Discussion Paper Series

RIEB

Kobe University

DP2023-15

Destination Trade Credit and Exports: Evidence from Cross-Country Panel Data

Changyuan LUO
Shuai ZENG
Laixun ZHAO

June 29, 2023

Research Institute for Economics and Business Administration
Kobe University
2-1 Rokkodai, Nada, Kobe 657-8501 JAPAN

Destination Trade Credit and Exports: Evidence from Cross-Country Panel Data

Changyuan Luo Shuai Zeng Laixun Zhao

Abstract: We examine the impact of destination trade credit (DTC) on exports, using cross-country panel data for 2000-2018 and focusing on financing by foreign trade partners. We find DTC promotes a country's exports disproportionately more in liquidity-dependent industries, a consistent result after addressing endogeneity and various robustness tests. DTC mainly promotes trade by increasing export quantity, while lowering export prices and export varieties. Further, the effect is greater if the level of financial development of the source country is lower, but smaller if the product complexity of industries becomes higher. During the 2008 global financial crisis, DTC also contributes to export expansion, but the effect is relatively small.

Keywords: informal finance; destination trade credit; exports; cash in advance; deferred payment
JEL Classification: F10, G20, G30

Please address correspondence to:
Luo: Institute of World Economy, Fudan Univerisity, China; chyluo@fudan.edu.cn.
Zeng: School of Economics, Fudan University, China; szeng18@fudan.edu.cn.
Zhao: Research Institute for Economics & Business, Kobe University, Japan; zhao@rieb.kobe-u.ac.jp.

1. Introduction

Financial development is an important determinant of a country's comparative advantage. While the existing literature mainly focuses on the linkage between formal finance and exports (Beck, 2002, 2003; Manova, 2013), informal finance as an alternative source of financing is also important. According to IMF (2009), about 60% of international transactions is settled through informal finance, including *deferred payment* and *cash in advance*. However, little is known about its impact on export activities. This paper aims to partially fill the gap, from the side of *export destinations*.

An export firm may be financed via *destination trade credit* (DTC), i.e., financing by its trading partners in the destination countries, in particular, by *cash in advance* and *deferred payment*. The route of cash in advance is relatively clear, which is provided by the importer to the exporter where partial payment is made before delivery. A typical recent example is that, in the wake of chip supply shortage, chip buyers such as Apple and Qualcomm, are expected to pay TSMC (Taiwan Semiconductor Manufacturing Co., Ltd.) NT$150 billion in advance in 2022 (about 9% of TSMC's total revenue in 2021).[1]

A more indirect way is deferred payment, which is reflected in the production process of exporters, who may need to import intermediates or capital goods. If such imports are purchased from the suppliers located in the export destination country, the suppliers may allow the exporters to defer payment. In this case, exporters are financed by their upstream trading partners in the destination country. The route of deferred payment is also reflected in the chip industry. SMIC (Semiconductor Manufacturing International Corporation) is a semiconductor foundry in China,

[1] https://money.udn.com/money/story/12950/6021414?from=edn_next_story. TSMC is one of the largest semiconductor foundries in the world. According to TSMC's annual report, the revenue in 2021 is about NT$1.59 trillion.

with a quarter of its customers located in the US.[2] Simultaneously, it also imports equipment from the US to produce chips. According to transaction information disclosed by SMIC in February 2020, it purchased equipment in the form of deferred payment from Lam Research Corporation (US), in the amount of $601 million.[3]

Given the above stylized cases, in this paper, we explore the causal effects of DTC on exports, using an identification strategy proposed by Rajan and Zingales (1998). This approach combines the cross-country variation with the cross-industry variation, similar to a difference-in-difference (DID) method. The first difference comes from DTC across countries. As detailed transaction-level data are not available for most countries in our sample, we use the Balance of Payments (BOP) containing information on cross-border deferred payment and cash in advance to construct the measure of DTC. The second difference stems from the financial vulnerability across industries, measured by the industry's dependence on short-term external liquidity.

Using the bilateral trade data provided by CEPII-BACI, we find that DTC promotes a country's exports disproportionately more in liquidity-dependent industries, and this result passes a number of robustness checks, including placebo and instrumental variable tests. We also find that DTC lowers the export prices and narrows the range of export products, and thus, the promotion effect is mainly attributed to the increase of export quantity. Further investigation reveals that the promotion effect exhibits heterogeneity: The lower the level of financial development in the source country, the greater the trade promotion, and the higher the product complexity, the smaller the trade promotion. Finally, during the 2008 global financial crisis, DTC also contributes to export expansion, but the effect appears to be relatively weak.

[2] http://www.ftchinese.com/story/001089642?archive.
[3] https://asia.tools.euroland.com/tools/Pressreleases/GetPressRelease/?ID=3700922&lang=zh-CN&companycode=cn-smi&v=. According to the disclosed purchase agreement, the payment time is 30-60 days after receiving the equipment.

The paper is related to two strands of literature. The first strand studies the role of informal finance, showing that informal finance can make up for deficiencies in formal financial development and have important effects on firm behavior (Fisman and Love, 2003; Allen et al., 2019). Long and Zhang (2011) reveal that domestic trade credit helps exports by alleviating firms' financial constraints, while ignoring the role of international trade credit. Schmidt-Eisenlohr (2013) studies the optimal choice between export payment contracts. Antràs and Foley (2015) and Demir and Javorcik (2018) show that the choice of payment contracts is related to the enforcement of contract and market competition, respectively. While they mainly focus on the determinants of the choice of payment contracts, we are interested in how DTC affects firms' export behavior. Chor and Manova (2012) point out that informal financing obtained from destination countries is important for exports. The present paper thus complements the previous studies by exploring the role played by informal finance in *international* transactions, with direct empirical evidence.

The second strand examines the impact of financial development on exports. Beck (2002, 2003) shows that domestic financial development is an important source of comparative advantage. Manova (2013) finds that countries with more developed financial markets export more in financially vulnerable sectors. Moreover, financial development can affect the price and quality of export products (Fan et al., 2015). Minetti et al. (2021) argue that domestic financial structure also matters. In addition to domestic financial development, Ma and Xie (2019) find that the financial development of destination countries is important in shaping bilateral trade patterns. Claessens and van Horen (2021) show that exports tend to be larger when banks from the destination country are present in the source country. While most of the existing literature focuses on the formal financial development of the source country or the destination country, little is known about the impact of

informal finance on export activities. The present paper attempts to fill this gap from the perspective of destination trade credit.

Perhaps our paper is the closest to Eck et al. (2015), who study the role of international trade credit in exports, but differs from them in two aspects. First, while they suggest that cash in advance is helpful for exports by overcoming difficulties arising from information asymmetry, we consider not only cash in advance but also deferred payment and focus on the channel through which DTC eases financing constraints. Second, they treat the total cash in advance from domestic and foreign trading partners as a proxy variable of international trade credit using a single country's data. In contrast, we use information on the balance of payments from a large sample of countries over almost 20 years, which enables us to distinguish between trade credit related to international trade and domestic business, and draw more general conclusions.

The contributions of this paper are reflected in the following aspects. First, while the existing literature pays little attention to informal finance and its role in international trade, we complement the literature by examing the effects of DTC on exports. Second, the present study uses information on the balance of payments to construct the measure of DTC for many countries over a long period, allowing for more general conclusions to be drawn. Third, we show that DTC promotes more exports from source countries with lower levels of financial development, which provides a new perspective to explain that countries with underdeveloped formal finance can still achieve rapid export growth.

The remainder of this paper is organized as follows. Section 2 explains the theoretical discussion and identification strategy. Section 3 present the baseline estimation results, the endogeneity discussion, and a series of robustness checks. Section 4 makes extended analyses,

including the heterogeneous effects of DTC and the effects on other dimensions of export performance. Section 5 concludes.

2. Theoretical Discussion, Data and Identification Strategy

In this section, we first provide a theoretical discussion on how DTC affects exports and then introduce the data sources, variable construction and the identification strategy.

2.1. Theoretical discussion

The core logic that DTC is conducive to export expansion is that trade credit, as an important source of financing, can alleviate the financing constraints faced by firms and thus contribute to the smooth progress of export activities. Compared with domestic sales, export activities usually involve higher fixed costs and variable costs on the one hand, and on the other hand, the payment of international trade takes longer time and faces higher risks. Therefore, firms with sufficient liquidity have a better chance of becoming exporters (Chaney, 2016). However, many firms often have difficulty meeting the requirements of export activities with their own funds and thus require the support of external finance.

