, \tag{1}$$

where q_A and q_B are the output quantities produced by customers A and B; x, z, y_A, and y_B are the input quantities; $\eta \in (0, 1)$ is a constant. Customers compete in the same product market with the following demand functions:

$$p_A = \theta_A - q_A - \gamma q_B, \text{ and } p_B = \theta_B - q_B - \gamma q_A, \tag{2}$$

where p_A and p_B are product prices of A and B. θ_A and θ_B are positive constants indicating market sizes, and constant $\gamma \in [0, 1]$ captures the extent of competition between A and B.

We follow Giannetti et al. (2021) and use discounted cash flows to model the benefit of trade credit. Intuitively, trade credit allows customers to defer payment to suppliers until a future date, thus lowering the customers' effective costs of input purchased from suppliers (as well as the effective revenue to the suppliers). The duration of such deferment captures the generosity of trade credit. Specifically, we assume that the costs of capital for customers A and B, and supplier Y are ϕ_A, ϕ_B, and ϕ_Y, respectively. Hence, their respective discount factors are:

$$\delta_A = \frac{1}{1+\phi_A}, \delta_B = \frac{1}{1+\phi_B}, \text{ and } \delta_Y = \frac{1}{1+\phi_Y}. \tag{3}$$

All payments to the supplier and customers are discounted according to these discount factors.

We assume that the input prices of factors X, Y and Z are exogenously given by $c_x > 0$, $\bar{c}_y > 0$, and $c_z > 0$. As discussed in Giannetti et al. (2021), this assumption considers the input price of upstream suppliers as being determined by a fringe of entrants offering the input at a certain cost. It allows us to abstract from strategic interactions in the upstream market and focus on the downstream market (also see, e.g., Rey and Tirole, 2007; Akcigit et al., 2021). Therefore, if supplier Y offers trade credit to customers A and B with deferments of t_A and t_B years, then the effective prices to customers A and B (as input costs, $c_{y,A}$ and $c_{y,B}$), and that to supplier Y (as revenues, $r_{y,A}$ and $r_{y,B}$) are given by:

$$c_{y,A} \equiv \delta_A^{t_A} \bar{c}_y, \text{ and } c_{y,B} \equiv \delta_B^{t_B} \bar{c}_y, \tag{4}$$

$$r_{y,A} \equiv \delta_Y^{t_A} \bar{c}_y, \text{ and } r_{y,B} \equiv \delta_Y^{t_B} \bar{c}_y, \tag{5}$$

all of which are smaller than $\bar{c}_y$, reflecting the discounted prices due to trade credit.

2.1.2 Optimal production decisions and profits

We compute the customers' optimal production decisions in the product market, which determine the payoffs of the Nash bargaining games on date 0. To conserve space, we delegate the detailed computations to Appendix A and provide the outline as follows.

Given the Cobb-Douglas production functions in Equation (1), we solve the customers' cost minimization problems for given output quantities and obtain the cost functions:

$$K_A\left(c_x, c_{y,A}, q_A\right) = k_A q_A, \text{ with } k_A \equiv \left[\left(\frac{1-\eta}{\eta}\right)^{\eta} + \left(\frac{\eta}{1-\eta}\right)^{1-\eta}\right] c_x^{1-\eta} c_{y,A}^{\eta}, \tag{6}$$

$$K_B\left(c_z, c_{y,B}, q_B\right) = k_B q_B, \text{ with } k_B \equiv \left[\left(\frac{1-\eta}{\eta}\right)^{\eta} + \left(\frac{\eta}{1-\eta}\right)^{1-\eta}\right] c_z^{1-\eta} c_{y,B}^{\eta}. \tag{7}$$

Variables k_A and k_B are endogenous marginal costs for A and B, through which trade credit affects their production (recall that $c_{y,A} \equiv \delta_A^{t_A} \bar{c}_y$ and $c_{y,B} \equiv \delta_B^{t_B} \bar{c}_y$). To reflect this dependence of k_A and k_B on t_A and t_B, we denote $k_A = k_A\left(t_A\right)$ and $k_B = k_B\left(t_B\right)$. In particular, if $t_A = 0$, then $c_{y,A} \equiv \delta_A^{t_A} \bar{c}_y = \bar{c}_y$, denoting the case in which customer A switches to other suppliers (which do not offer trade credit). A similar interpretation for $t_B = 0$ applies.

When solving the customers' cost minimization problems, we also obtain the optimal input demands of A and B for producing quantities q_A and q_B as follows:

$$x = \left(\frac{c_{y,A}}{c_x}\right)^{\eta} \left(\frac{1-\eta}{\eta}\right)^{\eta} q_A \text{ and } y_A = \left(\frac{c_x}{c_{y,A}}\right)^{1-\eta} \left(\frac{\eta}{1-\eta}\right)^{1-\eta} q_A; \tag{8}$$

$$z = \left(\frac{c_{y,B}}{c_z}\right)^{\eta} \left(\frac{1-\eta}{\eta}\right)^{\eta} q_B \text{ and } y_B = \left(\frac{c_z}{c_{y,B}}\right)^{1-\eta} \left(\frac{\eta}{1-\eta}\right)^{1-\eta} q_B. \tag{9}$$

These two equations will be used to compute suppliers' equilibrium revenues once the customers' optimal production quantities q_A and q_B are given.

Equipped with the cost functions in (6) and (7) and the product demand functions in (2), we can compute the equilibrium outputs for customers A and B:

$$q_A = \frac{2\left(\theta_A - k_A\right) - \gamma\left(\theta_B - k_B\right)}{4-\gamma^2} \text{ and } q_B = \frac{2\left(\theta_B - k_B\right) - \gamma\left(\theta_A - k_A\right)}{4-\gamma^2}. \tag{10}$$

Using the first-order-conditions for the customers' profit maximization problems, we compute their optimal profits as $\pi_A = q_A^2$ and $\pi_B = q_B^2$, where q_A and q_B are evaluated at the optimal production quantities in Equation (10).

Analyzing the profit functions, we obtain the following lemma that provides the key intuition for our later model prediction.

Lemma 1. *For customer A, the marginal benefit of obtaining trade credit from supplier Y (i.e., t_A) to raise its profit (i.e., π_A) decreases as the input cost for factor X (i.e., c_x) is lowered. That is,* $\frac{\partial}{\partial c_x}\frac{\partial \pi_A}{\partial t_A} > 0$.

Lemma 1 states that obtaining more trade credit from supplier Y lowers customer A's input cost, thus increasing its production and raising its equilibrium profit. However, such marginal benefit becomes attenuated as customer A's input cost of the other factor, X, decreases. Put differently, as c_x declines, customer A relies less on supplier Y's trade credit to raise profits. As such, when facing a declining c_x, customer A becomes less demanding for supplier Y's trade credit. This incentive creates an opportunity for supplier Y to pull back some trade credit from A and reallocate it to customer B – if supplier Y simultaneously serves both. Such a "cross-subsidy" effect, however, is absent if customers A and B are served by separate (non-common) suppliers, in which case the suppliers are not able to internally allocate trade credit from one customer to another.

2.2 Nash bargaining and trade credit determination

We now go back to date 0 and compute the equilibrium trade credit that supplier Y provides to customers A and B based on Nash bargaining. We start by considering the main case of interest – when factor Y is served by the common supplier. In Section 2.4, we consider the contrasting case in which factor Y is served by separate suppliers. The timeline of the bargaining game is as follows. On date 0, customer A and common supplier Y bargain over trade credit t_A, and customer B and supplier Y bargain over trade credit t_B. These two bargaining games happen simultaneously so that when the bargaining takes place, all parties hold correct beliefs about the equilibrium values of t_A^* and t_B^*. On date 1, the model develops as in the previous subsections. That is, the two customers produce q_A and q_B, given the values of (t_A, t_B) determined in the first stage. Finally, the product market clears and every player receives the payoff.

2.2.1 Equilibrium characterization of trade credit

In order to solve the equilibrium, we need to solve two best response functions: the best response of customer A's trade credit (t_A) to customer B's trade credit (t_B), and vice versa. These best responses in turn determine the equilibrium of the two Nash bargaining games. In the following, we illustrate in detail the solution for the game between customer A and supplier Y as an example. The game between customer B and supplier Y can be solved analogously.

When computing the Nash bargaining outcomes, we need to figure out the payoff in and out of an agreement. If customer A and common supplier Y reach an agreement on trade credit t_A, then the profits of the two players are:

$$\pi_A^{IN} = (q_A^{IN})^2 \text{ and } \pi_Y^{IN} = r_{y,A}^{IN} y_A^{IN} + r_{y,B}^{IN} y_B^{IN}, \tag{11}$$

where the superscript "IN" means "*in* the agreement," that is, when A and Y reach a deal. Specifically, q_A^{IN} takes the value in Equation (10) when customer A receives trade credit t_A and customer B receives trade credit t_B^* – which is customer A's rational belief about the trade credit that customer B obtains from the customer B-supplier Y bargaining game:

$$q_A^{IN} = \frac{2\left(\theta_A - k_A\left(t_A\right)\right) - \gamma\left(\theta_B - k_B\left(t_B^*\right)\right)}{4 - \gamma^2}. \tag{12}$$

Supplier Y's prices are $r_{y,A}^{IN} = \delta_Y^{t_A} \bar{c}_y$ and $r_{y,B}^{IN} = \delta_Y^{t_B^*} \bar{c}_y$, and its quantities y_A^{IN} and y_B^{IN} are given by Equations (8) and (9) with $q_A = q_A^{IN}$ and $q_B = q_B^{IN}$ (defined in a way similar to (12)).

If customer A and supplier Y fail to reach a deal, then A's profit becomes:

$$\pi_A^{OUT} = (q_A^{OUT})^2, \tag{13}$$

where the superscript "OUT" means "*out* of the contract," and

$$q_A^{OUT} = \frac{2\left(\theta_A - k_A\left(0\right)\right) - \gamma\left(\theta_B - k_B\left(t_B^*\right)\right)}{4 - \gamma^2}, \tag{14}$$

where $k_A(0)$ indicates that customer A switches to an outsider supplier without obtaining trade credit. The common supplier Y loses customer A's business, so its profit only originates from the sales to customer B:

$$\pi_Y^{OUT} = r_{y,B}^{OUT} y_B^{OUT}, \tag{15}$$

where $r_{y,B}^{OUT} = \delta_Y^{t_B^*} \bar{c}_y$ (by Equation (4)), $\pi_Y^{OUT} = \delta_Y^{t_B^*} \bar{c}_y y_B^{OUT}$ (by Equation (9)), and $q_B^{OUT} = \frac{2\left(\theta_B - k_B\left(t_B^*\right)\right) - \gamma\left(\theta_A - k_A(0)\right)}{4-\gamma^2}$ (by Equation (10)).

In equilibrium, it must be the case that both customers A and B maintain business with supplier Y, because this outcome is in everyone's best interest. As such, the Nash bargaining game is:

$$\max_{t_A} \left(\pi_A^{IN} - \pi_A^{OUT}\right)^{\alpha_A} \left(\pi_Y^{IN} - \pi_Y^{OUT}\right)^{1-\alpha_A}$$

where $\alpha_A \in (0,1)$ denotes the bargaining power of customer A. Solving the above program generates the best response: $t_A = f_A\left(t_B^*\right)$. Similarly, we can compute the best response of customer B: $t_B = f_B\left(t_A^*\right)$. The equilibrium trade credit pair $\left(t_A^*, t_B^*\right)$ is thus jointly determined by these two best response functions.

2.2.2 Prediction on the equilibrium trade credit to customer B

Our goal is to examine how the equilibrium trade credit obtained by customer B from the common supplier Y (i.e., t_B^*) varies with customer A's input cost of factor X (i.e., c_x). This examination allows us to derive the potential spillover effect of customer A's input cost changes on B through the the common supplier. While the Nash bargaining equilibrium cannot be solved analytically, it is possible to numerically characterize the optimal trade

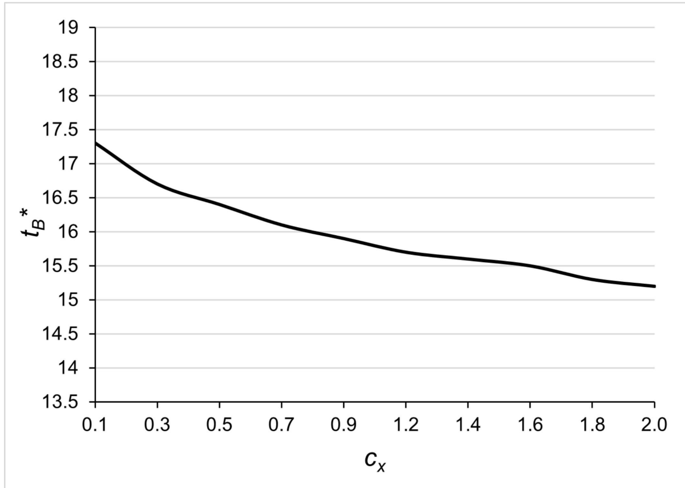

Figure I. The optimal trade credit t_B^* as a function of c_x. Parameter values are $\theta_A = \theta_B = 10, \eta = 0.5, \gamma = 0.9, \alpha_A = \alpha_B = 0.5, \phi_A = \phi_B = \phi_Y = 0.1, \bar{c}_y = c_z = 1$.

credit t_B^* as a function of c_x, as illustrated in Figure I.

Figure I shows that a reduction in c_x increases customer B's equilibrium trade credit from the common supplier Y. The intuition is as follows. The lowered c_x – the input cost of factor X for customer A – strengthens A's market position relative to customer B. Therefore, B optimally demands more trade credit in the Nash bargaining with supplier Y, in order to stay competitive and fend off the growing threat. Supplier Y accommodates such demand in equilibrium because it is in its best interest to maintain business with B. This accommodation occurs *despite* that offering more trade credit reduces Y's profit, and it is owing to Y's role of serving both customers A and B.

Specifically, as a common supplier, Y has the ability to cross-subsidize trade credit between A and B. When customer B requests extra trade credit upon the threat of rival A, Y is able to fulfill this request while trimming the trade credit allocated to customer A in the meantime. This cross-subsidy is sustainable because as shown in Lemma 1, customer A becomes less demanding with supplier Y given that it already benefits from the lowered c_x. As such, the common supplier's cost of granting trade credit to B is partially offset by the tightening credit to A. Given the diminished cost, customer B is able to bargain for extra credit to a large extent. Based on this observation, we derive the first prediction for our empirical analyses as follows.