In the existing literature on finance and international trade, most scholars have focused on the role of formal financial development, generally concluding that it is has a significant promoting effect on exports, especially in industries with high dependence on external finance (Beck, 2002; Beck, 2003; Manova, 2013). However, informal finance may also significantly affect export activities (Chor and Manova, 2012; Foley and Manova, 2015; Iacovone et al., 2019). Unlike formal finance, informal finance represented by trade credit mainly meets the short-term financing needs of firms. In addition to long-term financing needs (such as financing for R&D), firms also require external funds to meet short-term working capital needs. Trade credit precisely gives an important

source of liquidity for the short-term financing needs (Foley and Manova, 2015; Iacovone et al., 2019), provided by trading partners located in the destination countries.

As mentioned above, DTC can exhibit in two forms. One is cash in advance, and the other is deferred payment, as illustrated in Figure 1.

[Insert Figure 1 here: Routes of Destination Trade Credit]

Studies have found that buyers with sufficient liquidity will pay in advance to sellers to ensure the production and timely delivery of goods (Mateut, 2014). Similarly, as in Figure 1, if the importer provides funds to the exporter in the form of cash in advance (Route 1), the exporter's financing constraints can be reduced, which helps achieve a smooth transaction.

A different and more indirect way (Route 2) is reflected in the production process of exporters who need to import intermediate or capital goods from the destination country. Suppliers in the destination country may provide informal financing by allowing exporters to defer payment.

2.2. Data and variables

2.2.1 Destination trade credit

The measurement of DTC is a key issue in our empirical analysis. It would be ideal to have detailed transaction-level data and construct a proxy variable directly. However, such data are not available for most countries. Previous studies are either based on the transaction information in a single country (Antràs and Foley, 2015), or have treated the total cash in advance that firms receive from domestic and foreign trading partners as a single proxy variable of DTC (Eck et al., 2015). In contrast, in the present paper, we use the balance of payments (BOP) data published by the IMF to construct the measurement of DTC. The advantages of this approach are reflected in two aspects. First, BOP contains information on cross-border deferred payment and cash in advance, which could more accurately capture the scale of informal finance used in international trade. Second,

the BOP data are publicly available for a large sample of countries, allowing us to draw more general conclusions from the numerous cases of many countries.

Specifically, the trade credit and advances account of BOP is divided into asset and liability items, where the asset item records the cash in advance of the importer and the accounts receivable of the exporter. Since this study focuses on the informal financing provided by the destination country to the exporting country, we use the information on assets in the account of the former country, which reflects the overall scale of DTC. Referring to Imlau (2017) and Carroll and Neumann (2022), we use the ratio of asset to GDP to measure the level of DTC.[4] Maskus et al. (2012) and Maskus et al. (2019) also use similar methods to measure the level of international financial development. The advantage is that it is based on publicly and widely available data. We do recognize that it may have measurement errors, but the errors would underestimate the impacts of DTC, just like the measurement of financial development and cost of external finance in Raddatz (2006) and Chor and Manova (2012), not exaggerating the impacts.

2.2.2 External liquidity dependence

The key industry measure of financial vulnerability in this paper is external liquidity dependence (*ELD*), which reflects the degree of short-term financing needs across industries, and is constructed following Fisman and Love (2003).[5] It is a suitable measure since trade credit (including DTC) mainly meets firms' needs of short-term financing rather than bank credit, such as the working capital requirements (Chor and Manova, 2012; Levine et al., 2018; Iacovone et al., 2019). Industry dependence on external liquidity may vary in different countries, so there may be some bias in using only US data for measurement. However, in the literature using Rajan-Zingales

[4] Unfortunately, the available BOP data have not been broken down to the bilateral level or specific forms of informal finance. We only have information of DTC at the destination country level.
[5] Variable calculated using US firm data for 1980-1989 and equals the ratio of the change in accounts payable over the change in total assets.

strategy, it is a common practice to use the United States as the benchmark country to calculate industry characteristic indicators, such as in Manova (2013), Levine et al. (2018), Minetti et al. (2019), and Li and Su (2022). The main reasons for choosing this approach are as follows.[6]

First, the *ELD* calculated by using US data can better reflect the true dependence of each industry on external liquidity (Levine et al., 2018; Minetti et al., 2019; Li and Su, 2022). Due to the developed and well-established financial system in the US, firms there are less constrained by insufficient external financial resources. Therefore, the degree of dependence of US firms on external liquidity can be considered as an almost optimal choice. Second, the indicators calculated using US data are not endogenous to the levels of financial development in other countries (Manova, 2013; Bilir et al., 2019). The *ELD* calculated using other countries' data may reflect supply-side constraints (whether external funds are abundant), but the *ELD* calculated based on historical US data can better address this concern. Third, the Rajan-Zingales strategy dose not require industries in every country have the same level of *ELD* as those in the US, but rather that the ranking of industries remains relatively stable across countries (Manova, 2013; Manova et al., 2015). Thus, the *ELD* calculated by using US data reflects the true level of external liquidity dependence and captures the inherent technological characteristics of each industry, so it is a good proxy variable for ranking industries in all countries. In addition, firm-level data required for calculating *ELD* is also difficult to obtain for many countries, but using the US as the reference country provides convenience for empirical research (Manova, 2013).

2.2.3 Control variables

[6] In the robustness tests, referring to Fan et al. (2015), we use the Chinese Industrial Enterprise Database (CIED) to calculate the *ELD* in China, and then perform regression analysis with Chinese customs data. The results in Appendix A2 indicate that DTC still contributes to export expansion.

In the empirical analysis, we also add a matrix of control variables commonly used in the gravity model, including the geographic distance between two countries (*lndist*, natural log value), whether the two countries share a common border (*contig*: 1 when bordering each other; 0 otherwise), share a common language (*com_lang*: 1 with a common language; 0 otherwise), have a common legal origin (*com_leg*: 1 with a common legal origin; 0 otherwise), and are in the same regional trade agreement (RTA) (*rta*: 1 in the same RTA; 0 otherwise). The control variables are taken from the CEPII database.

2.2.4 Trade data

The trade data are from the CEPII-BACI database, which gives information on bilateral trade at the HS 6-digit product level for 2000-2018. We aggregate the trade data to source-destination-ISIC industry-year level. The HS–ISIC comparison table is calculated from the WITS database, and the corresponding product and industry standards are HS1996 and ISIC Rev. 2, respectively. The sample includes 36 ISIC industries with data of external liquidity dependence.[7]

Table 1 reports the summary statistics for a set of key variables used in the paper.

[Insert Table 1 here: Summary statistics]

2.3. Identification strategy

We empirically test whether DTC affects international trade, employing the identification approach as in Rajan and Zingales (1998).[8] This approach makes use of the difference in the level of DTC across destination countries, as well as the difference in external liquidity dependence across industries. It has also been widely used in the literature (Iacovone et al., 2019; Minetti et al,

[7] The 36 ISIC industries retained include 27 three-digit code industries and 9 four-digit code industries. See Kroszner et al. (2007) and Manova et al. (2015).

[8] We have also attempted to aggregate the trade data of CEPII-BACI into the "source-destination-year" level, and conducted regression analysis using the single-term DTC as the core explanatory variable. The estimated coefficient of DTC is also significantly positive, indicating that DTC is beneficial for export expansion, as shown in Appendix A1.

2021), mainly for two reasons. Firstly, compared to typical cross-country regressions with core explanatory variables at the country level, this approach combines the cross-country variation in financial development with the exogenous cross-industry variation in financial vulnerability, which is much less exposed to endogeneity concerns caused by missing variables and reverse causality (Foley and Manova, 2015; Bilir et al., 2019). Secondly, this approach can help us identify the channels through which variables at the country level play a role (Choi et al., 2018; Huang et al., 2020). Specifically, in this paper, if DTC promotes export expansion by alleviating liquidity constraints, we should expect that DTC's export promotion effect be greater in industries with higher dependence on external liquidity.

Specifically, we construct the following equation:

$$lnExport_{ijkt} = \alpha + \beta DTC_{jt} \times ELD_k + \theta' \boldsymbol{Control} + \gamma_{it} + \varphi_{jt} + \delta_k + \varepsilon_{ijkt}, \qquad (1)$$

where *i* and *j* are respectively the source and destination countries, *k* is the industry, and *t* is the year. $lnExport_{ijkt}$ is the natural logarithm of the export value of industry *k* in country *i* to country *j* in year *t*. We use the consumer price index (CPI) of the US to deflate exports to obtain the real value as in Li et al (2021). DTC_{jt} is the level of DTC in country *j*, which is equal to the asset item in the trade credit and advances account of the country over its GDP. ELD_k is the measure of financial vulnerability, which is the degree of (short-term) external liquidity dependence of industry *k,* as in Fisman and Love (2003).[9]

The interaction term $DTC_{jt} \times ELD_k$ is the core explanatory variable. If the estimated coefficient β of this term is significantly positive, it means that industries with higher external liquidity needs benefit more, which is in line with our expectation.

[9] Variable calculated using US firm data for 1980-1989 and equals the ratio of the change in accounts payable over the change in total assets.