Prediction 1. *As the input cost of customer A (c_x) decreases, customer B obtains more trade credit (t_B^*) from the common supplier Y in equilibrium.*

Prediction 1 depicts that the effect of A's lowered input cost spills over to its rival B's trade credit, and this spillover effect is obtained through the presence of a common supplier Y. In Appendix C, we further show that the equilibrium trade credit obtained by customer A (i.e., t_A^*) decreases as c_x is lowered – opposite to the pattern of t_B^*. The contrast thus suggests a shift in Y's trade credit allocation from customer A to customer B – and this is as if the rival B pulls trade credit away from customer A via their common supplier, namely, the act to avoid feeding the mouth that bites.

2.3 Comparative statics

We next examine comparative statics of our main result in terms of (1) the bargaining power between customer B and common supplier Y; (2) the bargaining power between customer A and supplier Y, and (3) the extent of financial constraints facing supplier Y. Figure II plots how the relation between c_x and t_B^* varies along the three dimensions.

Panel A plots t_B^* as a function of c_x for two cases, based on whether the parameter α_B that governs the bargaining power of customer B over common supplier Y is high ($\alpha_B = 0.7$) or low ($\alpha_B = 0.3$). Intuitively, greater bargaining power affords B to pull more trade credit from Y upon the growing threat of rival A. In this case, we expect to observe that the sensitivity of t_B^* to c_x should become more pronounced. This is indeed what we observe in Panel A. For ease of exposition, we normalize the two cases to start from the same level of t_B^* (when c_x is at its minimum value of 0.1) so that we can focus on the slope of the t_B^* function. The slope of the dashed line (for lower bargaining power of B) is flatter than that of the solid line (for higher bargaining power), as expected.

Panel B plots the relation between t_B^* and c_x based on the bargaining power of customer A over common supplier Y (α_A). The intuition for this parameter is opposite to that

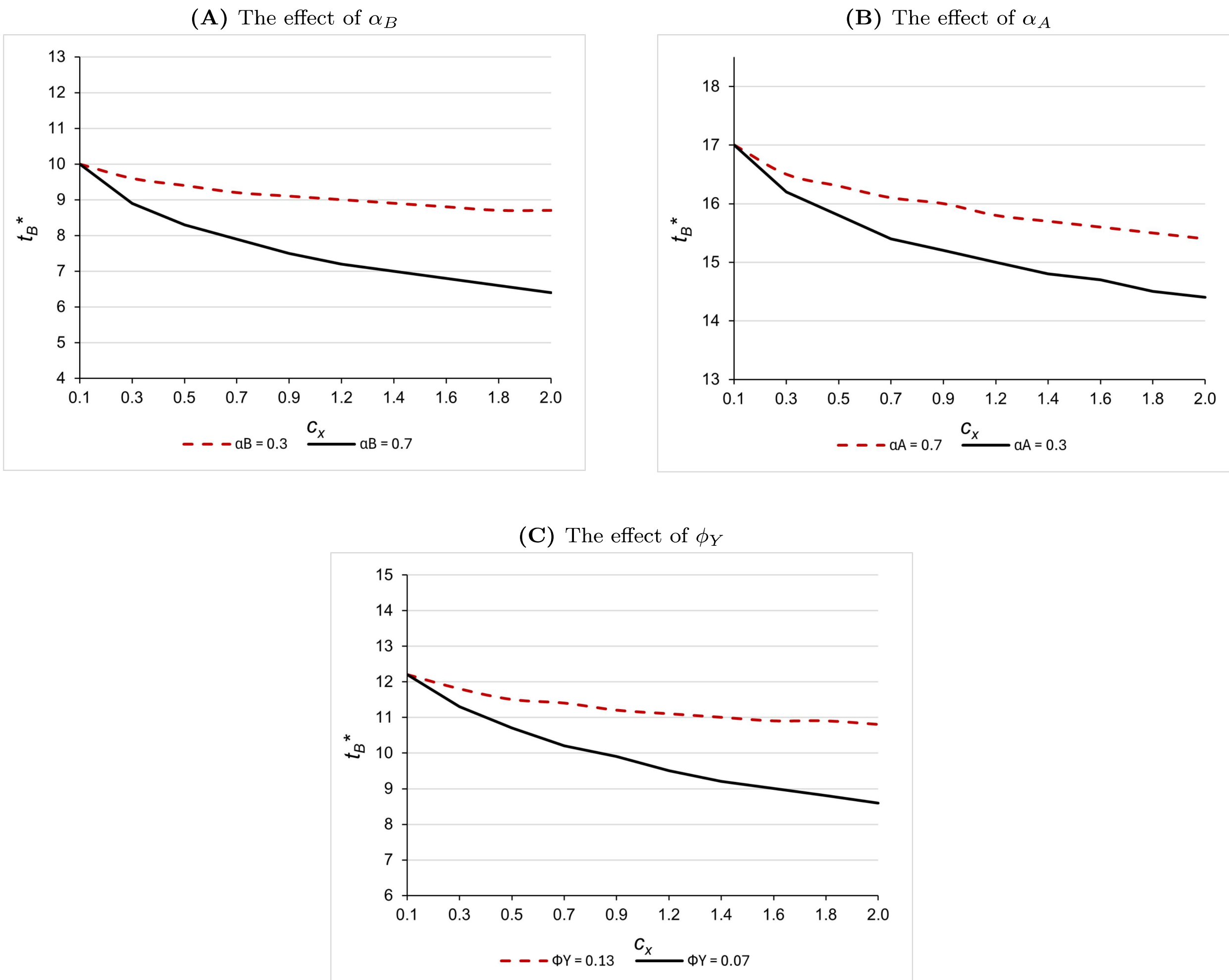

Figure II. Comparative statics for the optimal trade credit t_B^* as a function of c_x. Parameter values follow those in Figure I, except for the variable of interest of each panel.

for the case of α_B. That is, the lower customer A's bargaining power, the easier it is for Y to pull away A's trade credit and re-allocate it to customer B; after all, B is in greater demand of this trade credit due to the rising threat from A. Put differently, lower bargaining power of A makes the trade credit cross-subsidization easier to execute. In such a case, we expect that customer B's trade credit from Y should be more responsive to the declining c_x, ceteris paribus. Panel B confirms this intuition. The increase in t_B^* is less significant for the case of a higher α_A than for the case of a lower α_A, as the input cost of A decreases.

Lastly, in Panel C, we examine how the response of t_B^* to c_x depends on the financial constraints of supplier Y. Following Liu et al. (2023), we capture the extent of financial constraints by supplier Y's cost of capital (i.e., the discount rate, ϕ_Y). As Liu et al. (2023) point out, a higher cost of capital reflects the fact that the firm faces greater difficulty in raising funding and thus is more likely financially constrained. In such a case, supplier Y is more hesitant in accommodating customer B's request, and thus less likely to side with B in pulling the trade credit away from A. Therefore, the trade credit obtained by customer B should be less responsive to changes in c_x. We observe this pattern in Panel C.

Prediction 2. *The sensitivity of the equilibrium trade credit obtained by customer B (t_B^*) in response to the lowering input cost of customer A (c_x) should be greater when:*

- *customer B has stronger bargaining power with the common supplier Y;*
- *customer A has weaker bargaining power with the common supplier Y; and*
- *the common supplier Y is less financially constrained.*

2.4 The case of separate suppliers

In this section, we consider the case in which two separate suppliers of factor Y serve customers A and B, respectively. Here we assume that certain frictions exist such that each supplier can only serve one of the two customers but not both, that is, supplier $\mathrm{Y_A}$ only serves customer A and supplier $\mathrm{Y_B}$ only serves customer B. In practice, we can consider this friction as arising from, e.g., the geographical distance between customers and suppliers, or other search costs that hinder the two parties from establishing a business relation.

Compared to the common supplier case, the optimal production decisions for the separate supplier case stay the same as those in Section 2.1.2. The main difference here lies in the suppliers' outside options in the Nash bargaining process (described in Section 2.2.1). Specifically, if customer A and supplier $\mathrm{Y_A}$ reach an agreement on credit t_A, then the profits of customer A and supplier $\mathrm{Y_A}$ are respectively:

$$\pi_A^{IN} = (q_A^{IN})^2 \text{ and } \pi_{Y,A}^{IN} = r_{y,A}^{IN} y_A^{IN}, \tag{16}$$

where the superscript "IN" again indicates "*in* the agreement." If customer A and supplier $\mathrm{Y_A}$ fail to reach an agreement, then customer A's profit becomes:

$$\pi_A^{OUT} = (q_A^{OUT})^2. \tag{17}$$

In this case, supplier $\mathrm{Y_A}$ loses customer A's business and supplier $\mathrm{Y_A}$'s profit becomes 0 because customer A is its only customer. That is, $\pi_{Y,A}^{OUT} = 0$.

Like before, we then analyze the Nash bargaining outcome to compute the best response of customer A's trade credit to customer B's: $t_A = f_A(t_B^*)$. We can similarly compute the best response of customer B, $t_B = f_B(t_A^*)$, and intersect with customer A's best response to determine the equilibrium trade credit pair (t_A^*, t_B^*).

Figure III plots customer B's optimal trade credit t_B^* as a function of c_x using the dashed line for this separate supplier case. For ease of comparison, the faded solid line plots t_B^* for the common supplier case, as derived in Section 2.2.2. Figure III shows that a reduction in c_x similarly increases the optimal trade credit t_B^* – reflecting B's incentive to request extra trade credit from its own supplier $\mathrm{Y_B}$, when it faces rising threat from rival A. However, compared to the common supplier case, the sensitivity of t_B^* to c_x is less significant. This can be seen by the relatively flatter dashed line compared to the solid line. This contrast is intuitive: Without the ability to cross-subsidize trade credit between customers A and B, supplier $\mathrm{Y_B}$ cannot offset the cost of providing additional trade credit to B by cutting the allocation to A. Since $\mathrm{Y_B}$ bears all the cost of trade credit concession, it is restrained from generously accommodating B's demand for extra credit. $\mathrm{Y_B}$ cannot simply pull trade credit from any other customers either: In the absence of government benefits, other customers are unwilling to give up their trade credit to $\mathrm{Y_B}$ (as customer A does) – making the cross-subsidization infeasible.

Prediction 3. *The relation between customer A's input cost of A (c_x) and customer B's trade credit in equilibrium (t_B^*) is less significant in the separate supplier case than in the*

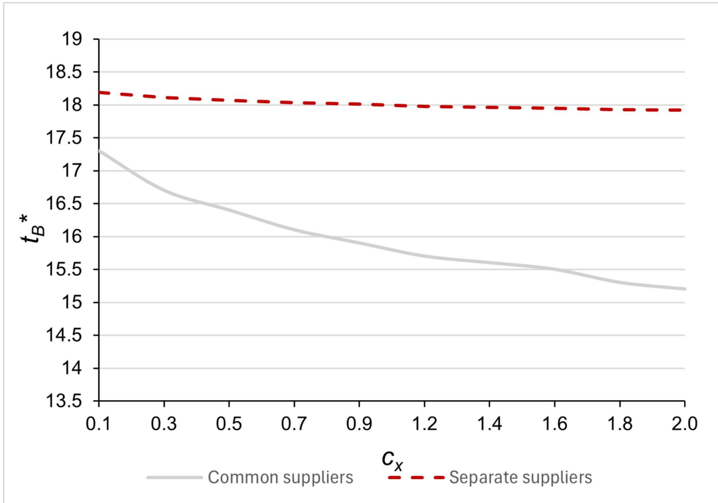

Figure III. The optimal trade credit t_B^* as a function of c_x for the case of separate suppliers. Parameter values are $\theta_A = \theta_B = 10, \eta = 0.5, \gamma = 0.9, \alpha_A = \alpha_B = 0.5, \phi_A = \phi_B = \phi_Y = 0.1, \bar{c}_y = c_z = 1$. The faded solid line plots the result from Figure I for reference.

common supplier case.

2.5 The case of muted competition

Prediction 3 illustrates the importance of common suppliers in carrying out the spillover effect of government benefits. Another important cornerstone of our theoretical framework is the intensity of competition between customers A and B – which gives rise to their incentives to avoid feeding the mouth that bites. In this section, we examine this second cornerstone.

To do so, we derive customer B's equilibrium trade credit t_B^* under different values of γ – the parameter governing the competition intensity between customers A and B. The dashed line in Figure IV plots t_B^* as a function of c_x when the competition is muted ($\gamma = 0.05$). For comparison, the faded solid line plots t_B^* for the baseline case derived in Section 2.2.2, when $\gamma = 0.9$. Figure IV shows that as muted competition suppresses customer B's incentive to avoid the mouth that bites, its equilibrium trade credit becomes largely insensitive to increases in c_x. The following prediction summarizes this observation.

Prediction 4. *The relation between customer A's input cost of A (c_x) and customer B's*

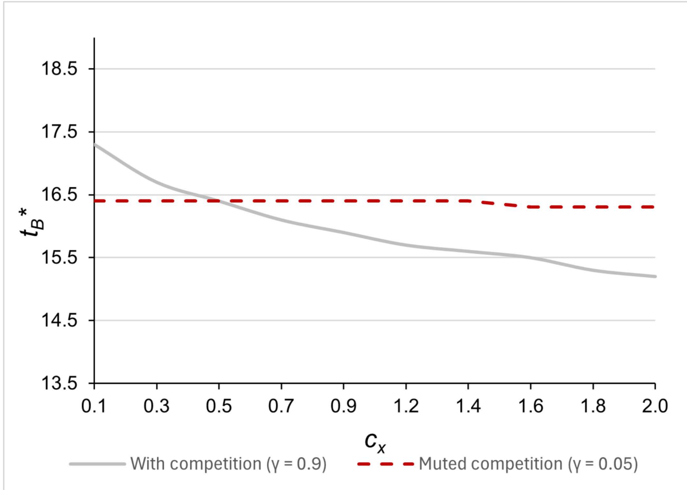

Figure IV. The optimal trade credit t_B^* as a function of c_x for the case of muted competition. Parameter values are $\theta_A = \theta_B = 10, \eta = 0.5, \alpha_A = \alpha_B = 0.5, \phi_A = \phi_B = \phi_Y = 0.1, \bar{c}_y = c_z = 1, \gamma = 0.9$ or 0.01.

trade credit in equilibrium (t_B^*) is less significant when the competition between the two customers is muted.

Taken together, Sections 2.2.2 to 2.5 highlight the two cornerstones underlying the spillover effect of government benefits on trade credit: (1) common suppliers who have the ability to internalize the allocation of trade credit across customers, and (2) competing customers who have incentives to avoid subsidizing the rivals.