$\boldsymbol{Control}$ represents a matrix of control variables commonly used in the gravity model, as explained in Subsection 2.2.3. γ_{it} is the source-year fixed effect, controlling for the influence of factors varying at the source-year level. φ_{jt} is the destination-year fixed effect, controlling for the influence of factors varying at the destination-year level and absorbing the effect of DTC_{jt}. δ_k is the industry fixed effect, and ELD_k does not change over time and is absorbed by δ_k. ε_{ijkt} is the error term. We cluster the standard error at the source-destination-industry level.

3. Estimation Results and Analysis

In this section, we report the baseline estimation results based on Eq. (1), followed by a discussion of endogeneity and robustness checks.

3.1. Baseline estimation results

In Table 2, no control variables are included in column (1), bilateral geographical distance (*lndist*) is included in column (2), and all control variables are included in column (3). The estimated coefficients of the core explanatory variable $DTC \times ELD$ are significantly positive regardless if control variables are included, indicating that the higher the DTC, the more the exports of industries with higher external liquidity dependence, which confirms our prediction.

Regarding the control variables, the estimated coefficient of distance (*lndist*) is significantly negative. Geographical distance can be regarded as trade resistance. The greater the distance, the higher the trade cost. On the other hand, the coefficients for common border (*contig*), common language (*com_lang*), common legal origin (*com_leg*) and common RTA (*rta*) are all significantly positive. That is, trade resistance would be reduced if the two countries border each other, share a common language or common legal origin, or are in the same RTA.

[Insert Table 2 here: Baseline estimation results]

The Rajan-Zingales approach focuses on identifying the heterogeneous effects of DTC at different levels of external liquidity dependence, which to some extent alleviates the potential endogeneity bias (Iacovone et al., 2019). However, the interaction term as the core explanatory variable could still be endogenous if the level of DTC were picking up other destination characteristics or the external liquidity dependence were picking up other industry characteristics.[10] To address such concerns, we include more control variables to alleviate possible estimation bias caused by omitted factors.

We start by examining whether external liquidity dependence (*ELD*) captures other industry characteristics. In Eq. (1), we interact a set of other industry characteristics with *DTC*, and include these interaction terms as additional controls. The first is long-term external finance dependence (*FD*), which is the fraction of capital expenditure not financed with cash flow from operations, capturing the external funding that firms need for long-term investment projects (Manova et al., 2015). If the DTC also helps to ease the long-term needs for external finance and *ELD* is correlated with *FD*, the coefficient of the interaction term *DTC*×*ELD* in Eq. (1) will be misestimated. Second, we add the interaction between industry growth opportunity (*Gro*) and *DTC*. It is possible that *ELD* captures information about the growth opportunities of the industry (Fisman and Love, 2007). Also, Raddatz (2006) points out that industries with high liquidity needs might be human capital or R&D intensive. Therefore, the interaction between human capital intensity (*Hum*) and *DTC*, and the interaction between R&D intensity (*RD*) and *DTC*, are included. Finally, referring to Manova (2013) and Ma and Xie (2019), we add the interaction terms of physical capital intensity (*Cap*) and natural resource intensity (*Na*) with *DTC*. In Table 3, regardless of whether the interactions are included one by one (columns (1)-(6)), or included all at once (column (7)),

[10] *DTC* and *ELD* could be subject to measurement errors. However, Raddatz (2006) and Chor and Manova (2012) suggest that such a measurement error is more likely to cause coefficients to be underestimated, not exaggerating the impacts of DTC.

the estimated coefficients of the core explanatory variable *DTC*×*ELD* remain significantly positive, and the magnitude is bigger than in the baseline estimation, indicating that external liquidity dependence is not likely to capture other industry characteristics.[11]

[Insert Table 3 here: Controlling for other industry characteristics]

Next, we examine whether the level of DTC captures other features of the destination country. Referring to Manova (2013), we include the interaction term between the level of economic development of the destination country (*Econ*, the natural log of GDP per capita) and *ELD*. Ma and Xie (2019) suggest that the financial development of destination countries also help exporters alleviate financial constraints. Thus, we include the interaction term between the level of financial development in the destination country (*Fin*, the ratio of private credit to GDP) and *ELD*. In addition, we include the interaction terms between the openness level of the destination country (*Open*, the proportion of import and export volume in GDP), institutional quality (*Rule*, the level of rule of law), and *ELD*. In Table 4, the estimated coefficients of the core explanatory variable *DTC*×*ELD* are still significantly positive.[12] Column (6) reports the results when the six interaction terms of *DTC* and the four interaction terms of *ELD* are all included. The coefficients of *DTC*×*ELD* are still significantly positive, and the magnitude is bigger than in the baseline estimation. Thus we conclude that the problem of omitted variables may not be serious in our model specification.

[Insert Table 4 here: Controlling for other destination characteristics]

[11] The value of external long-term finance dependence and R&D intensity is from Krosner et al. (2007), that of growth opportunity is from Fisman and Love (2007), and that of human capital intensity, physical capital intensity and natural resource intensity is from Manova (2013).

[12] Data for economic development, formal financial development, and openness of export destination countries are from the WDI database. Data for institutional quality are from the WGI database.

From Tables 3 and 4, it can be seen that the newly added interaction terms with relatively stable estimated coefficients include *DTC*×*Gro*, *DTC*×*Hum* and *Econ*×*ELD*. In columns (2), (7) of Table 3 and column (6) of Table 4, the coefficients of *DTC*×*Gro* are significantly positive, indicating that DTC has a greater effect on promoting exports in industries with more growth opportunities. The possible reason is that such industries have a greater demand for external funds, resulting in a greater impact of DTC (Fisman and Love, 2007; Ciccone and Papaioannou, 2009).

In columns (3), (7) of Table 3 and column (6) of Table 4, the estimated coefficients of *DTC*×*Hum* are significantly positive, indicating that DTC has a greater effect on promoting exports in industries with higher human capital density. The possible reason is that such industries also rely more on external funds, and the impact of DTC on these industries is more significant (Raddatz, 2006; Ciccone and Papaioannou, 2009).

In columns (1), (5) and (6) of Table 4, the estimated coefficients of *Econ*×*ELD* are significantly negative. The possible reason is: when the economic development level of the destination country is higher, the level of its formal finance development may also be higher. And there may be a substitution relationship between formal finance and informal finance, so the destination country with less economic development is more likely to provide liquidity to exporting countries in the form of trade credit (Fisman and Love, 2003).

3.2. Addressing endogeneity

To further address endogeneity concerns, we conduct additional tests: (i). using instrumental variables for DTC to check the robustness of the estimation results; (ii). conducting a placebo test, using data from Chinese exports.

3.2.1 Using instrumental variables

In this subsection, we further use the instrumental variable method to deal with the possible endogeneity of *DTC*. Existing studies have shown that the degree of trust is closely related to the development of informal finance (Levine et al., 2018; Iacovone et al., 2019). The willingness of a firm to provide trade credit depends largely on whether it trusts its trading partners. Since the present paper investigates the impact of DTC, we need to find appropriate instrumental variables for *DTC* in terms of the trust level in the destination country. The World Value Survey (WVS) provides information about the level of trust in different countries. We use the "degree of trusting neighbors" in the questionnaire as the instrumental variable of *DTC*.[13] Generally speaking, if the residents of a country have lower trust in their neighbors, they are less likely to provide credit to trading partners in foreign countries. Moreover, the degree of trust in neighbors does not directly affect bilateral trade.

Specifically, referring to Levine et al. (2018), we use the proportion of respondents who answered "completely trust" on whether they trust their neighbors as a measure of the trust level in the destination country (*Trust*).[14] We use *Trust* in WVS Wave 5 (2005-2009) to measure the trust level for 2000-2009, *Trust* in WVS Wave 6 (2010-2014) for 2010-2016 and *Trust* in WVS Wave 7 (2017-2022) for 2017-2018. This approach is based on the view that trust changes very slowly in the long run and exhibits high persistence (Levine et al., 2018).

Then, we multiply *Trust* and *ELD* as the instrumental variable of *DTC*×*ELD*. Column (1) of Table 5 reports the estimation results for 2000-2018. The first stage shows that the instrumental variable is positively correlated with *DTC*×*ELD*, and the *Kleibergen-Paap F-stats* also suggests

[13] This question was asked after the WVS Wave 5.

[14] In the WVS questionnaire, there are four choices for the question "trust in neighbors": trust completely, trust somewhat, do not trust very much, and do not trust at all.

that the regression passes the weak identification tests. The second stage shows that, the estimated coefficient of our interested interaction term remains significantly positive.