3 Data, Sample, and Summary Statistics

3.1 Data and sample

Our primary data source comes from a manual collection of trade credit disclosures in U.S. public firms' annual reports (10Ks). Two Financial Accounting Standards Board (FASB) regulations provide the basis of these disclosures: First, Statement of Financial Accounting Standards (SFAS) No. 14 and No. 131 require that public firms in the U.S. report major customers in their 10K disclosures to the Securities and Exchange Commission (SEC).[9]

[9] SFAS No. 14 and No. 131 set 10% of sales as the threshold for defining a major customer, but firms often also voluntarily disclose major customers falling below this threshold.

Second, FASB No. 105 requires firms to disclose their credit concentrations, for which accounts receivable balances to major customers frequently qualify. We start with Compustat supplier firm-years that report sales to at least one major customer, excluding suppliers in financial (SIC codes 6000-6999) and utility (SIC codes 4900-4999) industries and requiring that firms have basic financial information (such as total assets, book equity, leverage, sales, total receivables, and year-end share price) in that year. We then manually read a supplier's 10Ks to obtain its trade credit amount provided to each major customer at each year-end. Our sample period is 2008-2013, including three years before the implementation of *QuickPay* and three years after. The resulting pair-level trade credit dataset includes 2,229 supplier-customer-year observations, with 503 unique suppliers, 339 unique customers, and 831 unique customer-supplier pairs. See Freeman (2023a) for more details on the data collection process. This sample constitutes the basis for our following analyses.

3.2 Stage-one analysis

As discussed in the Introduction and Illustration 2, our empirical analyses consist of two stages. In stage one, we use the *QuickPay* reform to identify customers that experience an exogenous reduction in the production cost – corresponding to the lowered c_x in our model. This stage is illustrated by the left half of Illustration 2, and below we discuss more details about how we conduct this stage-one test.

The U.S. federal government's *QuickPay* reform mandated accelerated payment from federal agencies to their small business contractors from the previous 30-day maximum (as required by the Prompt Payment Act, see Chapter 39 of Title 31 of the U.S. Code) to a new 15-day maximum for eligible contractors.[10] As businesses – particularly small businesses – struggled in the post-recession era, the goal of *QuickPay* was to improve the cash flows and profitability of businesses.[11] We conjecture (and verify) that the acceleration in government

[10]See Memorandum M-11-32 from the Executive Office of the President, Office of Management and Budget.

[11]The policy was officially announced on September 14, 2011, and mandated adoption by all federal agencies by November 1. However, federal agencies knew about the planned reform in advance, and some – most

payment creates a liquidity influx and in turn, allows the affected suppliers X (in Illustration 2) to re-distribute the freed-up liquidity to customers in the form of increased trade credit. This re-distribution is denoted by the solid arrows in Illustration 2. Accordingly, these "affected customers" experience a reduction in their input cost (c_x in our model in Section 2). For ease of exposition, we label these affected customers simply as customer A hereafter.

To identify suppliers X affected by *QuickPay*, we obtain data on all government procurement contracts for fiscal years 2009-2010, and manually match names of government contractors to suppliers included in the Compustat Segment database. Since *QuickPay* specifically targets small businesses, we record whether a given transaction is denoted "small business" in the contracting data. The small business classification by government agencies is based on the Small Business Administration (SBA)'s industry-specific classifications, which are defined by firm sales and/or number of employees. However, we observe that certain transactions classified as "small business" are with contractors whose parent corporations are larger than the SBA-specified size threshold. This observation means that the government's classification is likely at the establishment level rather than the parent level.[12] For this reason, we classify a parent firm as a small business contractor if a significant fraction of its reported government procurement contracts is denoted "small business." This entity is likely influenced by *QuickPay*, and is classified as an affected supplier (supplier X in Illustration 2).[13] Accordingly, a customer that is served by at least one affected supplier but not associated with government agencies is classified as an affected customer (customer A). Suppliers that are not affected by *QuickPay* are control suppliers.

notably, the Department of Defense that accounts for 2/3 of government procurement (Barrot and Nanda, 2020) – preemptively adopted quicker payment terms by late April 2011. See Memorandum 2011-O0007 from the Office of the Under Secretary of Defense.

[12] Contractors are identified by both their Dun and Bradstreet DUNS number and their parents' DUNS number, which are often different. While the "small business" classification happens at the DUNS level, Compustat GVKEYs best correspond to the parent DUNS, leading to the disconnect of small business classifications between subsidiaries and parents. For example, in 2009, we identified five Federal contracts with Adobe Inc., three of which were labeled as small business contracts. The Small Business Administration (SBA) considers a business in Adobe's primary NAICS code (541511) to be a small business if it earns less than $30 million in revenue. In 2009, Adobe's revenues were around $2.9 billion.

[13] We define the "significant fraction" as at least 25% of the reported transactions, but our results are robust to alternative thresholds such as 10%, 20%, and 33%.

Among our identified small business contractors, some were already paid within 15 days before *QuickPay*, and thus are excluded from affected suppliers X. More specifically, contracts for purchases of perishable food products were already paid in less than 15 days. Hence, we exclude SIC codes 2000-2200 from the affected supplier group. Contracts designated "cost-plus" rather than "fixed price" were also typically paid in 15 days prior to *QuickPay*: this is because fixed-price contracts involve a pre-negotiated price, whereas cost-plus contracts involve the reimbursement of expenses plus a profit margin.[14] Hence, our affected supplier group excludes firms with a substantial fraction (75% or more) of contracts categorized as cost-plus.[15]

3.3 Stage-two analysis

In our stage-two analysis – corresponding to the right half of Illustration 2, we study how customer B (the rival of customer A) reacts to the growing threat from A, which enjoys a lowered input cost (i.e., c_x) after *QuickPay*. That is, we examine whether B attempts to capture extra trade credit from the common supplier Y to avoid feeding the mouth that bites. This stage would then uncover the spillover effect of *QuickPay* on customer B, and we further analyze whether this effect propagates through the channel of common suppliers.

3.4 Variable construction

Throughout our analyses, we examine pairwise trade credit (*Trade Credit*), defined as the receivables extended to a customer by a supplier scaled by the supplier's sales to the customer. We construct pair-level and firm-level control variables that can affect trade credit, as motivated by the literature (e.g., Petersen and Rajan, 1997; Giannetti et al., 2011; Klapper et al., 2012). *Relationship Length* is the log of the number of years since a supplier

[14] Barrot and Nanda (2020) report that 60% of government spending is through fixed-price contracts, and that the Department of Defense, which accounts for two thirds of government contract spending, already paid cost-plus contracts within 15 days.

[15] Our results are robust to alternative cutoffs including 90%, 70%, and 67%.

first reports sales to a customer; *Sales Dependence* is the percentage of the supplier's sales made to the customer; *Size* is the logarithm of firm assets; *Leverage* is book debt scaled by total assets; *Profitability* is operating income scaled by total assets; *R&D Intensity* is R&D expenses scaled by total assets (set equal to zero when missing); *Q* is the firm's Tobin's Q (market value of assets relative to book value of assets); *Tangibility* is plant, property, and equipment as a percentage of total assets; *HHI* is industry concentration as measured by the Herfindahl Index. *Relationship Length* and *Sales Dependence* are defined at the pair-level, and other controls are defined for the customer and supplier, respectively. All continuous variables are winsorized at the 1st and 99th percentiles.

3.5 Summary statistics

Table 1 reports the summary statistics for the key variables. Panel A reports summary statistics for the sample used in stage-one analysis (the left half of Illustration 2), and Panel B reports summary statistics for stage two (the right half of Illustration 2). In Panel A, approximately 20% of our sample pair-year observations involve affected Suppliers (X). On average, the percentage of supplier sales to federal government agencies is 0.2%; among suppliers that are government contractors, the average is 1.8%.[16] 47.7% of the sample observations are in the post-*QuickPay* period.

As to pair-level control variables, the average *Trade Credit*, the ratio of pair-level trade credit to pair-level sales, is 0.178. *Sales Dependence* of the supplier on the customer averages 23.8%. The average *Relationship Length* is 5.61 years (1.725 in log-years). Comparing firm level controls, suppliers tend to be smaller, less leveraged, and less profitable than their customers, with greater *R&D intensity*.

In Panel B, 28.1% of observations involve customers in the same industry as an affected customer (A) and with a common supplier (i.e., customers B; see more details in Section 5.1), while the remaining 71.9% of observations involve the common suppliers' other

[16]Our results continue to hold if we require above-median, above-75th percentile, at least 5%, or at least 10% government dependence.

customers (i.e., non-B customers). The average *Trade Credit* is 0.180. *Sales Dependence* of the supplier on the customer averages 23.4%. The average *Relationship Length* is 5.57 years (1.718 in log-years). Control variables are similar to those in Panel A.

In Figure 1, we plot the time trend of the average number of rivals that share at least one supplier, as well as the average number of rivals a shared supplier serves. It shows that the phenomenon of rival customers sharing common suppliers has become increasingly prevalent over the past few decades.

4 The Redistribution of Supplier Liquidity Following *QuickPay*

Our stage-one analysis – corresponding to the left half of Illustration 2 – aims to identify the set of customers A that experience an exogenous reduction in their input cost (c_x in the model). To do so, we adopt a difference-in-differences (DiD) analysis around *QuickPay*. Specifically, we compare the changes in trade credit between an affected supplier X and customer A – the first difference, with trade credit changes between the same customer A and a control supplier unaffected by *QuickPay* – the second difference. In this setting, our key variable of interest is *Affected Supplier*, which indicates whether customer A's trade credit comes from a supplier affected by *QuickPay* or a control supplier. By contrasting the same customer A's trade credit from affected versus control suppliers, we mute changes in the customer's demand for trade credit that might coincide with *QuickPay*, and isolate a supply effect. In other words, this DiD setting allows us to identify whether *QuickPay* leads suppliers to redistribute freed-up liquidity to their customers in the form of additional trade credit. If so, this effect would create an exogenous reduction in customer A's input, creating a lowered c_x as in the model. Specifically, we estimate the following equation:

$$TradeCredit_{s,c,t} = \mu_{s,c} + \tau_t + \beta Post \times AffectedSupplier_s + Controls_{s,c,t} + \epsilon_{s,c,t}, \quad (18)$$

where s denotes a supplier, c denotes a customer, and t denotes year. This analysis is performed using pairs involving affected customers A only (i.e., those having at least one supplier affected by *QuickPay*, as defined in Section 3.2). *Affected Supplier* is a dummy variable that equals one if a pair involves an affected supplier, and zero if the pair involves control suppliers without exposure to *QuickPay*. In robustness tests (Section 7.2), we also use *Affected Sales* – the proportion of supplier sales arising from government contracts – as a continuous version of *Affected Supplier* to capture a supplier's exposure to *QuickPay*. *Post* is a dummy variable that equals one if an observation is in the post-*QuickPay* period (i.e., years 2011-2013), and zero if the observation is in the pre-*QuickPay* period (i.e., years 2008-2010). We incorporate either pair fixed effects or supplier and customer fixed effects throughout our analysis to control for time-invariant pair-level or firm-level characteristics. These fixed effects fully absorb the variation in *Affected Supplier* alone. We further control for year fixed effects, which absorbs *Post*. Lastly, we include pair-level and firm-level control variables discussed in Section 3.4. The standard errors are double-clustered at the supplier and customer levels.

Table 2 reports the results. The DiD estimator, namely, the coefficient estimate of *Affected Supplier* $\times$ *Post*, is significantly positive in all model specifications, indicating that payment acceleration from *QuickPay* leads affected suppliers to extend more trade credit to their general (non-government) customers, compared to control suppliers unaffected by the reform. This effect is economically significant. Affected customers A receive 4.1% to 4.4% more payables relative to their total purchases from the affected suppliers X (benchmarked against control suppliers), representing about 22% to 25% of the sample standard deviation of *Trade Credit*.

An important premise for the DiD approach is the parallel trends assumption, which states that the trends in trade credit should not significantly differ between treatment and control pairs in the absence of the treatment. To examine this premise and provide richer dynamics of our baseline result, we perform the following dynamic DiD model:

$$TradeCredit_{s,c,t} = \mu_{s,c} + \Sigma_{i=2008}^{2013}(\beta_i Year_i \times AffectedSupplier_s) + Controls_{s,c,t} + \epsilon_{s,c,t} \tag{19}$$

where $Year_i (i = 2008 \text{ to } 2013)$ are indicator variables for the fiscal years around the implementation of *QuickPay* in 2011, and other variables are the same as in Equation (18). We omit the interaction terms involving the year dummy for 2010 as the baseline and include pair fixed effects in our estimation (corresponding to the specification in column (6) of Table 2). We plot the yearly DiD estimators (i.e., β_i) in Figure 2.

As can be seen, there is no visible difference in trade credit between the affected and control pairs in the years leading up to *QuickPay*, verifying the parallel trends assumption. Following *QuickPay*, affected suppliers X extend additional trade credit to the affected customers A: the effect begins at the end of 2011, a few months after *QuickPay* was first adopted, and it gradually increases in magnitude over time.

In Appendix B, we further examine if the stage-one result exhibits cross-sectional variation depending on the relative supplier-customer bargaining power. This examination is inspired by recent studies, including Giannetti et al. (2021); Murfin and Njoroge (2015) and Barrot (2016). We expect that following the liquidity influx from *QuickPay*, affected suppliers are more likely to extend extra trade credit to customers with greater bargaining power. This is indeed what we find in Table A1.

5 The Spillover Effects of *QuickPay* to Rival Customers

The stage-one analysis allows us to identify customer A, which experiences an exogenous reduction in the input cost. We next perform stage-two analysis to study the spillover effect of *QuickPay* through common suppliers, as demonstrated by the right half of Illustration 2. This part is the main focus of our study, which directly tests Predictions 1 to 3 derived in Section 2.

5.1 Baseline results

We start with Prediction 1. That is, conditional on customer A benefiting from *QuickPay* (i.e., a lowered c_x), we explore whether rival customers B extract additional trade credit from common supplier Y to avoid feeding the mouth that bites. Specifically, we examine, given a common supplier Y, how this supplier's trade credit to customer B changes after the implementation of *QuickPay* – a time-series difference. We add to this difference a second layer of variation that originates from the cross section – by comparing the trade credit that the same supplier Y provides to a control group of customers (non-B) over the same period. This additional cross-sectional difference captures confounding factors that may affect supplier Y's overall trade credit provisions and that may coincide with the timing of *QuickPay*. These two layers form a DiD setting. In this setting, our key variable is *Customer B*, which indicates whether the common supplier Y's trade credit goes to customers B or control customers served by Y.[17]

To implement this setting, we first identify customers B. By definition, customers B are rivals of customers A on the product market. To this end, we aim to capture firms competing in the same product market space (as in the beginning case of Home Depot and Lowe's), and thus are most likely incentivized to avoid subsidizing the rivals. We start by considering whether the two firms are in the same 4-digit SIC industry. We later expand this consideration to include, e.g., product similarity and geographical proximity, in Section 7.2.

Next, we identify the common set of suppliers (Y) that serve both customers A and B prior to the enactment of *QuickPay*. Here we exclude suppliers affected by *QuickPay* (i.e., supplier X in Illustration 2) because they are the focus of the former stage-one analysis.

[17]Control customers exclude government customers.

Based on this framework, we perform the following DiD analysis:

$$TradeCredit_{s,c,t} = \mu_{s,c} + \tau_t + \beta Post \times CustomerB_s + Controls_{s,c,t} + \epsilon_{s,c,t}, \quad (20)$$

where s denotes a supplier, c denotes a customer, and t denotes year. This estimation is performed only using pairs involving the set of common suppliers (Y). *Customer B* is a dummy variable that equals one if a pair involves customer B, and zero if it involves control (non-B) customers of Y. *Post* is a dummy variable that equals one if an observation is in the post-*QuickPay* period (i.e., years 2011-2013) – the period when customer A poses heightened threat due to the benefits from *QuickPay*. It equals zero if the observation is in the pre-*QuickPay* period (i.e., years 2008-2010). We incorporate the same set of fixed effects as well as the pair-level and firm-level control variables in Equation (18). The standard errors are double-clustered at the supplier and the customer levels.

Table 3 reports the results. The DiD estimator, namely, the coefficient estimate of *Customer B* $\times$*Post*, is significantly positive in all specifications, indicating that following *QuickPay*, trade credit from the common suppliers Y increases significantly to customer B, relative to other control customers. This effect is economically significant: Customers B receive 8.3-10.0% more payables relative to their total purchases from the common suppliers (benchmarked against the controls), representing about 45% to 54% of the sample standard deviation of *Trade Credit*.

These findings are consistent with Prediction 1. In Appendix C, we further show that the trade credit offered by the common supplier to customer A decreases following *QuickPay*, opposite to what we observe for customer B. This contrast is again consistent with the model prediction, which suggests a shift in Y's trade credit allocation from customer A to customer B – as if the rival B pulls trade credit away from customer A via their common supplier, i.e., the act of avoiding feeding the mouth that bites. In turn, these findings establish that the effect of *QuickPay* on customer A spills over to affect the trade credit of seemingly unrelated market participants: customers B.

Similar to Section 4, we perform a dynamic DiD model for Equation (20) to check the parallel trends assumption. Specifically, we run a regression model similar to column (6) of Table 3, but replace *Post* with a set of year dummies other than 2010 (the baseline). We then interact each year dummy with *Customer B*, and plot the yearly DiD estimators in Figure 3. The results again show no pre-*QuickPay* trends in trade credit between the pairs involving customer B and the control.

Based on the economic magnitudes estimated from the two stages, we derive the extent of *QuickPay*'s spillover effect on trade credit. Specifically, in stage one, we estimate that customer A receives about 4.4% additional trade credit (relative to sales) from government supplier X following *QuickPay*. This magnitude corresponds to the trade credit change in the left half of Illustration 2, and represents vertical transmission of the *QuickPay* effect. In response, customer B pulls about 10% incremental trade credit (relative to sales) from supplier Y, as estimated in stage two. This magnitude corresponds to the right half of Illustration 2, and represents horizontal transmission of the *QuickPay* shock through common suppliers. Using the average sales amount for the two pairs (X-A and Y-B), we estimate that for each dollar increase in customer A's trade credit originating from *QuickPay*'s liquidity influx to government suppliers, customer B obtains an approximately extra one dollar of trade credit from the common supplier Y.[18]

5.2 Cross-sectional variation

We next empirically test theoretical Prediction 2 pertaining to cross-sectional variation. Prediction 2 states that customer B's trade credit increase following *QuickPay* should be stronger when (1) customer B has stronger bargaining power over the common supplier, (2) customer A has weaker bargaining power over the common supplier, or (3) the common supplier faces lower financial constraints. We consider these three predictions separately.

[18] Specifically, the average annual sales between X and A are about \$164 million in our sample period, and the average sales between Y and B are about \$81 million.

To capture customer B's bargaining power over supplier Y, we estimate the customer's dependence on supplier Y – that is, the ratio of pair-level sales to customer B's cost of goods sold in the year prior to *QuickPay*. A lower dependence indicates that customer B has a higher bargaining power, and vice versa. We divide the sample into three subgroups: When customer B's dependence on Y falls into the bottom, middle, and top tercile of the sample distribution, respectively. We then estimate a model similar to Equation (20) separately in these subsamples. Figure 4 Panel A plots the coefficients of the DiD estimators, *Customer B* $\times$ *Post*, for each tercile.

One limitation of this analysis is that in each subsample, we have a limited number of observations, which reduces the power of test. Therefore, we focus on the magnitudes of the coefficient estimates rather than their statistical significance. Panel A is consistent with Prediction 2: the increase in customer B's trade credit following *QuickPay* is more prominent in the case when B has stronger bargaining power over the common supplier. This can be seen from the larger DiD coefficient in tercile 1 (indicating the case of strongest bargaining power), and the weakening DiD coefficients across the three terciles.

In Panels B and C, we perform similar analyses based on customer A's bargaining power and supplier Y's financial constraints, respectively. Specifically, in Panel B, we capture customer A's bargaining power over supplier Y using the average dependence of customers A on supplier Y. That is, for each supplier Y - customer A pair, we calculate the ratio of pair-level sales to A's cost of goods sold in the year prior to *QuickPay*. We then take the mean of the pair-level dependence measures across all customers A for a given Y. This aggregate measure gauges the extent to which Y could pull away trade credit from the pool of customers A, and re-allocate this credit to customer B. As predicted, we observe a greater increase in B's trade credit following *QuickPay* when rival A's bargaining power is weaker, as shown by the increasing trend of the DiD coefficients across the three terciles.

Panel C considers the extent of financial constraints faced by the common supplier. We measure financial constraints with the Size-Age (SA) Index developed by Hadlock and

Pierce (2010). Consistent with Prediction 2, when supplier Y is less financially constrained (tercile 1), there is a larger increase in customer B's trade credit following *QuickPay*; this effect decreases as Y's financial constraints tighten.

5.3 The case of separate suppliers

In our theoretical framework, we considered a contrasting case in which customer B and rival A source input from their respective suppliers – i.e., $\mathrm{Y_A}$ and $\mathrm{Y_B}$. In this case, because the supplier of B cannot cross-subsidize trade credit across its customers, it will not accommodate B's request for extra credit as generously as in the common supplier case. As a result, Prediction 3 states that the increase in B's trade credit from the separate supplier following *QuickPay* should be less significant. We now empirically examine this prediction.

Specifically, we focus on customer B's trade credit from a different set of suppliers that only serve customer B but not A – that is, the non-common suppliers $\mathrm{Y_B}$ in the model.[19] We then implement a similar analysis as in Section 5.1 to compare how customer B's trade credit from $\mathrm{Y_B}$ changes around the *QuickPay*. We again supplement this time-series difference with a second layer of cross-sectional variation by comparing $\mathrm{Y_B}$'s trade credit to control customers (other customers served by $\mathrm{Y_B}$) in the same period. As before, the credit to these control customers accounts for suppliers' overall credit provision during the event window.

Table 4 reports the results. The DiD estimator, i.e., the coefficient estimate of *Customer B* × *Post*, is not statistically distinguishable from zero in any specifications, with switching signs. Put differently, when facing the heightened threat from rival customer A, B's trade credit from non-common suppliers does not experience a significant increase. This result is consistent with Prediction 3, and it is in sharp contrast to the former common supplier setting. This contrast demonstrates that the existence of common suppliers – with the ability to cross-subsidize trade credit – is an important cornerstone of our model: It amplifies the spillover effect of government subsidies to the trade credit of B.

[19] We exclude suppliers affected by *QuickPay* used in the former stage-one analysis.

5.4 The role of product market competition

In this section, we examine the second cornerstone of our model based on Prediction 4. This prediction states that the increase in customer B's trade credit following *QuickPay* should be less pronounced when the competition between customers A and B is muted. To perform this test, we study a different set of customers C – ones that share a common supplier with customer A but do not compete with customer A in the product market. In this way, we maintain the role of the common suppliers but mute the product market competition between the two customers. This approach thus allows us to isolate the competitive force in driving the spillover effect in trade credit.

The empirical design is similar to that in Section 5.1, but swaps the common suppliers between customers A and B with the common suppliers between customers A and C. We examine these common suppliers' trade credit provision to customer C around the *QuickPay*, benchmarked against their trade credit to control customers (i.e., other customers served by these common suppliers). The choice of this benchmark again accounts for suppliers' overall credit provision over time. In this setting, the variable *Customer C* indicates whether a common supplier's trade credit is to customer C or to other control customers.

Table 5 reports the results. Consistent with Prediction 4, we do not find a significant increase in a common supplier's trade credit to customer C following the *QuickPay*. The DiD estimator, namely, the coefficient estimate of *Customer C* $\times$ *Post*, is insignificantly negative in all specifications.

Taken together, the two sets of results in Sections 5.3 and 5.4 highlight the two cornerstones underlying our theoretical framework: common suppliers who have abilities to internalize the allocation of trade credit across customers, and competing customers that have incentives to avoid feeding the mouth that bites.

6 Real effects at the firm and industry levels

In this section, we examine the implications of our findings for the real economy, at both firm and industry levels. At the firm level, *QuickPay* strengthens customer A's market position by reducing its operational cost (c_x). To the extent that customer B – sharing a common supplier Y – is able to bargain for more trade credit as a "defense" against A's growing threat, we predict that B should perform better in the product market than peers without common suppliers.

Extending this intuition to the industry level, we expect that frequent presence of common suppliers helps "level the playing field" in an industry. By re-allocating trade credit among customers, the common suppliers may absorb firm-specific shocks in part of the industry and thus balance out industry peers' market positions – akin to supplier Y partially undoing customer A's greater threat following the *QuickPay* shock and shifting its trade credit to the threatened customer B. As such, firms in industries with frequent common suppliers along the supply-chains should see less cross-sectional dispersion in product market performance. Such a shock-absorbing effect complements prior studies documenting that supply chain instability can intensify customers' operational risks and amplify downstream market shocks.

6.1 The firm level analysis

We start with testing the firm level prediction. For each customer B in Illustration 2 (the rival of customer A sharing the common supplier Y), we identify customers that likewise compete with A (in the same 4-digit SIC industry) but do not share common suppliers. These customers serve as the controls; by contrasting their performance with that of customer B around *QuickPay*, we can analyze whether customer B benefits from the common supplier's provision of extra trade credit.[20]

We examine each customer's sales growth and Tobin's Q to capture its market position and firm value, respectively. Sales growth is defined as the annual percentage change in a firm's sales, a common proxy for product market strength (see, e.g., Campello (2003, 2006) and Fresard (2010)). Tobin's Q, measured as a firm's market value of assets to the book value of assets, captures the overall growth potential and market value of a publicly traded company.

Figure 5 plots customer B's sales growth and Tobin's Q around *QuickPay*, relative to the controls. The figure is obtained by estimating a dynamic DiD model similar to Figure 2 and Figure 3, in which the dependent variables are sales growth (Panel A) and Tobin's Q (Panel B), respectively. Each point corresponds to a yearly DiD estimator and the surrounding bars correspond to the two-sided 90% confidence intervals.

For both measures, we observe that customer B begins to perform significantly better than the controls from approximately one year following the passage of *QuickPay* (i.e., year 2012). This lagged effect is sensible given that the extra trade credit obtained by customer B (as shown in Figure 3) might take time to affect B's product market outcomes. Once the effect is in place, the better performance persists for at least three years.

Table 8 presents the results of the DiD model. The dependent variables are sales growth (columns (1) and (2)) and Tobin's Q (columns (3) and (4)). The independent variable of interest is the interaction between *Customer B* – an indicator for customer B versus the control customers, and *Post* – an indicator for observations after *QuickPay*. Its coefficient indicates whether customer B, being able to obtain extra trade credit from the common supplier, performs better than the control customers that lack the ability to pull additional trade credit. Here the pre-event period consists of three years prior to *QuickPay* (2008, 2009, and 2010), and the post-event period consists of 2012-2014 (omitting 2011) to account for the lagged effect as seen in Figure 5.

[20] The inclusion of industry by year fixed effects in our estimations effectively adjusts for time-varying trends in these two performance measures (Gormley and Matsa (2014)).

Consistent with our prediction, the positive coefficients of *Customer B* $\times$ *Post* suggest that customer B benefits from the common suppliers' extra trade credit provision. The economic magnitude of this result is sizable: Customer B enjoys an increase of 0.092 sale growth (53.5% of the sample mean) following *QuickPay*, relative to the control customers. Similarly, customer B enjoys an increase of 0.181 Tobin's Q (8.88% of the sample mean) than does the control.

6.2 The industry level analysis

We next examine the industry level real effects. For each industry, we calculate (1) the number of sample firms that share at least one common supplier (*No. firms sharing*) and (2) the number of sample firms a shared supplier serves (*No. firms served*). We have reported the cross-industry averages of these two measures over time in Figure 1. For our purpose here, they help capture how frequent the presence of common suppliers is in a given industry. Based on our prediction, we expect that industries with more common suppliers (shock absorbents) – whose "field" is better "leveled" – should see less dispersion in their firms' product market performance and market value.

To capture the dispersion of firm outcomes, we calculate the interquartile range (IQR) of sales growth and Tobin's Q among the sample firms in a given industry year – that is, the difference between the third quartile and the first quartile of the distribution of firm-level sales growth (or Tobin's Q) within an industry-year. These IQRs constitute the dependent variables of interest for the regression analyses.

The independent variable of interest is an indicator – *Freq. Common Supplier* – which equals one if an industry's fraction of firms that share at least one common supplier (i.e., *No. firms sharing* divided by the total number of firms) is above the median of its distribution across all industries in a year, and equals zero otherwise. This indicator captures whether an industry has frequent presence of common suppliers relative to others.

Table 8 reports the results for the industry IQRs (dispersion) for sales growth (columns

(1) and (2)) and Tobin's Q (columns (3) and (4)). The IQRs are calculated one-year ahead of when the dependent variable (*Freq. Common Supplier*) is measured. Our results are robust to IQRs calculated two- or three-years ahead. The significant and negative coefficients of *Freq. Common Supplier* suggest that industries with frequent presence of common suppliers see a smaller dispersion of product market performance and market value than those with fewer common suppliers. The economic magnitude of this effect is again sizable, given that the mean of sales growth IQR and Tobin's Q IQR are 0.230 and 0.784, respectively. Overall, the suggestive evidence in this section reveals that the presence of common suppliers can act as a moderator on firm-specific shocks and level the playing field in an industry segment.