The degree of trust in the destination country may also affect exports through formal financial development and institutional environment. In this case, using the trust level as the instrumental variable of DTC may not satisfy the exclusive restriction. To eliminate the possibility that the instrumental variable does not meet the exclusion restriction, we use the heteroskedasticity-based identification approach proposed by Lewbel (2012).[15] This identification approach has also been widely used in the literature, such as in Emran and Hou (2013), Dang and Rogers (2016), and O'Connor and Graham (2019).

Referring to Lewbel (2012), if the residual obtained by regressing the endogenous variable *DTC×ELD* on *Trust×ELD* and the control variables have heteroskedasticity, the product of the residual and centered *Trust×ELD* is an ideal instrumental variable. We use the Breusch-Pagan test of heteroskedasticity as in Lewbel (2012), and the result shows that the null hypothesis of homoscedastic error is rejected with a *p*-value equal to 0.00, indicating the applicability of this approach. Column (2) of Table 5 reports the estimation using the newly constructed instrumental variable. The first-stage results are significantly positive, and *Kleibergen-Paap F-stats* also rejects the weak identification hypothesis. The second-stage results are also significantly positive, which further demonstrates the reliability of the baseline estimation results.

To further test the reliability of the instrumental variable constructed based on Lewbel (2012), we have attempted to include the interaction term between the formal financial development level of the destination country (*Fin*, the ratio of private credit to GDP) and *ELD*, as well as the interaction term between the institutional environment level of the destination country

[15] See Lewbel (2012) and Dang and Rogers (2016) for the rationale and detailed application steps of this method.

(*Rule*, the level of rule of law) and *ELD*, as control variables into the regression equation. We use the Lewbel approach for regression again, and as shown in column (3) of Table 5, the estimation coefficient of *DTC*×*ELD* is significantly positive, indicating that the main conclusion is still valid.

[Insert Table 5 here: Instrumental variable tests]

3.2.2 Conducting placebo tests

In this subsection, we conduct a placebo test, using the Chinese customs data.[16] There are two main trade modes in China: ordinary trade (OT) and processing trade (PT). More specifically, processing trade includes two sub-categories: processing with imports (PI) and pure assembly (PA). As Manova and Yu (2016) point out, when conducting processing trade, the exporter imports all or part of the raw materials and other intermediate goods, and re-exports final goods after processing. Under PA, foreign firms provide raw materials or intermediate goods to the exporter free of charge. Under PI, the exporter imports the materials or intermediate goods with its own money. Therefore, the exporter only pays for domestic inputs and processing under PA, but pays for domestic inputs, foreign inputs and processing under PI.

In contrast, an *ordinary trade* exporter bears the cost of design, domestic and foreign inputs, import duties on foreign inputs, the cost of assembly, and the cost of sales abroad. As a result, the working capital or liquidity needs are the lowest under PA, higher under PI, and the highest under OT. Hence, if DTC truly helps ease the liquidity constraints, we should expect that the positive impact of DTC on exports is the greatest under OT, smaller under PI and the smallest under PA. Otherwise, the baseline results might be caused by omitted factors rather than DTC.

Next, we use Chinese customs data for 2000-2006 to conduct a placebo test. We only retain samples of exports (including ordinary and processing trade), and aggregate the data to the level

[16] The Chinese customs data report detailed information of each export transaction, including export value, quantity, product, firm name and ownership, destination countries, trade mode and so on.

of "firm-destination-product-trade, regime-year" while excluding the samples of trade intermediaries.[17] Products are classified at the six-digit HS1996 level. Using the correspondence table provided by the WITS database, we obtain the ISIC industry corresponding to the HS product and the corresponding external liquidity dependence. The core explanatory variable is still the interaction term *DTC*×*ELD*. The explained variable is the natural logarithm of export value which is deflated by the consumer price index (CPI) of the US. We add the firm-year fixed effect to control for the factors that change with firm-year, like productivity and leverage ratio, as well as a series of macro-level variables, such as the development level of formal and informal finance in the region where the firm is located. We also add the destination-year fixed effect and ISIC industry fixed effects.

Columns (1)-(4) of Table 6 report the estimation results for ordinary trade (OT), processing trade (PT), processing with imports (PI) and pure assembly (PA), respectively. The estimated coefficient of *DTC*×*ELD* is significantly positive in column (1), indicating that DTC promotes ordinary exports in China. The coefficient of *DTC*×*ELD* is positive but insignificant in column (3), and that of *DTC*×*ELD* is negative and insignificant in columns (2) and (4). These results are all in line with our expectations.[18]

[Insert Table 6 here: Placebo test]

3.3. Additional robustness checks

Firstly, Pseudo-Poisson maximum likelihood estimation (PPML) is applied. Silva and Tenreryo (2006) note that consistent estimation results can be obtained using the PPML method

[17] Referring to Ahn et al. (2011), we delete the firms containing the Chinese characters of "jin chu kou", "jing mao", "mao yi", "ke mao" and "wai jing" in their names.
[18] Manova et al. (2015) point out that the Chinese state-owned enterprises (SOEs) should be dropped when examining firms' export decisions in a financially constrained environment, because SOEs are not necessarily profit-maximizing entities. Our results remain unchanged after dropping SOEs from our sample.

in the case of zero-valued trade. In column (1) of Table 7, the coefficient of *DTC*×*ELD* is still significantly positive.

Secondly, we adopt alternative measures for external liquidity needs. Specifically, we consider another two proxies for an industry's dependence on external liquidity. The first is the ratio of inventories to sales (*Invent*). A higher ratio means that a smaller fraction of inventory investment can be financed by current revenue and represents a higher external liquidity dependence in the short run (Raddatz, 2006). The second is the ratio of short-term debt to sales (*Debt*), which captures both the actual use of external liquidity and the ability of a firm to pay its current liabilities. A higher value of *Debt* also represents a higher external liquidity dependence. *Invent* is obtained from Kroszner et al. (2007) and *Debt* from Raddatz (2006). They calculate the two measures based on US firms for 1980-1989 and take the median ratio across firms in the same ISIC code as the proxy for that industry.[19] In columns (2)-(3) of Table 7, the results indicate that DTC helps to promote exports more in higher external liquidity-dependence sectors.

Thirdly, we control for additional fixed effects. In column (4) of Table 7, we replace the industry fixed effects with industry-year fixed effects to control for the impact of potential unobserved time-varying industry characteristics, such as the inherent volatility of the industry. In column (5), we add the source-industry fixed effects to control for the potential heterogeneous impact of source country characteristics across industries. In column (6), we replace the source-industry fixed effects with source-industry-year fixed effects to control for the potential heterogeneous impact of unobserved time-varying source country characteristics across industries. And we find the estimation results remain valid.

[19] Raddatz (2006) calculates the measures based on four-digit ISIC industries. To obtain the values for three-digit ISIC industries, we take the mean ratio across four-digit ISIC codes in the same three-digit ISIC codes as the proxy for that industry.

Fourthly, we cluster standard errors at different levels. In the baseline estimation, standard errors are clustered at the exporter-destination-industry level. Here, we cluster standard errors at source-destination level in column (7), and at destination-year level in column (8). The results still confirm the causal relationship between DTC and exports.

[Insert Table 7 here: Additional robustness checks]

Finally, we examine the impact of DTC on other dimensions of export performance. In the baseline estimation, the explained variable is the natural logarithm of export value. Here, we decompose the value of export into export quantity (*lnquantity)* and export price (*lnprice*) to further investigate the effects of DTC, and Table 8 reports the estimation results. In column (1), the coefficient of *DTC*×*ELD* is significantly positive, indicating that DTC promotes export quantity. In column (2), the coefficient of *DTC*×*ELD* is significantly negative, indicating that with higher DTC, the export price of industries with higher liquidity dependence is lower. This result might seem unexpected, but it is not difficult to understand. When a trading partner in the destination country provides financial support to its counterpart in the exporting country, it may have the bargaining power to ask for a lower price.

Next, we further investigate the effect of DTC on the extensive margin of trade. We take the (log) number of HS six-digit products at source-destination-industry-year level as the explained variable (*lncount*). In column (3) of Table 8, the coefficient of *DTC*×*ELD* is significantly negative, indicating that with higher DTC, the export product varieties of industries with higher liquidity dependence are lowered.

[Insert Table 8 here: Other dimensions of export performance]

4. Quantifying the Different Impacts of Destination Trade Credit

In this section, several more extended analyses are conducted.[20] First, we check if DTC has heterogeneous impacts on exports across source countries with different levels of financial development. Then, we examine the impact of DTC during the global financial crisis. Finally, we attempt to explore the different effects across industries from the perspective of product complexity.

4.1. Financial development across source countries

We start with the level of financial development in the source countries. If DTC helps to relax liquidity constraints, the effect would be larger for the exporters who are unable to raise enough funds in the formal financial market. Therefore, the difference in the financial development across source countries could be used as another exogenous variation to provide further causal evidence. To test this hypothesis, we include an interaction term between *DTC*×*ELD* and a dummy variable in the model specification. This dummy is equal to 1 for source countries with financial development above the median in the initial year of our sample period (*Formal_source*), and equal to 0 otherwise. The measure of financial development is the ratio of private credit to the source country's GDP.

Control variables are included in column (2) but not in colum (1) of Table 9. In both columns, the coefficient of *DTC*×*ELD*×*Formal_source* is significantly negative and the coefficient *of DTC*×*ELD* is significantly positive, indicating that the export promotion effect of DTC is smaller among source countries with better financial development. We also divide the sample into two subsamples according to the value of *Formal_source.* As in Appendix A3, the estimated coefficients are both positive, but only significant in the subsample with a lower level of financial development. Referring to Li et al. (2021), we perform Fisher's Permutation test. The

[20] We also roughly calculate the impacts of DTC on the GDP growth rate and employment rate. As shown in Appendix A4, one standard deviation increase in DTC leads to an average increase of 1.77% in exports, 0.35% in GDP and 0.18% in employment.

p-value indicates that the difference of the coefficients between the two subsamples is significant. These results confirm our conjecture that DTC is more helpful for exports when the source country has a lower level of financial development.

[Insert Table 9 here: Financial development across source countries]

4.2. DTC and exports in the global financial crisis

International trade has suffered a sharp decline during the 2008-2009 crisis. The lack of timely and sufficient financial support is a reason (Chor and Manova, 2012). To study the role played by DTC during the financial crisis, we create a dummy for the years 2008-2009 (*Crisis*), and run the regression with an interaction term between this dummy and *DTC*×*ELD* for 2000-2009. Control variables are included in column (2) but not in column (1) of Table 10. Columns (1)-(2) of Table 10 reports the coefficient of *DTC*×*ELD*×*Crisis* is significantly negative, while that of *DTC*×*ELD* is significantly positive. It indicates that *DTC* helps firms to export during the crisis, but the effect is weaker compared to the pre-crisis period. It should be pointed out that the financial crisis may affect both exports and DTC, resulting in biased estimation coefficient for *DTC*×*ELD*×*Crisis*. If the financial crisis causes the level of DTC to rise (fall), the negative impact of the financial crisis on exports may be under- (over-) estimated. We calculate the mean of DTC year by year and find it to be higher during the financial crisis,[21] indicating that the estimated coefficient of *DTC*×*ELD*×*Crisis* is more likely to be an underestimated result.

We also divide the sample into *pre-crisis* period (2000-2007) and *crisis* period (2008-2009), and find that *DTC* help firms to export during the crisis, but the effect is weaker compared to the pre-crisis period, as shown in Appendix A3.

[Insert Table 10 here: DTC and exports in the global financial crisis]

[21] A possible reason is that informal finance has made up for the shortcomings of formal finance during the financial crisis (Chor and Manova, 2012).

To gain a better understanding of the above, we look into how the effect of DTC changes over time, by setting a model as in Chor and Manova (2012):

$$lnExport_{ijkt} = \alpha + \sum_{m=200}^{2009} \beta_m ITC_{jt} \times ELD_k + \theta' \boldsymbol{Control} + \gamma_{it} + \varphi_{jt} + \delta_k + \varepsilon_{ijkt} \quad (2)$$

The coefficients of β_m capture the dynamic effect. In Figure 2, the gray area indicates the 95% confidence intervals. Most of the β_m coefficients are positive and significant, confirming our main findings. The values of β_m in 2008-2009 are obviously smaller than those before the crisis. The possible explanation is that DTC might not be enough to meet firms' long-term financing needs and overcome the difficulties caused by the crisis, even though it could help firms to meet their short-term needs. Nevertheless, the international trade volume may have contracted more without DTC during the crisis.

[Insert Figure 2 here: Effect of DTC on exports over time]

4.3. Product complexity

Garcia-Marin et al. (2020) argue that contract enforcement is harder for more complex products because it is difficult for courts to verify a successful transaction. The more complex the product, the more likely an exporter might default its contractual obligations. As such, one would expect the export promotion effect of DTC to be weaker when product complexity is higher.

Here we construct a measure for product complexity (*Comp*) using the indicator proposed by Rauch (1999), where the products are divided into three categories: differentiated products, reference price products and homogeneous products. We convert Rauch's original classification of products from SITC Rev.2 to ISIC Rev.2, and aggregate the data to ISIC level by calculating the share of SITC differentiated products (Minetti et al., 2021).[22] A higher share means that the industry is more complex. Then, we include an interaction term between product complexity

[22] The concordance between SITC and ISIC comes from Muendler's website: https://econweb.ucsd.edu/muendler/html/resource.html.

(*Comp*) and *DTC*×*ELD* in the model specification. The results are reported in columns (1)-(2) of Table 11. Column (1) uses the conservative classification of Rauch (1999) and column (2) uses the liberal classification. The coefficients of the triple interaction terms are negative and significant at 1% level, consistent with our expectation.

[Insert Table 11 here: Product complexity (1)]

To provide further evidence, we also consider using the variation of institutional quality across source countries. If the strength of legal rights is weaker, firms would be more likely to default. We divide the sample into two subsamples according to the median of source countries' rule of law in 2000. As in columns (1)-(4) of Table 12, the absolute value of coefficients of *DTC*×*ELD*×*Comp* are bigger in low rule-of-law source countries (*Law*=0). The *p*-value indicates that the difference of the triple interaction terms is significant.

[Insert Table 12 here: Product complexity (2)]

5. Concluding Remarks

Financial development is an important factor affecting international trade. From the perspective of DTC, this study examines the impact of informal finance on exports. Specifically, using bilateral trade data for multiple countries and industries for 2000-2018, we find that DTC promotes a country's exports disproportionately more in short-term liquidity-dependent industries. The result remains consistent after addressing endogeneity and various robustness checks. Further analyses show that the effect is greater when the level of financial development of the source country is lower. DTC mainly promotes trade by increasing export quantity, while it causes a decline in export prices and a reduction of export varieties. The export promotion effect of DTC is limited when the product complexity becomes larger. During the 2008 global financial crisis, the effect of DTC still exists, but is relatively weak.

The present paper extends and supplements the literature on the nexus between finance and international trade. Due to data limitation, this study cannot accurately distinguish between cash in advance and deferred payment. As data availability improves in the future, the different roles played by these two settlement approaches can be further investigated. In addition, the role of DTC in global value chains (GVCs) also warrants further research.

References

Ahn, J.; Khandelwal, A. K. and Wei, S. J. "The Role of Intermediaries in Facilitating Trade." *Journal of International Economics*, 2011, 84(1), 73-85.

Allen, F.; Qian, M. and Xie, J. "Understanding Informal Financing." *Journal of Financial Intermediation*, 2019, 39, 19-33.

Antràs, P. and Foley, C. F. "Poultry in Motion: A Study of International Trade Finance Practices." *Journal of Political Economy*, 2015, 123(4), 853-901.

Ball, L., Leigh, D. and Loungani, P., "Okun's Law: Fit at 50," *Journal of Money, Banking and Credit*, 2017, 49(7), 1413-1441.

Beck, T. "Financial Development and International Trade: Is There a Link?" *Journal of International Economics*, 2002, 57(1), 107-131.

Beck, T. "Financial Dependence and International Trade." *Review of International Economics*, 2003, 11(2), 296-316.

Bilir, L. K., Chor, D. and Manova, K. "Host-Country Financial Development and Multinational Activity." *European Economic Review*, 2019, 115, 192-220.

Carroll, S. and Neumann, R. "The Importance of International Trade Credit for Industry Investment." *Journal of Economics and Business*, 2022, 122, 106082.

Chaney, T. "Liquidity Constrained Exporters." *Journal of Economic Dynamics and Control*, 2016, 72, 141-154.

Ciccone, A. and Papaioannou, E. "Human Capital, the Structure of Production, and Growth." *The Review of Economics and Statistics*, 2009, 91(1), 66-82.

Choi, S., Furceri, D., Huang, Y. and Loungani, P. "Aggregate Uncertainty and Sectoral Productivity Growth: The Role of Credit Constraints." *Journal of International Money and Finance*, 2018, 88, 314-330.

Chor, D. and Manova, K. "Off the Cliff and Back? Credit Conditions and International Trade during the Global Financial Crisis." *Journal of International Economics*, 2012, 87(1), 117-133.

Claessens, S. and Van Horen, N. “Foreign Banks and Trade.” *Journal of Financial Intermediation*, 2021, 45, 100856.

Dang, H. A. H. and Rogers, F. H. “The Decision to Invest in Child Quality Over Quantity: Household Size and Household Investment in Education in Vietnam.” *The World Bank Economic Review*, 2016, 30(1), 104-142.