7 Robustness tests

7.1 Differentiating the direct and indirect effects following Berg et al. (2021)

Our results so far show that customer B's trade credit from the common supplier Y significantly increases following *QuickPay*. This effect reflects B's incentive to combat the growing threat from rival A, which now enjoys lowered production costs. As discussed in Berg et al. (2021), the estimated effect may blend in a direct effect of *QuickPay* and an indirect effect – arising from customer B's peers in both the treated and control groups. Specifically, within the treated group, as more customers of supplier Y become treated (like customer B), customer B itself faces less competition because its product market peers are collectively weakened by the stronger rival A. Such dampened competition, namely, the "treated group effect," mitigates customer B's urgency in demanding extra trade credit.[21] On the other hand, when more firms become treated and weakened, the control group (i.e., supplier Y's other non-B customers that compete for the same input and trade credit from Y) grows

[21] Furthermore, when more customers of supplier Y become treated, they will each get a smaller allocation of extra trade credit because the common supplier Y can only pull limited credit from customer A to accommodate the higher demand.

relatively stronger. This effect, namely, the "control group effect," makes customer B more eager to obtain extra trade credit to defend its market position.

The "treated group effect" and "control group effect" are both indirect effects of *QuickPay*, and they generate opposite predictions on how customer B's trade credit should move. We disentangle these effects by estimating the following model as in Berg et al. (2021):

$$\begin{aligned}\Delta TC_{s,c} &= \beta_0 + \beta_1 CustomerB_{s,c} + \beta_T \times \bar{d}_s \times CustomerB_{s,c} \\ &+ \beta_C \times \bar{d}_s \times (1 - CustomerB_{s,c}) + \epsilon_{s,c}.\end{aligned} \tag{21}$$

Equation (21) is a modification of our main DiD model (Equation (20)) to suit the specifications in Berg et al. (2021). For each common supplier (Y)-customer pair, the dependent variable is the customer's trade credit *change* from the pre-*QuickPay* period to the post period. Therefore, this equation performs a cross-sectional estimation in lieu of the previous panel regression. Here each common supplier s defines the group, and c denotes a customer of a given supplier. $\bar{d}_s$ is the fraction of treated customers of the supplier, that is, the fraction of the supplier's customers that are customers B, sharing the common supplier s with the rival A. As before, $CustomerB$ is an indicator for whether a customer is treated (a customer B) or not. In this equation, β_1 captures the direct effect of *QuickPay* on customer B's trade credit. β_T captures the "treated group effect" and β_C captures the "control group effect". Berg et al. (2021) provide detailed theoretical grounds for the interpretation of these coefficients. We present the estimation results in Appendix D.2 and visualize the direct and indirect effects in Figure 6.

Figure 6 plots customer B's trade credit as a function of the treatment intensity ($\bar{d}_s$) using the estimated coefficients β_0, β_1, β_T, and β_C. For ease of reference, these coefficients are tabulated immediately below the figure. Following Berg et al. (2021), the $E[\Delta TC_B|\bar{d}_s]$ line represents the function for the treated units, the $E[\Delta TC_{non-B}|\bar{d}_s]$ line represents the control units, and $E[\Delta TC_{avg}|\bar{d}_s]$ line represents the group-level averages.

The coefficient β_1 is 0.221, indicating that the direct effect of *QuickPay* is larger than our baseline estimate in Table 3. This direct effect is indicated by the difference between lines for the treated ($E[\Delta TC_B|\bar{d}_s]$) and control units ($E[\Delta TC_{non-B}|\bar{d}_s]$) at $\bar{d}_s = 0$. Consistent with the above intuition, we observe that the "treated group effect" has a negative effect on customer B's trade credit, as indicated by the coefficient β_T. The "control group effect," captured by β_C, has a positive effect. Given these opposite effects, the $E[\Delta TC_{avg}|\bar{d}_s]$ line, which provides the aggregate effect if all groups are treated with an intensity of $\bar{d}_s$, exhibits a hump shape. These opposite effects also explain the cross-over of treated units and control units lines – suggesting that the differences between the treated and control effects shrink as $\bar{d}_s$ increases. These interpretations are consistent with Berg et al. (2021) Fig. 2 (p. 1120).

It is worth noting that disentangling the direct and indirect effects is less relevant for our stage-one analysis. This is because in stage one, we aim to verify that accelerated government payments afford suppliers to grant more trade credit to customer A, thus reducing the customer's production cost. Regardless of whether the reduced costs arise from a direct or an indirect effect of *QuickPay*, it warrants a lowered value of the parameter c_x in our model, and thus enables us to study customer B's response in terms of trade credit in stage two.

7.2 Alternative measures

We next perform robustness tests for our baseline stage-two analysis by considering alternative definitions of rivals and exposure to the *QuickPay* reform. First, we repeat the DiD analysis of Equation (20) using expanded rival definitions. Previously in Table 3, we identify customer B (the rivals of the customer A) based on industry classification. Here we alternatively identify customer B based on whether they share high product similarity with the customer A (Hoberg and Phillips, 2016), whether these customers possess similar market dominance (i.e., industry and sales), or whether they split similar customer bases (i.e., industry and geographical distance).

Table 8 reports the results. Columns (1) and (2) define customer B as the top 20 firms with the greatest product similarity as a customer A, using Hoberg and Phillips' 10K-text-based product description measures. Columns (3) and (4) define customer B as firms in the same industry (at the 4-digit SIC level) and with similar sales (within 50-200% ex ante sales) as a customer A. Columns (5) and (6) define customer B as firms in the same industry (at the 4-digit SIC level) as and headquartered within 500 miles of a customer A. To conserve space, we only repeat the analysis of Equation (20) with firm/pair fixed effects and year fixed effects. Our Table 3 results continue to hold: The DiD estimator is significantly positive in all columns with comparable or even larger magnitudes than those in Table 3 .

Finally, in our stage-one analysis, we have used the binary variable *Affected Supplier* to capture a supplier's *QuickPay* exposure, and to examine how it redistributes the freed-up liquidity to non-government customers. We now use a continuous variable (*Affected Sales*) in lieu of the binary indicator. Specifically, *Affected Sales* is the average proportion of a supplier's sales from government contracts in 2009-2010 (the year before *QuickPay*) among its total sales. Table 9 shows that the DiD estimator for *Affected Sales* × *Post* remains positive and significant.

8 Conclusion

Product market rivals often source upstream inputs from the same set of suppliers. Because these inputs are typically sold on credit, sharing a supplier could create the incentive for customers to strategically demand trade credit in order to prevent the supplier from providing liquidity to rivals – to avoid feeding the mouth that bites. Such an incentive becomes aggravated when government subsidies strengthen certain customers' product market position, driving their rivals to more aggressively pull away the common suppliers' liquidity. Thus, the effect of government subsidies spills over to a broader set of market participants through the supply chain.

In this paper, we build a Nash bargaining model to illustrate this intuition. We predict that common suppliers, through their ability to internalize the allocation of trade credit across customers, amplify rivalry firms' incentives to avoid feeding the mouth that bites and in turn, the spillover effect of government subsidies.

Using (1) the U.S. government's *QuickPay* reform – which permanently shortened the government's payable days – to represent such government subsidies and (2) the hand-collected trade credit information between customers and common suppliers, we find empirical support for our model predictions. Following *QuickPay*, affected contractors extend more trade credit to corporate customers. In response, rivals of these corporate customers begin to extract more trade credit from the common suppliers, indicating their efforts to pull away these suppliers' liquidity from the customers already benefiting from *QuickPay*. In contrast, we do not observe this effect among the non-rivals of affected customers, or when the rivals do not share common suppliers with the *QuickPay*-benefiting customers. Overall, our paper identify an under-explored channel – the sharing of common suppliers – through which trade credit policies spill over among firms operating in the same product market.

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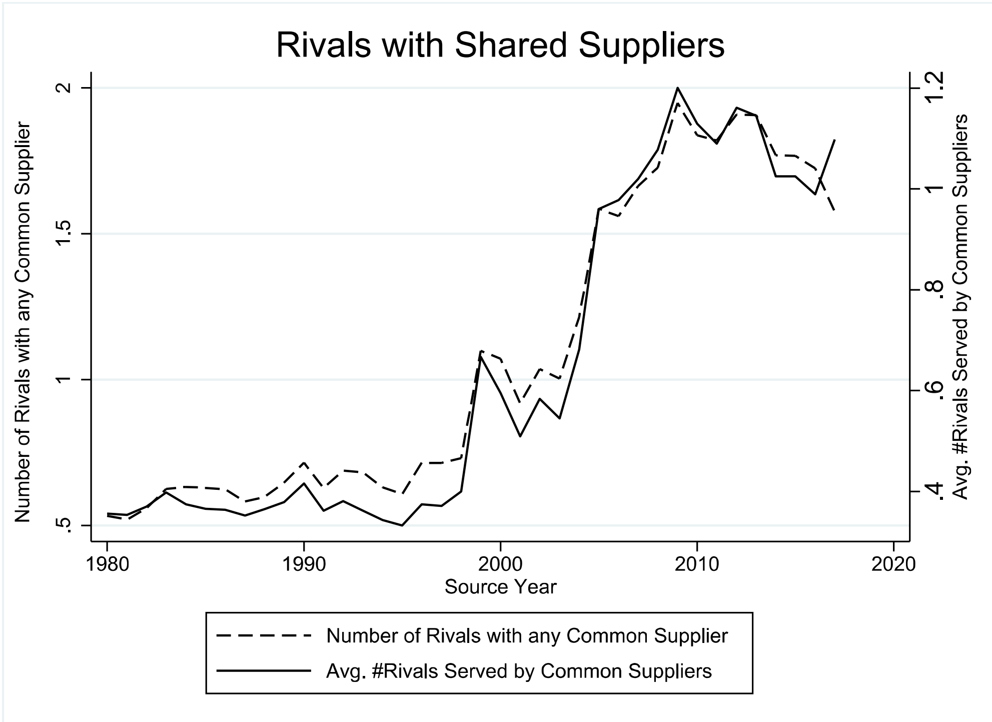


Figure 1. Number of Rival Customers Sharing Common Suppliers Over Time. This figure plots the time trend of the average number of rivals that share at least one common supplier (the left y-axis), as well as the average number of rivals a shared supplier serves (the right y-axis). To draw the dashed line, we first count the total number of same-industry rivals that share at least one common supplier with a customer in a given year, and then take average of this variable across all customers in that year. To draw the solid line, we first identify all suppliers of a given customer in a year. Then, for each such supplier, we count the number of same-industry rivals this supplier is serving in the year and average across all suppliers. Lastly, we average this variable across all customers in that year.

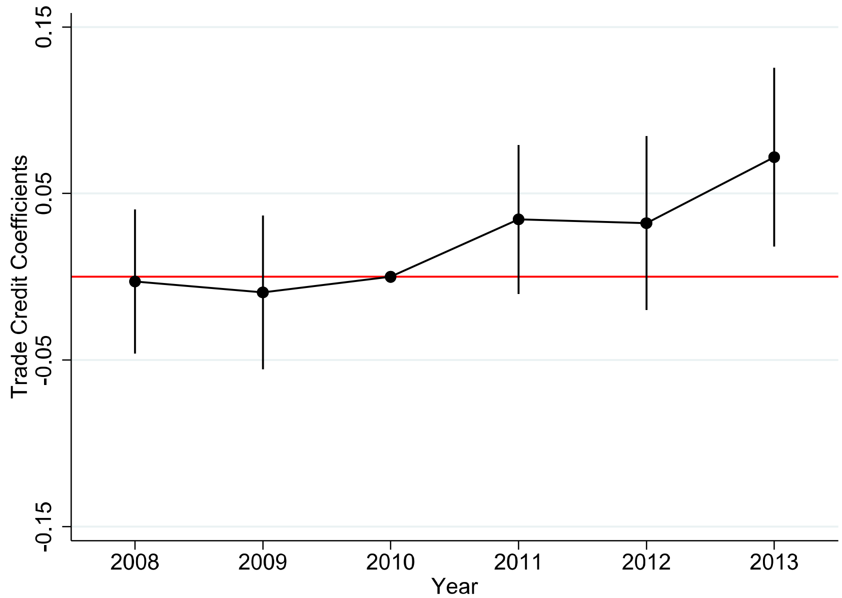


Figure 2. Trade Credit from Affected vs. Unaffected Suppliers by Year This figure plots yearly DiD estimators from Equation 4, a dynamic difference-in-differences regression around the enactment of *QuickPay*. It shows, on a yearly basis, the differential trade credit extended by suppliers affected by *QuickPay* vs. the trade credit extended by suppliers not affected by *QuickPay* to the same set of customers. The specification incorporates pair and year fixed effects along with controls following column (6) of Table 2, except the *Post* indicator is replaced with indicators for year. 2010 is the omitted interaction year. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. The two-sided 90% confidence intervals are plotted.

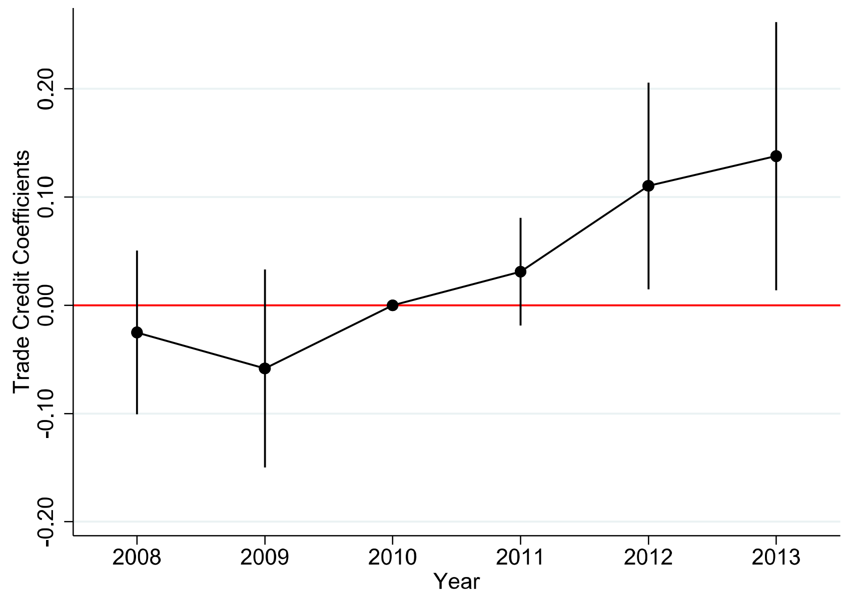


Figure 3. Trade Credit Received by Customer B vs Non-Customer B by Year This figure plots yearly DiD estimators from a dynamic difference-in-differences regression based on an expanded version of Equation (20). Coefficients show, on a yearly basis, the differential trade credit extended to customer B by common supplier Y vs. trade credit extended by the common supplier to all other customers. The specification incorporates pair and year fixed effects along with controls following column (6) of Table 3, except that the *Post* indicator is replaced with indicators for year. 2010 is the omitted interaction year. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. The two-sided 90% confidence intervals are plotted.