Demir, B. and Javorcik, B. “Don’t Throw in the Towel, Throw in Trade Credit!” *Journal of International Economics*, 2018, 111, 177-189.

Eck, K.; Engemann, M. and Schnitzer, M. “How Trade Credits Foster Exporting.” *Review of World Economics*, 2015, 151(1), 73-101.

Engemann, M.; Eck, K. and Schnitzer, M. “Trade Credits and Bank Credits in International Trade: Substitutes or Complements?” *The World Economy*, 2014, 37(11), 1507-1540.

Emran, M. S. and Hou, Z. “Access to Markets and Rural Poverty: Evidence from Household Consumption in China.” *Review of Economics and Statistics*, 2013, 95(2), 682-697.

Fan, H., Lai, E. L. C. and Li, Y. A. “Credit Constraints, Quality, and Export Prices: Theory and Evidence from China.” *Journal of Comparative Economics*, 2015, 43(2), 390-416.

Fisman, R. and Love, I. “Trade Credit, Financial Intermediary Development, and Industry Growth.” *The Journal of Finance*, 2003, 58(1), 353-374.

Fisman, R. and Love, I. “Financial Dependence and Growth Revisited.” *Journal of the European Economic Association*, 2007, 5(2-3), 470-479.

Foley, C. F. and Manova, K. “International Trade, Multinational Activity, and Corporate Finance.” *Annual Review of Economics,* 2015, 7, 119-146.

Garcia-Marin, A.; Justel, S. and Schmidt-Eisenlohr, T. “Trade Credit, Markups, and Relationships.” International Finance Discussion Papers 1303. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/IFDP.2020.1303.

Huang, Y., Pagano, M. and Panizza, U. “Local Crowding-Out in China.” *The Journal of Finance*, 2020, 75(6), 2855-2898.

Iacovone, L.; Ferro, E.; Pereira-López, M. and Zavacka, V. Banking Crises and Exports: Lessons from the Past. *Journal of Development Economics*, 2019, 138, 192-204.

IMF. *Sustaining the Recovery. World Economic Outlook.* International Monetary Fund, 2009 (October).

Imlau, S. I. “The International Trade Credit Channel: Implications for Industry Performance.” *Theses and Dissertations*, University of Wisconsin Milwaukee, 2017, 1490.

Kroszner, R. S.; Laeven, L. and Klingebiel, D. “Banking Crises, Financial Dependence, and Growth.” *Journal of Financial Economics*, 2007, 84(1), 187-228.

Levine, R.; Lin, C. and Xie, W. "Corporate Resilience to Banking Crises: The Roles of Trust and Trade Credit." *Journal of Financial and Quantitative Analysis*, 2018, 53(4), 1441-1477.

Lewbel, A. "Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models." *Journal of Business & Economic Statistics*, 2012, 30(1), 67-80.

Lewer, J. J. and Van den Berg, H., "How Large is International Trade's Effect on Economic Growth?" *Journal of Economic Surveys*, 2003, 17(3), 363-396.

Li, X. and Su, D. "Total Factor Productivity Growth at the Firm-Level: The Effects of Capital Account Liberalization." *Journal of International Economics*, 2022, 139, 103676.

Li, Y.; Jian, Z.; Tian, W., and Zhao, L. "How Political Conflicts Distort Bilateral Trade: Firm-Level Evidence from China." *Journal of Economic Behavior & Organization*, 2021, 183, 233-249.

Lin, S. and Ye, H. "Foreign Direct Investment, Trade Credit, and Transmission of Global Liquidity Shocks: Evidence from Chinese Manufacturing Firms." *Review of Financial Studies*, 2018, 31(1), 206-238.

Long, C. and Zhang, X. "Cluster-based Industrialization in China: Financing and Performance." *Journal of International Economics*, 2011, 84(1), 112-123.

Ma, X. and Xie, W. "Destination Country Financial Development and Margins of International Trade." *Economics Letters*, 2019, 177, 99-104.

Manova, K. "Credit Constraints, Heterogeneous Firms, and International Trade." *Review of Economic Studies*, 2013, 80(2), 711-744.

Manova, K.; Wei, S. J. and Zhang, Z. "Firm Exports and Multinational Activity Under Credit Constraints." *Review of Economics and Statistics*, 2015, 97(3), 574-588.

Manova, K. and Yu, Z. "How Firms Export: Processing vs. Ordinary Trade with Financial Frictions." *Journal of International Economics*, 2016, 100, 120-137.

Maskus, K. E., Neumann, R. and Seidel, T. "How National and International Financial Development Affect Industrial R&D." *European Economic Review*, 2012, 56(1), 72-83.

Maskus, K. E., Milani, S. and Neumann, R. "The Impact of Patent Protection and Financial Development on Industrial R&D." *Research Policy*, 2019, 48(1), 355-370.

Mateut, S. "Reverse Trade Credit or Default Risk? Explaining the Use of Prepayments by Firms." *Journal of Corporate Finance*, 2014, 29, 303-326.

Minetti, R., Mulabdic, A., Ruta, M. and Zhu, S. C. "Financial Structures, Banking Regulations, and Export Dynamics. *Journal of Banking & Finance*, 2021, 124, 106056.

O'Connor, K. J. and Graham, C. "Longer, More Optimistic, Lives: Historic Optimism and Life Expectancy in the United States." *Journal of Economic Behavior & Organization*, 2019, 168, 374-392.

Raddatz, C. "Liquidity Needs and Vulnerability to Financial Underdevelopment." *Journal of Financial Economics*, 2006, 80(3), 677-722.

Rajan, R. and Zingales, L. “Financial Development and Growth.” *American Economic Review*, 1998, 88(3), 559-586.

Rauch, J. E. “Networks versus Markets in International Trade.” *Journal of International Economics*, 1999, 48(1), 7-35.

Schmidt-Eisenlohr, T. “Towards a Theory of Trade Finance.” *Journal of International Economics*, 2013, 91(1), 96-112.

Silva, J. S. and Tenreyro, S. “The Log of Gravity.” *Review of Economics and statistics*, 2006, 88(4), 641-658.

Van den Berg, H. and Lewer, J. J. *International Trade and Economic Growth*, New York: Routledge, 2015.

Tables and graphs

Table 1: Summary statistics

Variables	Obs	Mean	Std. Dev.	P25	Median	P75
Panel A: Dependent variable						
lnExport	4197833	1.256	3.282	-1.312	1.088	3.621
Panel B: Regressor of interest						
DTC×ELD	4197833	0.332	1.105	0.047	0.158	0.334
DTC	4197833	4.427	12.916	0.738	2.495	4.644
ELD	4197833	0.075	0.036	0.060	0.070	0.080
Panel C: Control variables						
lndist	4197833	8.431	0.968	7.779	8.698	9.161
contig	4197833	0.044	0.206	0	0	0
com_lang	4197833	0.140	0.347	0	0	0
com_leg	4197833	0.358	0.479	0	0	1
rta	4197833	0.326	0.469	0	0	1

Notes: Panel A displays the key dependent variable in the estimations. *Export* (log) are measured in 100,000 USD. Panel B displays the regressors of interest, including *DTC*, *ELD* and the interaction between *DTC* and *ELD*. Panel C displays the control variables.

Table 2: Baseline estimation results

	(1)	(2)	(3)
DTC×ELD	0.016**	0.018***	0.017***
	(0.007)	(0.007)	(0.007)
lndist		-1.484***	-1.168***
		(0.005)	(0.006)
contig			0.804***
			(0.020)
com_lang			0.541***
			(0.013)
com_leg			0.190***
			(0.008)
rta			0.503***
			(0.009)
Constant	1.250***	13.759***	10.754***
	(0.004)	(0.038)	(0.050)
Source-Year FE	Yes	Yes	Yes
Destination-Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	4197833	4197833	4197833
Adj.R^2	0.447	0.562	0.570

Notes: Dependent variable is export value (logarithm). Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance level at 0.01, 0.05, and 0.1, respectively.

Table 3: Controlling for other industry characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DTC×ELD	0.018***	0.031***	0.045***	0.021***	0.059***	0.069***	0.074***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.009)
DTC×FD	0.002***						-0.001
	(0.000)						(0.001)
DTC×Gro		0.035***					0.057***
		(0.006)					(0.011)
DTC×Hum			0.005***				0.009***
			(0.001)				(0.001)
DTC×RD				0.006***			-0.034**
				(0.002)			(0.015)
DTC×Cap					0.000		-0.031***
					(0.007)		(0.010)
DTC×Na						-0.002***	-0.000
						(0.001)	(0.001)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Source-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4197833	4197833	3172173	4197833	3172173	3172173	3172173
Adj.R²	0.570	0.570	0.579	0.570	0.579	0.579	0.579

Notes: Dependent variable is export value (logarithm). Columns (1)-(5) include respectively the interaction terms *DTC×FD*, *DTC×Gro*, *DTC×Hum*, *DTC×RD, DTC×Cap*, and *DTC×Na.* Column (7) includes all the six interaction terms. Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance levels at 0.01, 0.05, and 0.1, respectively.