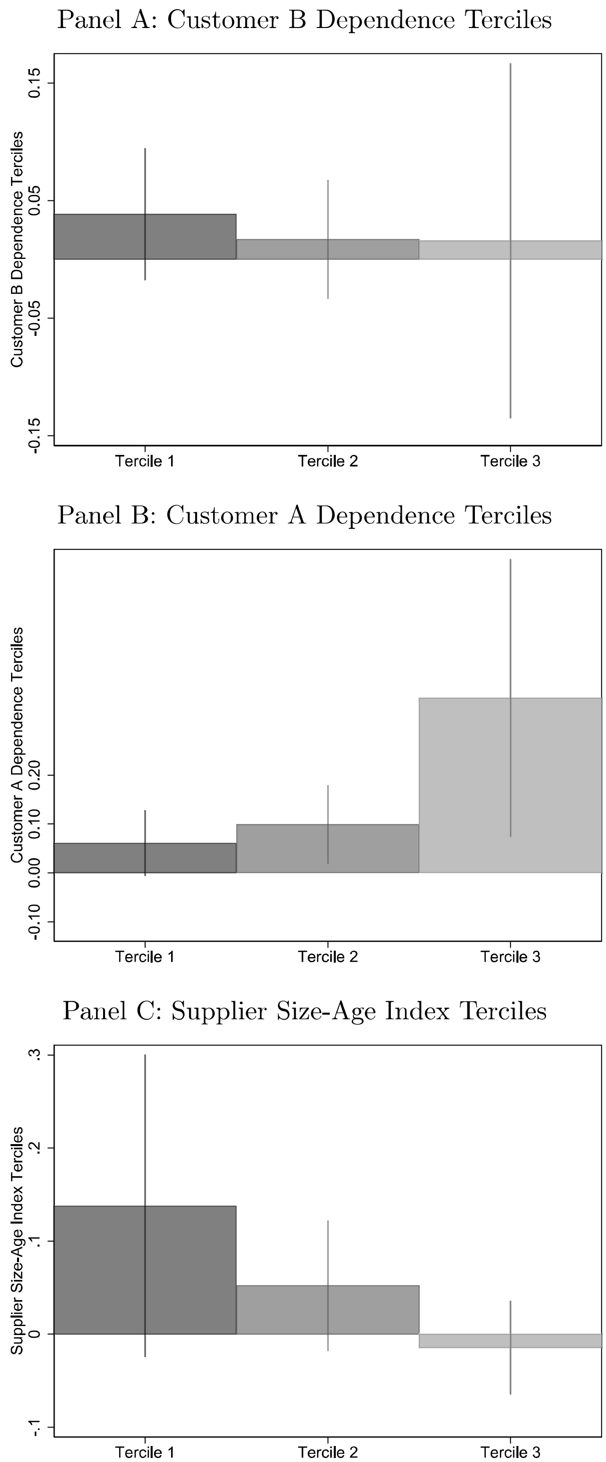


Figure 4. Cross-sectional Variation in Stage-Two Analysis This figure plots the coefficient estimates of *Customer B* × *Post* for each tercile of the subsample tests for the stage-two analysis. Panel A splits the sample by customer B's dependence on common supplier Y, proxied by the ratio of pair-level sales to customerB's cost of goods sold in the year prior to *QuickPay*. Panel B splits the sample by customer A's dependence on supplier Y, proxied by the ratio of pair-level sales to customer A's cost of goods sold in the year prior to *QuickPay*. Panel C splits the sample by the extent of supplier Y's financial constraints, using terciles of Hadlock and Pierce's (2010) Size-Age Index. The two-sided 90% confidence intervals are displayed, computed from standard errors clustered by customer. Regressions include customer and year fixed effects.

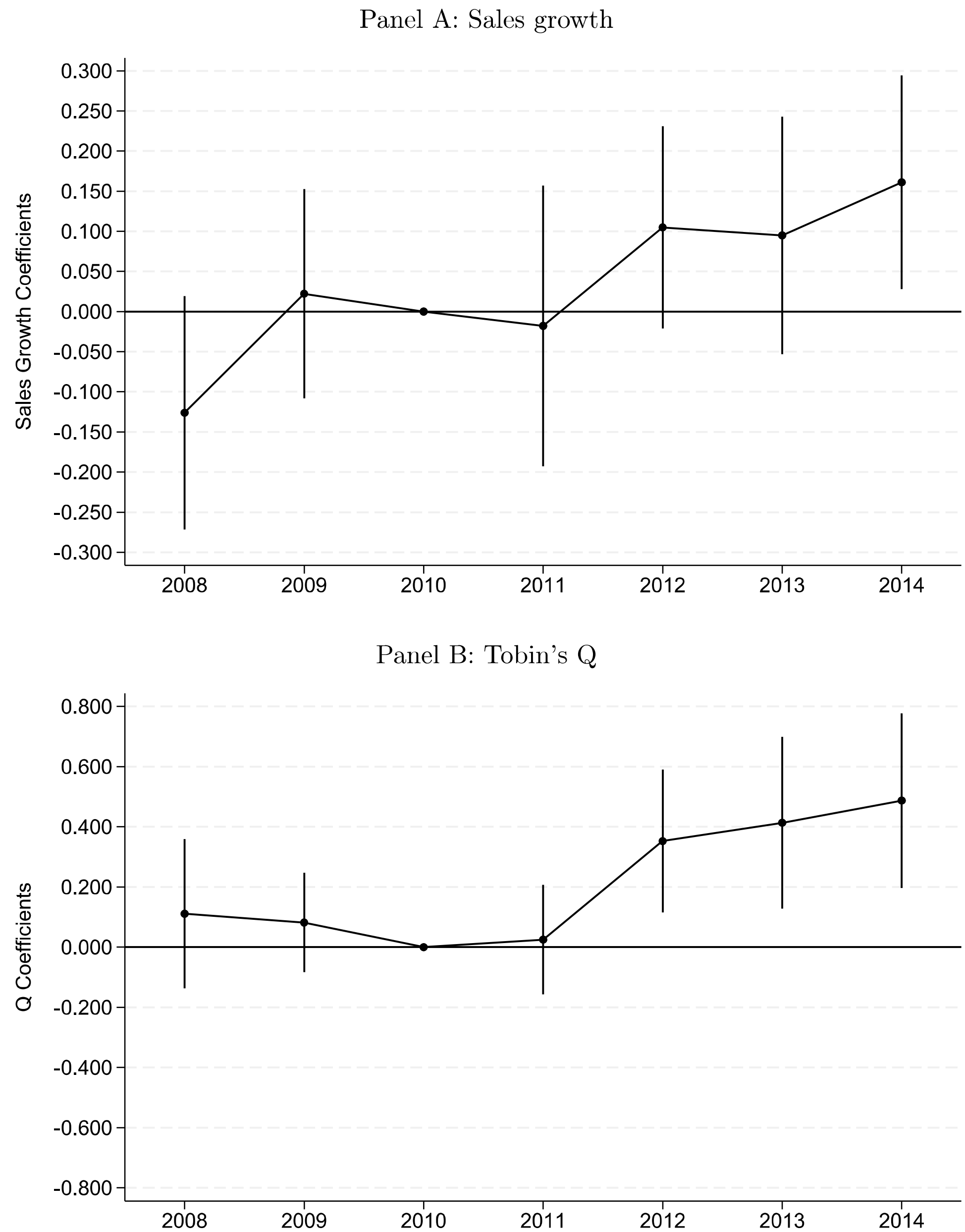
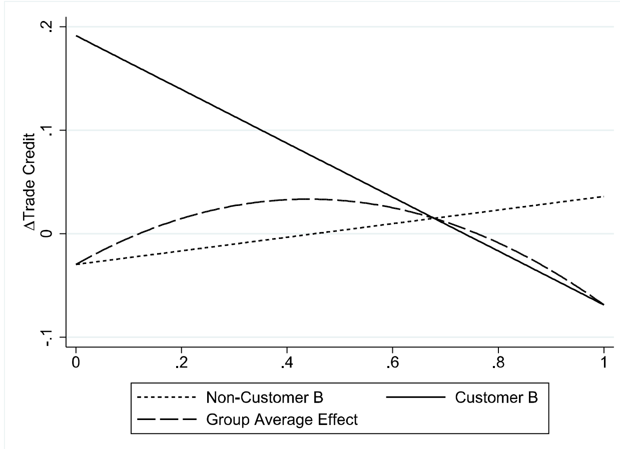


Figure 5. Dynamics of Firm-level Outcomes Around *QuickPay* This figure plots yearly DiD estimators by estimating a dynamic difference-in-differences regression around the enactment of QuickPay, in a similar way as in Figure 3. It shows, on a yearly basis, the sales growth and Tobin's Q of customer B vs. the control customers. 2010 is the omitted interaction year. In Panel A, the dependent variable of the regression is sales growth, the annual percentage change in sales from the previous year. In Panel B, dependent variable Tobin's Q, the market-to-book ratio of the firm's equity. The two-sided 90% confidence intervals are plotted.

Trade Credit to Supplier Y's Customers as a Function of $\bar{d}_s$



Variable:	β_0	β_1	β_T	β_C
	-0.030	0.221*	-0.260	0.066
	(-0.67)	(1.82)	(-1.31)	(0.59)

Figure 6. Direct and Indirect Effects of *QuickPay*. This figure disentangles the direct and indirect effects of *QuickPay* following Berg et al. (2021), by reporting its effects for customer B (the treated group), non-B (the control group), and the group average, plotted as a function of $\bar{d}_s$, the proportion of a supplier Y's pre-*QuickPay* customers classified as customer B. The customer B, i.e., the treated units line, is plotted based on the equation: $E[\Delta TC_B|\bar{d}_s] = \beta_0 + \beta_1 + \beta_T \bar{d}_s$. The non-customer B, i.e., the control units line is based on the equation: $E[\Delta TC_{non-B}|\bar{d}_s] = \beta_0 + \beta_C \bar{d}_s$. The group-average line is based on the equation: $E[\Delta TC_{avg}|\bar{d}_s] = \beta_0 + (\beta_1 - \beta_C)\bar{d}_s + (\beta_T - \beta_C)\bar{d}_s^{\,2}$. The coefficient estimates (t-statistics) are from Equation (21) and reported below the figure.

Table 1. Summary Statistics

This table reports summary statistics of the key variables in the study. The sample is based on firms in the Compustat Segment database with available information regarding customer-supplier level trade credit. The sample spans 2008-2013. Panel A reports summary statistics for the sample of the stage-one analysis, and Panel B reports summary statistics for the sample of the stage-two analysis. *Trade Credit* is the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. In Panel A, *Affected Supplier* is an indicator that equals one for pairs involving a supplier that is a government contractor eligible for *QuickPay* in either 2009 or 2010 (i.e., supplier X in Illustration 2), and equals zero for pairs involving a non-affected control pair. *Affected Sales* is the ratio of a supplier's government contract sales eligible for *QuickPay* to total supplier sales, averaged across 2009 and 2010. In Panel B, *Customer B* is an indicator that equals one for pairs involving a rival customer (same-industry customer) of an affected customer (i.e., a customer with at least one affected supplier in 2009 or 2010), and equals zero for pairs involving these suppliers' other customers. *Post* is an indicator for a year after the enactment of *QuickPay* (2011-2013). The unit of observation is a customer-supplier-pair-year. Other variable definitions are available in Appendix D.1. All control variables are winsorized at the 1st and 99th percentiles.

Panel A: Stage-One Sample Summary Statistics

Variable	Observations	Mean	SD	25pctl	Median	75pctl
***QuickPay* Measures**						
Post	1,577	0.477				
Affected Supplier	1,577	0.195	0.397			
Affected Sales	1,445	0.002	0.030	0.000	0.000	0.000
Pair-Level Characteristics						
Trade Credit	1,577	0.178	0.176	0.086	0.134	0.212
Sales Dependence	1,577	0.238	0.190	0.120	0.180	0.270
Relationship Length	1,577	1.725	0.862	1.099	1.792	2.398
Supplier (X) Characteristics						
Size	1,577	5.711	1.945	4.375	5.627	6.913
Leverage	1,577	0.176	0.212	0.000	0.108	0.283
Profitability	1,577	0.020	0.245	-0.018	0.093	0.145
R&D Intensity	1,577	0.116	0.163	0.003	0.068	0.157
Q	1,577	2.074	1.678	1.119	1.539	2.342
Tangibility	1,577	0.148	0.158	0.041	0.100	0.198
HHI	1,577	0.147	0.154	0.051	0.087	0.178
Customer (A) Characteristics						
Size	1,577	10.792	1.355	9.966	10.844	12.004
Leverage	1,577	0.234	0.152	0.120	0.203	0.277
Profitability	1,577	0.126	0.062	0.083	0.122	0.164
R&D Intensity	1,577	0.028	0.040	0.000	0.004	0.043
Q	1,577	1.522	0.547	1.131	1.417	1.732
Tangibility	1,577	0.225	0.199	0.064	0.137	0.367
HHI	1,577	0.229	0.182	0.084	0.174	0.321

Panel B: Stage-two Sample Summary Statistics

Variable	Observations	Mean	SD	25pctl	Median	75pctl
***QuickPay* Measures**						
Post	506	0.464				
Customer B	506	0.281				
Pair-Level Characteristics						
Trade Credit	506	0.180	0.184	0.082	0.135	0.229
Sales Dependence	506	0.234	0.195	0.120	0.170	0.260
Relationship Length	506	1.718	0.800	1.099	1.792	2.303
Supplier (Y) Characteristics						
Size	506	5.324	1.727	4.201	5.553	6.542
Leverage	506	0.179	0.221	0.000	0.094	0.286
Profitability	506	0.008	0.249	-0.066	0.102	0.157
R&D Intensity	506	0.138	0.193	0.000	0.077	0.184
Q	506	2.114	1.606	1.171	1.557	2.462
Tangibility	506	0.205	0.228	0.049	0.128	0.228
HHI	506	0.108	0.084	0.050	0.082	0.135
Customer (B) Characteristics						
Size	506	10.298	1.750	9.213	10.489	11.650
Leverage	506	0.247	0.165	0.135	0.212	0.332
Profitability	506	0.134	0.073	0.090	0.126	0.167
R&D Intensity	506	0.037	0.047	0.000	0.020	0.056
Q	506	1.558	0.684	1.096	1.353	1.765
Tangibility	506	0.248	0.187	0.098	0.188	0.360
HHI	506	0.158	0.158	0.057	0.093	0.188

Table 2. The Redistribution of Supplier Liquidity Following *QuickPay*

This table shows the effect of *QuickPay* on trade credit offered to corporate customers. The sample is limited to customers with at least one affected supplier. *Post* is an indicator for the three-year period after the enactment of *QuickPay* (i.e., years 2011-2013). *Affected Supplier* is an indicator for a supplier being a government contractor eligible for *QuickPay* in either 2009 or 2010, and is individually subsumed by fixed effects. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size*, *Leverage*, *Profitability*, *R&D Intensity*, *Q*, *Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.: *Trade Credit*	(1)	(2)	(3)	(4)	(5)	(6)
Affected Supplier × *Post*	0.039*	0.043**	0.044**	0.038*	0.041**	0.044**
	(1.94)	(2.32)	(2.20)	(1.90)	(2.19)	(2.14)
Post	0.001	0.005	0.011			
	(0.07)	(0.48)	(0.90)			
Sales Dependence		-0.125	-0.166		-0.127	-0.166
		(-1.12)	(-1.17)		(-1.14)	(-1.18)
Relationship Length		-0.028*	-0.056**		-0.031*	-0.075**
		(-1.86)	(-1.99)		(-1.98)	(-2.16)
S Size		0.009	0.009		0.011	0.011
		(0.51)	(0.46)		(0.65)	(0.54)
S Leverage		-0.035	-0.038		-0.028	-0.029
		(-0.57)	(-0.59)		(-0.47)	(-0.46)
S Profitability		-0.128	-0.100		-0.126	-0.095
		(-1.50)	(-1.35)		(-1.51)	(-1.34)
S R&D Intensity		-0.163	-0.113		-0.152	-0.092
		(-1.53)	(-1.41)		(-1.42)	(-1.20)
S Q		0.004	0.005		0.004	0.004
		(0.59)	(0.66)		(0.55)	(0.54)
S HHI		-0.009	0.002		-0.027	-0.024
		(-0.10)	(0.02)		(-0.29)	(-0.25)
S Tangibility		-0.169	-0.158		-0.169	-0.149
		(-1.60)	(-1.52)		(-1.60)	(-1.50)
C Size		-0.033	-0.016		-0.032	-0.019
		(-1.23)	(-0.57)		(-1.18)	(-0.66)
C Leverage		0.098	0.127		0.118	0.158
		(0.95)	(1.20)		(1.14)	(1.48)
C Profitability		0.226	0.196		0.256	0.246
		(1.47)	(1.31)		(1.59)	(1.61)
C R&D Intensity		-0.525	-0.772		-0.423	-0.598
		(-0.67)	(-0.93)		(-0.57)	(-0.77)
C Q		0.020	0.021		0.020	0.015
		(1.33)	(1.27)		(1.24)	(0.85)
C HHI		-0.071	-0.147		-0.046	-0.099
		(-0.56)	(-1.01)		(-0.35)	(-0.65)
C Tangibility		-0.052	-0.026		-0.031	0.016
		(-0.34)	(-0.15)		(-0.20)	(0.09)
Supplier FE	Yes	Yes		Yes	Yes	
Customer FE	Yes	Yes		Yes	Yes	
Pair FE			Yes			Yes
Year FE				Yes	Yes	Yes
R^2	0.478	0.488	0.523	0.477	0.488	0.525
Observations	1,483	1,483	1,398	1,483	1,483	1,398

Table 3. The Spillover Effect of *QuickPay*

This table shows the spillover effects of *QuickPay* to customers B (in Illustration 2), which are product market competitors of customers affected by *QuickPay* (customer A). *Customer B* is an indicator that equals one for a customer B, and zero for other customers served by common supplier Y. It is absorbed by the included fixed effects. *Post* is an indicator for a year after the enactment of *QuickPay*. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size, Leverage, Profitability, R&D Intensity, Q, Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.: *Trade Credit*	(1)	(2)	(3)	(4)	(5)	(6)
Customer B × *Post*	0.071**	0.089***	0.100***	0.063**	0.083***	0.097***
	(2.17)	(2.89)	(3.04)	(2.01)	(2.67)	(2.87)
Post	-0.007	-0.006	-0.004			
	(-0.38)	(-0.29)	(-0.17)			
Sales Dependence		-0.250	-0.287		-0.244	-0.280
		(-1.41)	(-1.56)		(-1.36)	(-1.53)
Relationship Length		-0.017	-0.035		-0.020	-0.052
		(-0.32)	(-0.62)		(-0.28)	(-0.63)
S Size		-0.034	-0.033		-0.031	-0.033
		(-1.20)	(-1.17)		(-1.18)	(-1.21)
S Leverage		-0.031	-0.045		-0.031	-0.045
		(-0.25)	(-0.35)		(-0.23)	(-0.33)
S Profitability		-0.306	-0.300		-0.287	-0.278
		(-1.58)	(-1.57)		(-1.54)	(-1.52)
S R&D Intensity		-0.359**	-0.352**		-0.322*	-0.315*
		(-2.05)	(-2.03)		(-1.84)	(-1.80)
S Q		0.011	0.011		0.011	0.011
		(0.84)	(0.87)		(0.85)	(0.86)
S HHI		-0.120	-0.189		-0.146	-0.208
		(-0.41)	(-0.62)		(-0.56)	(-0.76)
S Tangibility		-0.072	-0.073		-0.068	-0.066
		(-0.54)	(-0.54)		(-0.59)	(-0.57)
C Size		-0.024	-0.016		-0.020	-0.013
		(-0.63)	(-0.41)		(-0.52)	(-0.33)
C Leverage		0.141	0.136		0.154	0.159
		(1.18)	(1.09)		(1.36)	(1.34)
C Profitability		-0.147	-0.264		-0.080	-0.192
		(-0.91)	(-1.41)		(-0.46)	(-1.04)
C R&D Intensity		-0.772	-0.939		-0.741	-0.893
		(-0.97)	(-1.22)		(-0.92)	(-1.16)
C Q		0.055	0.058		0.050	0.050
		(1.38)	(1.44)		(1.13)	(1.10)
C HHI		-0.010	-0.016		0.026	0.012
		(-0.04)	(-0.07)		(0.12)	(0.06)
C Tangibility		-0.207	-0.154		-0.173	-0.112
		(-0.70)	(-0.52)		(-0.62)	(-0.39)
Supplier FE	Yes	Yes		Yes	Yes	
Customer FE	Yes	Yes		Yes	Yes	
Pair FE			Yes			Yes
Year FE				Yes	Yes	Yes
R^2	0.177	0.214	0.326	0.180	0.206	0.321
Observations	462	462	442	462	462	442

Table 4. Falsification Test – Non-Common Suppliers

This table shows a falsification test examining trade credit extended to customer B from suppliers not shared with customer A. These non-common suppliers are not affected by *QuickPay* and not selling to both customers A and B. *Customer B* is an indicator that equals one for a customer B, and zero for other customers served by the non-common suppliers. *Post* is an indicator for a year after the enactment of *QuickPay*. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size*, *Leverage*, *Profitability*, *R&D Intensity*, *Q*, *Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep.Var.: *Trade Credit*	(1)	(2)	(3)	(4)	(5)	(6)
Customer B × *Post*	0.018	0.012	0.004	0.016	0.005	-0.003
	(0.42)	(0.24)	(0.07)	(0.39)	(0.11)	(-0.07)
Post	-0.008	-0.014	-0.012			
	(-0.42)	(-0.49)	(-0.40)			
Controls		Yes	Yes	Yes		Yes
Supplier FE	Yes	Yes		Yes	Yes	
Customer FE	Yes	Yes		Yes	Yes	
Pair FE			Yes			Yes
Year FE				Yes	Yes	Yes
R^2	0.400	0.373	0.564	0.386	0.356	0.557
Observations	361	361	355	361	361	355

Table 5. Falsification Test – Muting Competition

This table shows a falsification test examining trade credit extended to non-rival customer C from suppliers shared with customer A. These common suppliers are not affected by *QuickPay* but sell to both customers A and C. *Customer C* is an indicator that equals one for a customer C, and zero for other customers served by the common suppliers of A and C. *Post* is an indicator for a year after the enactment of *QuickPay*. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size*, *Leverage*, *Profitability*, *R&D Intensity*, *Q*, *Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep.Var.: *Trade Credit*	(1)	(2)	(3)	(4)	(5)	(6)
Customer C × *Post*	-0.037	-0.020	-0.019	-0.041	-0.021	-0.021
	(-0.60)	(-0.25)	(-0.25)	(-0.66)	(-0.27)	(-0.26)
Post	-0.026	-0.005	-0.005			
	(-1.09)	(-0.33)	(-0.31)			
Controls		Yes	Yes	Yes		Yes
Supplier FE	Yes	Yes		Yes	Yes	
Customer FE	Yes	Yes		Yes	Yes	
Pair FE			Yes			Yes
Year FE				Yes	Yes	Yes
R^2	0.251	0.304	0.402	0.269	0.306	0.406
Observations	278	278	274	278	278	274

Table 6. Product Market Outcomes Following *QuickPay*

This table shows product market outcomes for customer B vs. control customers following *QuickPay*. Controls are those that compete with customer A but do not share common suppliers with customer A. *Customer B* is an indicator that equals one for a customer B, and zero for the controls. *Post* is an indicator for a year after the enactment of *QuickPay*. The sample period includes three years prior to *QuickPay* (2008-2010) and three years following *QuickPay* (2012-2014). The dependent variable in Columns (1) and (2) is *Sales Growth*, the annual percentage change in sales from the previous year, and the dependent variable in Columns (3) and (4) is *Tobin's Q*, the market-to-book ratio of the firm's equity. Controls include *Size, Leverage, Profitability, R&D Intensity*, *Tangibility*, and *HHI*. Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep. var.:	*Sales Growth*		*Tobin's Q*	
	(1)	(2)	(3)	(4)
Customer B × *Post*	0.123**	0.127**	0.270**	0.351**
	(2.51)	(2.33)	(2.12)	(2.42)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes		Yes	
Industry-Year FE		Yes		Yes
R^2	0.224	0.196	0.731	0.740
Observations	2,274	2,235	2,274	2,235

Table 7. Industry Dispersion

This table shows how the presence of shared suppliers affects industry-level dispersion of product market outcomes and market values. The sample is an industry-year panel spanning 1976-2017. *Freq. Common Supplier* is an indicator equal to one if the industry has a percentage of firms sharing a common supplier with a rival above the median frequency across industries in that year. The dependent variable in Columns (1) and (2) is the interquartile range (IQR) of *Sales Growth* across customers within the industry-year, while the dependent variable in Columns (3) and (4) is the IQR of *Tobin's Q* across customers within the industry-year. An industry is defined as a 4-digit SIC code. Controls, when included, are averaged across customers in the industry and include *Size, Leverage, R&D Intensity, Q, HHI, Tangibility,* and *Profitability.* Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by industry. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep. var.:	*Sales Growth IQR*		*Tobin's Q IQR*	
	(1)	(2)	(3)	(4)
Freq. Common Supplier	-0.045***	-0.036**	-0.072*	-0.066**
	(-3.08)	(-2.59)	(-1.80)	(-2.18)
Controls		Yes		Yes
Year FEs	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes
R^2	0.188	0.226	0.396	0.633
Observations	4,637	4,590	4,594	4,590

Table 8. Stage-Two Robustness: Alternative Peer Definitions

This table shows the spillover effects of *QuickPay* using alternative rival definitions. The regression setup follows that in Table 3. The definition of customer B (as in Illustration 2) varies across the table: Columns 1 and 2 define customer B as the 20 firms with the greatest product similarity to customer A, based on Hoberg and Phillips' text-based measures; Columns 3 and 4 define customer B as firms in the same industry (4-digit SIC code) and with similar revenues (50-200% ex ante revenues) as customer A; and Columns 5 and 6 define customer B as firms in the same industry (4-digit SIC code) and headquartered within 500 miles of customer A. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size*, *Leverage*, *Profitability*, *R&D Intensity*, *Q*, *Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. All other variables are defined as in Table 3. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Peer Sample:	*Top-20 in Product Similarity*		*Industry + Revenue*		*Industry + Geographic Proximity*	
Dep.Var: *Trade Credit*	(1)	(2)	(3)	(4)	(5)	(6)
Post × Rival Customer	0.105**	0.108**	0.164***	0.175***	0.117**	0.144***
	(2.35)	(2.36)	(3.34)	(3.39)	(2.45)	(2.83)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Supplier FE	Yes		Yes		Yes	
Customer FE	Yes		Yes		Yes	
Pair FE		Yes		Yes		Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.107	0.270	0.216	0.330	0.154	0.327
Observations	315	311	462	442	304	302

Table 9. Stage-One robustness: Continuous *QuickPay* Treatment

This table shows the effect of the *QuickPay* on trade credit offered to corporate customers. This table is similar to Table 2 except the treatment variable, *Affected Sales*, is defined continuously as the ex ante government contracting sales eligible for *QuickPay* as a percentage of total sales. The sample is limited to customers with at least one affected supplier. *Post* is an indicator for a year after the enactment of *QuickPay*. *Affected Sales* is averaged across 2009-2010 and is subsumed by fixed effects. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size*, *Leverage*, *Profitability*, *R&D Intensity*, *Q*, *Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. *Affected Sales* is bounded between 0 and 1 and other continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep.Var.: *Trade Credit*	(1)	(2)	(3)	(4)
Affected Sales × *Post*	0.187***	0.181**	0.204***	0.203***
	(3.00)	(2.56)	(3.32)	(2.91)
Post	0.009	0.013		
	(0.86)	(0.96)		
Controls	Yes	Yes	Yes	Yes
Supplier FE	Yes		Yes	
Customer FE	Yes		Yes	
Pair FE		Yes		Yes
Year FE			Yes	Yes
R^2	0.503	0.531	0.503	0.533
Observations	1,359	1,278	1,359	1,278

A Online Appendix: Model derivation and proof of Lemma 1

A.1 Derivation of product market equilibrium

We first compute customers' cost functions (6) and (7) in Section 2 and input functions (8) and (9). Suppose customer A plans to produce q_A units of outputs. Its cost minimization problem is:

$$\min_{(x,y_A)} c_x x + c_{y,A} y_A,$$

$$s.t.\ x^{1-\eta} y_A^{\eta} = q_A.$$

Solving this problem gives the cost function (6) of customer A and its input demand function (8). We can form a similar problem to compute customer B's cost function (7) and input demand function (9).