Table 4: Controlling for other destination characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
DTC×ELD	0.030***	0.025***	0.035***	0.027***	0.037***	0.087***
	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.009)
Econ×ELD	-1.006***				-1.334***	-0.807***
	(0.073)				(0.135)	(0.174)
Fin×ELD		-0.019***			-0.000	0.002
		(0.002)			(0.003)	(0.004)
Open×ELD			-0.899***		-0.454**	-0.418
			(0.199)		(0.212)	(0.282)
Rule×ELD				-1.009***	0.600***	0.263
				(0.104)	(0.200)	(0.258)
DTC×FD						-0.001
						(0.001)
DTC×Gro						0.052***
						(0.011)
DTC×Hum						0.009***
						(0.001)
DTC×RD						-0.034**
						(0.015)
DTC×Cap						-0.028***
						(0.010)
DTC×Na						-0.001
						(0.001)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Source-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4197833	3717475	4190239	4197833	3714198	2806996
Adj.R²	0.570	0.576	0.570	0.570	0.576	0.585

Notes: Dependent variable is export value (logarithm). Columns (1)-(4) include respectively the interaction terms *Econ×ELD, Fin×ELD*, *Open×ELD*, and *Rule×ELD.* Column (5) includes all the four interaction terms. Column (6) includes all the interaction terms between the six industry-level variables and *DTC* and the interaction terms between the four destination-level variables and *ELD*. Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

Table 5: Instrumental variable tests

	(1)	(2)	(3)
	Degree of trusting neighbors	Lewbel	
Panel A: Second stage	Dependent variable: *lnExport*		
DTC×ELD	3.327***	0.072*	0.096**
	(1.544)	(0.039)	(0.038)
Panel B: First stage	Dependent variable: *DTC×ELD*		
IV	0.952***	28.885***	33.459***
	(0.183)	(0.462)	(0.467)
Control	Yes	Yes	Yes
Fin×ELD, Rule×ELD			Yes
Source-Year FE	Yes	Yes	Yes
Destination-Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Kleibergen-Paap F-stats	26.925	3908.522	5126.518
N	2049757	2049757	1831027

Notes: Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

Table 6: Placebo test

	(1)	(2)	(3)	(4)
	OT	PT	PI	PA
DTC×Dep	0.046***	-0.008	0.031	-0.023
	(0.016)	(0.028)	(0.050)	(0.028)
Firm-year FE	Yes	Yes	Yes	Yes
Destination-year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	6618158	2152388	602765	1585195
Adj.R^2	0.304	0.286	0.223	0.309

Notes: Dependent variable is export value (logarithm). Robust standard errors in parentheses, clustered at the province-industry-destination level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

Table 7: Additional robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PPML	Alternative measures for *ELD*		Additional fixed effect			Clustering at different levels	
		Invent	Debt	Industry-Year	Source-Industry	Source-Industry-year	Source-Destination	Destination-Year
DTC×ELD	0.108***	0.007*	0.092***	0.016**	0.013**	0.012**	0.017***	0.017***
	(0.030)	(0.004)	(0.016)	(0.007)	(0.006)	(0.006)	(0.006)	(0.005)
Control	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Source-Year FE	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Destination-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes				Yes	Yes
N	14341824	4197833	4197833	4197833	4197806	4188506	4197833	4197833
Adj.R^2 or *Pseudo-*R^2	0.833	0.570	0.570	0.571	0.669	0.675	0.570	0.570

Notes: Dependent variable is export value in Column (1), and is the logarithm of export value in Columns (2)-(8). Robust standard errors in parentheses, clustered at the source-destination-industry level in Columns (1)-(6), at the source-destination level in Column (7), and at the destination-year level in Column (8). ***, **, and * represent significance at 0.01, 0.05, and 0.1, respectively.

Table 8: Other dimensions of export performance

	(1)	(2)	(3)
	lnquantity	*lnprice*	*lncount*
DTC×ELD	0.029***	-0.011***	-0.007***
	(0.008)	(0.002)	(0.002)
Control	Yes	Yes	Yes
Source-Year FE	Yes	Yes	Yes
Destination-Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	4197833	4197833	4197833
Adj.R^2	0.562	0.531	0.679

Note: Robust standard errors in parentheses, clustered at the source-destination-industry level. ***, **, and * represent significance at 0.01, 0.05, and 0.1, respectively.

Table 9: Financial development across source countries

	(1)	(2)
DTC×ELD×Formal_source	-0.059***	-0.061***
	(0.021)	(0.020)
DTC×ELD	0.065***	0.066***
	(0.019)	(0.018)
Control		Yes
Source-Year FE	Yes	Yes
Destination-Year FE	Yes	Yes
Industry FE	Yes	Yes
N	2388400	2369495
Adj.R^2	0.442	0.558

Notes: Dependent variable is export value (logarithm). Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

Table 10: DTC and exports in the global financial crisis

	(1)	(2)
DTC×ELD×Crisis	-0.056**	-0.064**
	(0.026)	(0.025)
DTC×ELD	0.065**	0.074***
	(0.027)	(0.025)
Control		Yes
Source-Year FE	Yes	Yes
Destination-Year FE	Yes	Yes
Industry FE	Yes	Yes
N	1858277	1808156
Adj.R^2	0.456	0.575

Notes: Dependent variable is export value (logarithm). Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

Table 11: Product complexity (1)

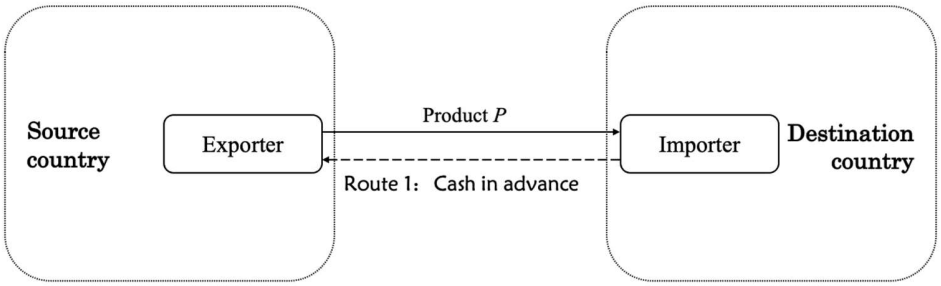
	(1)	(2)
	Conservative	Liberal
DTC×ELD×Comp	-0.199***	-0.200***
	(0.019)	(0.019)
DTC×ELD	0.104***	0.103***
	(0.013)	(0.012)
Control	Yes	Yes
Source-Year FE	Yes	Yes
Destination-Year FE	Yes	Yes
Industry FE	Yes	Yes
N	4197833	4197833
Adj.R^2	0.570	0.570

Notes: Dependent variable is export value (logarithm). Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

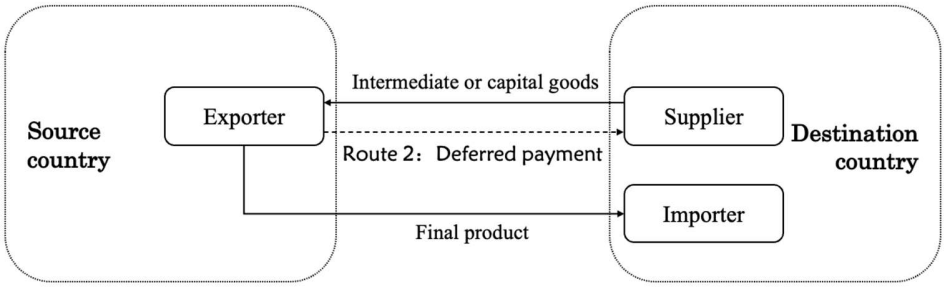
Table 12: Product complexity (2)

	(1)	(2)	(3)	(4)
	Conservative		Liberal	
	Law=1	*Law*=0	*Law*=1	*Law*=0
DTC×ELD×Comp	-0.164***	-0.273***	-0.165***	-0.278***
	(0.021)	(0.036)	(0.021)	(0.036)
DTC×ELD	0.074***	0.168***	0.073***	0.168***
	(0.014)	(0.022)	(0.014)	(0.022)
Control	Yes	Yes	Yes	Yes
Source-Year FE	Yes	Yes	Yes	Yes
Destination-Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
p-value for statistical difference tests	0.000		0.000	
N	2713865	1433167	2713865	1433167
Adj.R^2	0.619	0.473	0.619	0.474

Figure 1: Routes of Destination Trade Credit



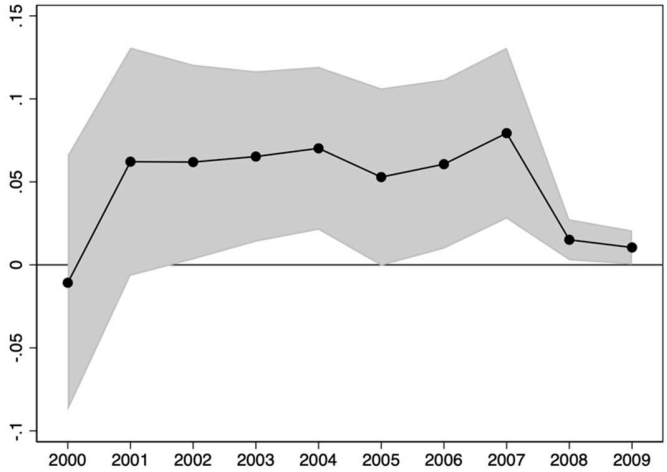
Route 1: Cash in advance



Route 2: Deferred payment

Notes: Solid and dotted arrows indicate the moving direction of goods and informal financing, respectively.