We next compute customer firms' optimal production decisions in the product market. Given the price function of customer A in Equation (2), customer A's profit maximization problem is given by:

$$\max_{q_A} \left[p_A q_A - k_A q_A\right] = \max_{q_A} \left[\left(\theta_A - q_A - \gamma q_B\right) q_A - k_A q_A\right]$$

$$= \max_{q_A} \left[\left(\theta_A - \gamma q_B - k_A\right) q_A - q_A^2\right]$$

Solving the first-order condition (FOC) gives:

$$q_A = \frac{\theta_A - \gamma q_B - k_A}{2}.$$

Similarly, solving customer B's profit maximization problem gives: $q_B = \frac{\theta_B - \gamma q_A - k_B}{2}$. Computing these two FOCs simultaneously gives the optimal production decision given in Equation (10).

Note that the equilibrium profit of customer A is: $\pi_A = \left(\theta - \gamma q_B - k_A\right) q_A - q_A^2$. Since the FOC implies that $\left(\theta - \gamma q_B - k_A\right) = 2q_A$, we have customer A's equilibrium profit as:

$$\pi_A = 2q_A q_A - q_A^2 = q_A^2.$$

Similarly, customer B's equilibrium profit is $\pi_B = q_B^2$.

A.2 Proof of Lemma 1

Proof. To prove Lemma 1, first note that

$$\partial \pi_A / \partial t_A = 2q_A \times \frac{\partial q_A}{\partial t_A} = 2q_A \times \frac{\partial k_A}{\partial t_A} \times \frac{-2}{4-\gamma^2}.$$

For the ease of exposition, let

$$k_A = \left[\left(\frac{1-\eta}{\eta}\right)^{\eta} + \left(\frac{\eta}{1-\eta}\right)^{1-\eta}\right] c_x^{1-\eta} c_{y,A}^{\eta} \equiv H c_x^{1-\eta} c_{y,A}^{\eta}, \text{ with}$$

$$H = \left[\left(\frac{1-\eta}{\eta}\right)^{\eta} + \left(\frac{\eta}{1-\eta}\right)^{1-\eta}\right].$$

Then, we have

$$\partial k_A/\partial t_A = H \times c_x^{1-\eta} \times \eta \times \ln(\delta_A) \times c_{y,A}^{\eta} = k_A \times \eta \times \ln(\delta_A), \text{ and}$$

$$\partial \pi_A/\partial t_A = 2q_A \times \frac{-2}{4-\gamma^2} \times k_A \times \eta \times \ln(\delta_A) = \frac{-4}{4-\gamma^2} \times \eta \times \ln(\delta_A) \times q_A \times k_A.$$

In this equation, because $\delta_A < 1$, and $\ln(\delta_A) < 0$, we have $\frac{-4}{4-\gamma^2} \times \eta \times \ln(\delta_A) > 0$. Therefore, the sign of $\partial \frac{(\partial \pi_A/\partial t_A)}{\partial c_x}$ is the same as the sign of the following derivative:

$$\partial \frac{(q_A \times k_A)}{\partial c_x} = q_A \times \partial k_A/\partial c_x + k_A \times \partial q_A/\partial c_x, \text{ where}$$

$$\partial q_A/\partial c_x = \frac{-2}{4-\gamma^2} \times \partial k_A/\partial c_x, \text{ and } \partial k_A/\partial c_x = H c_x^{-\eta} c_{y,A}^{\eta} (1-\eta) > 0.$$

After simplification, we have

$$\partial \frac{(q_A \times k_A)}{\partial c_x} = \left(q_A + k_A \times \frac{-2}{4-\gamma^2}\right) \times \partial k_A/\partial c_x.$$

The sign of this derivative, which is the sign of the original cross-derivative $\partial \frac{(\partial \pi_A/\partial t_A)}{\partial c_x}$, is determined by the sign of

$$q_A + k_A \times \frac{-2}{4-\gamma^2}.$$

Under the assumption that the effect of trade credit on customer A's profit follows the law of diminishing marginal returns, i.e.,

$$\partial \frac{(\partial \pi_A/\partial t_A)}{\partial t_A} < 0,$$

We can show that

$$\partial \frac{(\partial \pi_A/\partial t_A)}{\partial t_A} = \frac{-4\eta^2 \ln^2(\delta_A) k_A}{4-\gamma^2} \left(q_A + k_A \times \frac{-2}{4-\gamma^2}\right), \text{ where}$$

$$\frac{-4\eta^2 \ln^2(\delta_A) k_A}{4-\gamma^2} < 0.$$

Thus, we must have

$$q_A + k_A \times \frac{-2}{4-\gamma^2} > 0.$$

Given this condition is satisfied, the original cross-derivative $\partial \frac{(\partial \pi_A / \partial t_A)}{\partial c_x} > 0$. □

B Online Appendix: Cross-sectional analyses for Stage-one analysis

We examine if the stage-one results reported in Section 4 exhibit cross-sectional variation depending on the relative supplier-customer bargaining power. Inspired by recent studies, including Giannetti et al. (2021); Murfin and Njoroge (2015) and Barrot (2016), we expect that following the liquidity influx from *QuickPay*, affected suppliers are more likely to extend extra trade credit to customers with greater bargaining power. This prediction holds particularly in our case, because suppliers affected by *QuickPay* are small business contractors. Therefore, their decision to allocate the freed-up liquidity may be catered to customers with the strongest market positions.

To test this prediction, we perform a triple-differences regression analysis by augmenting Equation (18) with the triple interaction between *Affected Supplier* $\times$ *Post* and a measure of customer bargaining power over the suppliers. Specifically, for each supplier-customer pair, we calculate the customer's ex ante sales dependence on the supplier (*Dependence*), defined as pair-level sales scaled by the customers' COGS in the year prior to *QuickPay*. A higher value of this measure indicates that the customer has weaker bargaining power over its supplier.

Table A1 reports the results. As expected, the coefficient estimates of the triple-interaction term (i.e., *Affected Supplier*$\times$*Post*$\times$*Dependence*) are significantly negative, suggesting that customers heavily dependent on a supplier, or those with weaker bargaining power, do not benefit as much as ones with stronger bargaining power following the *QuickPay*. Put differently, suppliers allocate the *QuickPay* liquidity influx as extra trade credit particularly to customers with stronger bargaining power.

Table A1. Cross-Sectional Variation of the Redistribution Effect

This table shows how the effect of the *QuickPay* on trade credit varies cross-sectionally on pair-level bargaining power of the customer. The specification includes an interaction between *Affected Supplier* and ex ante customer dependence on the supplier, defined as the ratio of pair-level sales scaled by customer COGS, measured in the year prior to the enactment of *QuickPay*. The sample is limited to customers with at least one treated supplier. *Post* is an indicator for the three-year period after the enactment of *QuickPay* (i.e., years 2011-2013). *Affected Supplier* is an indicator for a supplier being a government contractor eligible for *QuickPay* in either 2009 or 2010, and is individually subsumed by fixed effects. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size*, *Leverage*, *Profitability*, *R&D Intensity*, *Q*, *Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.: *Trade Credit*	(1)	(2)	(3)	(4)
Affected Supplier × *Post* × *Dependence*	-0.475**	-0.495**	-0.406*	-0.418*
	(-2.13)	(-2.08)	(-1.77)	(-1.69)
Affected Supplier × *Post*	0.044**	0.045**	0.044**	0.044**
	(2.34)	(2.27)	(2.29)	(2.22)
Post × *Dependence*	0.086	0.087	0.071	0.067
	(1.02)	(1.03)	(0.82)	(0.77)
Affected Supplier × *Dependence*	1.294		2.920	
	(0.09)		(0.19)	
Post	0.002	0.001		
	(0.16)	(0.08)		
Dependence	5.320		4.757	
	(1.28)		(1.13)	
Controls	Yes	Yes	Yes	Yes
Supplier FE	Yes		Yes	
Customer FE	Yes		Yes	
Pair FE		Yes		Yes
Year FE			Yes	Yes
R^2	0.490	0.530	0.493	0.533
Observations	1,201	1,187	1,201	1,187

C Online Appendix: Customer A's equilibrium trade credit

Based on Section 2.2.2, Figure A1 plots the relation between c_x and customer A's equilibrium trade credit from the common supplier Y (i.e., t_A^*). Opposite to the pattern of t_B^* (the equilibrium trade credit for customer B), t_A^* decreases as c_x is lowered. As discussed in Section 2.2.2, this contrast suggests that as customer A's input cost lowers, the common supplier Y shifts trade credit allocation from A to B – and this is as if the rival B pulls trade credit away from A via their common supplier, or the act to avoid feeding the mouth that bites.

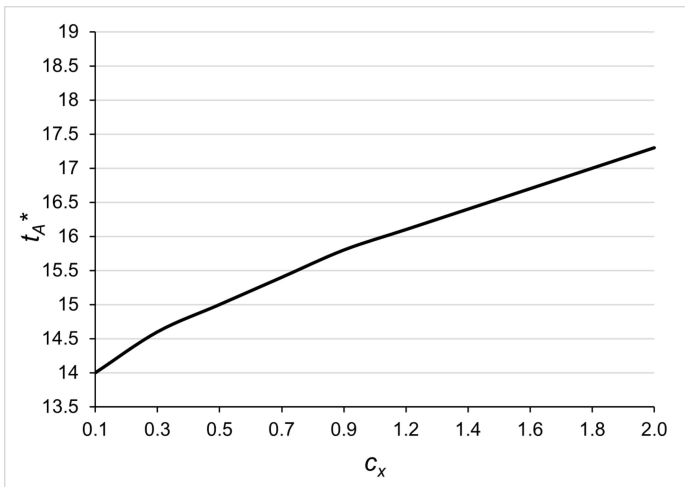


Figure A1. The optimal trade credit t_A^* as a function of c_x. Parameter values are $\theta_A = \theta_B = 10, \eta = 0.5, \gamma = 0.9, \alpha_A = \alpha_B = 0.5, \phi_A = \phi_B = \phi_Y = 0.1, \bar{c}_y = c_z = 1$.

To empirically test this pattern, we follow the same method as in Section 5.1, Equation (18), and Table 3, but replace the object of interest by customer A. That is, we compare how the common supplier Y's trade credit to customer A changes after *QuickPay*, benchmarked against the trade credit provided by Y to control (non-A) customers.

Table A2 reports the results. We observe that opposite to Table 3, the DiD estimator, *Customer B* $\times$*Post*, bear negative coefficients, indicating that following *QuickPay*, trade credit from the common suppliers Y to customer A decreases. This effect is consistent with the theoretical prediction in Figure A1.

Table A2. Trade Credit to Customer A vs. Supplier Y's Other Customers After *QuickPay*
This table shows how trade credit extended by supplier Y to customer A (as in Illustration 2) changes after *QuickPay*. *Customer A* is an indicator that equals one for a customer A, and zero for other customers served by the supplier Y. It is absorbed by the included fixed effects. *Post* is an indicator for a year after the enactment of *QuickPay*. The dependent variable is *Trade Credit*, the amount of trade credit offered by a supplier to an individual customer, scaled by the sales between the two. Controls include *Size, Leverage, Profitability, R&D Intensity, Q*, *Tangibility*, and *HHI* for both the customer and supplier, as well as pair-level *Relationship Length* and *Sales Dependence*. Variable definitions are available in Appendix D.1. Continuous variables are winsorized at the 1st and 99th percentiles. t-statistics are shown in parentheses, calculated from standard errors clustered by supplier firm and customer firm. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Customer A × *Post*	-0.049*	-0.074**	-0.082**	-0.041	-0.068*	-0.078**
	(-1.72)	(-2.09)	(-2.17)	(-1.54)	(-1.94)	(-2.05)
Post	0.045	0.068*	0.079*			
	(1.18)	(1.71)	(1.90)			
Controls			Yes	Yes	Yes	Yes
Supplier FE	Yes	Yes		Yes	Yes	
Customer FE	Yes	Yes		Yes	Yes	
Pair FE			Yes			Yes
Year FE				Yes	Yes	Yes
R^2	0.173	0.211	0.323	0.177	0.203	0.318
Observations	462	462	442	462	462	442

D Online Appendix: Additional tables

D.1 Variable Definitions

Variable	Definition
Trade Credit	Pair-level receivables scaled by pair-level sales
Sales Dependence	Sales to customer as a proportion of total supplier sales
Relationship Length	Logarithm of the number of years since the supplier first reported the customer as a major customer
Size	Logarithm of total assets
Leverage	Short-term debt+long-term debt, scaled by total assets
Profit	Operating income before depreciation scaled by total assets
R&D Intensity	R&D expenditures (set equal to zero when missing) scaled by total assets
Q	Tobin's Q, defined as (market cap+total book assets-book equity)/total book assets
HHI	Industry concentration
Tangibility	Plant, property, and equipment scaled by total assets
Dependence	Pair-level sales scaled by the customers COGS, measured in the year prior to *QuickPay* (2010)
Size-Age Index	The size-age financial constraint metric, measured in the year prior to *QuickPay* (2010), following Hadlock and Pierce (2010)

D.2 The direct and indirect effects

Table A3. Direct and Indirect Effects of *QuickPay*.
This table reports results that disentangle the direct and indirect effects of *QuickPay* on customer B's trade credit, prescribed by Berg et al. (2021) and follows Equation (21). The unit of observation is a common supplier (Y)-customer pair and the dependent variable is the change in a customer's trade credit after *QuickPay*, defined as the difference in the average trade credit in the post-*QuickPay* period and the average in the pre-*QuickPay* period. A group s is defined by a common supplier's group of customers prior to *QuickPay*. *Customer B* is an indicator that equals one for a customer B (the treated customer), and zero for other customers served by a given common supplier. $\bar{d}_s$ is the proportion of the group that is treated (i.e., that is a *Customer B*). t-statistics are shown in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Variable	Estimates	Coefficient label for Figure 5
Customer B	0.221*	β_1
	(1.82)	
$\bar{d}_s$ × *Customer B*	-0.260	β_T
	(-1.31)	
$\bar{d}_s$ × *(1-Customer B)*	0.066	β_C
	(0.59)	
Constant	-0.030	β_0
	(-0.67)	
R^2	0.015	
Observations	69	