Figure 2: Effect of DTC on exports over time



Notes: Time-varying β_m coefficients of *DTC*×*DLD* are obtained by estimating Eq. (2). Gray area indicates the 95% confidence interval of each β_m.

Appendix A1: Estimation results using DTC as the core explanatory variable

Table A1: DTC and exports

	(1)	(2)
DTC	0.376**	0.309*
	(0.177)	(0.172)
lnGDP	0.530***	0.506***
	(0.035)	(0.034)
lnGDP_p	0.463***	0.476***
	(0.083)	(0.079)
Fin	0.001***	0.001***
	(0.000)	(0.000)
Rule	-0.055	-0.052
	(0.036)	(0.034)
lndist	-1.285***	-1.287***
	(0.020)	(0.020)
contig	0.790***	0.787***
	(0.100)	(0.101)
com_lang	0.830***	0.834***
	(0.042)	(0.042)
com_leg	0.036	0.036
	(0.027)	(0.027)
rta	0.519***	0.521***
	(0.032)	(0.033)
Constant	-3.095***	-2.584***
	(0.757)	(0.728)
Source FE	Yes	
Source-Year FE		Yes
Destination FE	Yes	Yes
Year FE	Yes	Yes
N	250474	250473
Adj.R^2	0.768	0.772

Notes: Dependent variable is the natural logarithm of the export value of country *i* to country *j* in year *t*. Robust standard errors in parentheses, clustered at the source-destination level. ∗∗∗, ∗∗, and ∗ represent significance levels at 0.01, 0.05, and 0.1, respectively.

We have also attempted to aggregate the trade data of CEPII-BACI into the "source-destination-year" level, and conducted regression analysis using the single-term DTC as the core explanatory variable. As in Table A1 column (1), in addition to the core explanatory variable DTC and the control variables commonly used in the gravity equation, we add a group of control variables at the destination country level, including the natural logarithm of the GDP (*lnGDP*), the natural logarithm of the per capita GDP (*lnGDP_p)*, the formal financial development level (*Fin*) and the institutional quality level (*Rule*). We also include the source country fixed effect, destination country fixed effect and year fixed effect.

It can be seen that the estimated coefficient of DTC is significantly positive at the 5% level, indicating that DTC has a significant promoting effect on exports. In column (2), we add the source-year fixed effect to further control for the influence of factors varying at the source-year level. The estimated coefficient of DTC is also significantly positive, indicating again that DTC is beneficial for export expansion.

Appendix A2: Estimation results using *ELD* based on the Chinese data

To further test the robustness of the baseline estimation results, referring to Fan et al. (2015), we also use the Chinese Industrial Enterprise Database (CIED) to calculate the *ELD* in China, and then perform regression analysis based on the Chinese customs data.[23]

Firstly, referring to Fisman and Love (2003), we calculate the ratio of accounts payable to total assets of Chinese firms from 2004 to 2006, and then take the median ratio of each Chinese 2-digit industry as the measurement of the industry's *ELD*.[24] Secondly, based on the correspondence table between Chinese Industrial Classification (CIC) and ISIC provided by Huang et al. (2020), Chinese *ELD* (denoted as ELD^{CHN}) is mapped to the ISIC industry classification. Finally, similar to the placebo test, we use $DTC \times ELD^{CHN}$ as the core explanatory variable to perform regression analysis based on the Chinese customs data. We only retain the sample of ordinary trade exporters and exclude the sample of trade intermediaries.

Table A2: External liquidity dependence based on Chinese data

	(1)	(2)	(3)
	2000-2006	2000-2006	2004-2006
$DTC \times ELD^{CHN}$	0.057*	0.067**	0.056*
	(0.031)	(0.032)	(0.034)
$Fin \times ELD^{CHN}$		Yes	Yes
Firm-year FE	Yes	Yes	Yes
Destination-year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	5347385	4809776	3043641
$Adj.R^2$	0.316	0.316	0.323

Notes: Dependent variable is export value (logarithm). Robust standard errors in parentheses, clustered at the province-industry-destination level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

[23] Due to data limitation, we currently only have the firm-level database that can be used to calculate *ELD*. And the CIED is based on the Annual Surveys of Industrial Firms conducted by the National Bureau of Statistics of China.

[24] The reason for choosing 2004-2006 is: on the one hand, the data of CIED after 2004 only include information on accounts payable; on the other hand, the Chinese customs data used in the regression is up to 2006.

The estimation results are shown in Table A2. The regression of column (1) uses Chinese customs data from 2000 to 2006. The sample period used in column (2) is also from 2000 to 2006, but the interaction term between the formal financial development in the destination country (*Fin*) and ELD^{CHN} is added to control for the impact of the formal financial development. Column (3) shortens the sample interval in column (2) to 2004-2006 to match the data interval used to calculate ELD^{CHN}. It can be seen that the estimated coefficients of $DTC \times ELD^{CHN}$ in columns (1)-(3) are significantly positive. This result indicates that DTC still contributes to the export expansion after using *ELD* based on the Chinese data.

Appendix A3: Heterogeneity analysis results using sub-sample regression

Table A3: Heterogeneity analysis results using sub-sample regression

	(1)	(2)	(3)	(4)
	Full sample		2000-2009	
	Formal_source=1	*Formal_source*=0	2000-2007 (*pre-crisis*)	2008-2009 (*crisis*)
DTC×ELD	0.005	0.058***	0.075***	0.009*
	(0.010)	(0.016)	(0.025)	(0.005)
Control	Yes	Yes	Yes	Yes
Source-Year FE	Yes	Yes	Yes	Yes
Destination-Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
p-value for statistical difference tests	0.000		0.000	
N	1671286	698206	1355470	452686
Adj.R^2	0.600	0.395	0.576	0.573

Notes: Dependent variable is export value (logarithm). Robust standard errors in parentheses, clustered at the source-destination-industry level. ∗∗∗, ∗∗, and ∗ represent significance at 0.01, 0.05, and 0.1, respectively.

Appendix A4: Macroeconomic impacts of DTC

Table A4: Macroeconomic impacts for one standard deviation increase in *DTC*

Source of estimated coefficient	Export (%)	GDP (%)	Employment (%)
Column (3) of Table 2	1.77	0.35	0.18
Column (6) of Table 4	9.41	1.88	0.94
Column (2) of Table 5	7.73	1.55	0.78

We roughly calculate the impacts of DTC on the GDP growth rate and employment rate, in several steps. Firstly, we calculate the effect of DTC on exports. According to the estimated coefficient of *DTC*×*ELD* in column (3) of Table 2, if *ELD* takes the sample mean value (0.08) and *DTC* increases by one standard deviation (12.92), then exports will increase by 1.77% on average.[25]

Secondly, we calculate the impact of DTC on the GDP growth rate. Borrowing from Lewer and Van den Berg (2003) and Van den Berg and Lewer (2007), who systematically review the empirical literature on the effects of exports on economic growth, and conclude that every 1% increase in exports will drive an average GDP growth of 0.2 percentage points. Using this result, we find that GDP will increase by 0.35 percentage points for every standard deviation rise in *DTC* in our sample.[26]

Finally, according to *Okun's law* (Ball et al., 2017), we can roughly calculate the impact of DTC on employment through exports and economic growth. *Okun's law* shows that for every 1% increase in GDP, the employment rate increases by about 0.5%. Using this, we find that for every standard deviation rise of *DTC*, the employment rate will increase by 0.18 percentage points.[27]

[25] $(e^{0.017*12.92*0.08}-1)\times 100\%=1.77\%$.
[26] $1.77\times 0.2=0.35$.
[27] $0.35 \times 0.5=0.18$.

In addition, we also do calculations according to the estimated coefficients of column (6) in Table 4 and column (2) in Table 5. The results are reported in Table A4.