Is there an employee-based gender gap in informal financial markets? International evidence

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Abstract

We study the impact of female production workers on firms' access to trade credits across the world. Using two sources of plausibly exogenous variations in gender bias and a difference-in-differences framework, we document that firms with more female production workers have less access to trade credits in countries with stronger gender beliefs that favor males. This relationship is largely driven by firms in industries with unexpected credit shortages and industries dominated by males. Since female firms rely more on informal finance, this study is relevant for policies that direct female firms towards formal credit markets in highly gender-biased places.

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1. Introduction

A key function of financial markets is to identify investment opportunities with positive net present value (NPV) and allocate credits efficiently among them (Levine, 1997). In practice, however, this allocation process is often distorted by various sources of frictions, such as information asymmetry (Jaffee and Russell, 1976; Stiglitz and Weiss, 1981; Djankov et al., 2007), moral hazard (La Porta et al., 1997, 1998, 2000) and cultural factors (Stulz and Williamson, 2003; Guiso et al., 2004).

In particular, an important culture element, gender beliefs favoring males, has been emphasized by many recent studies that examine the function of financial markets (e.g., Alesina et al., 2013; Aterido et al., 2011). Ongena and Popov (2016), for example, document that female entrepreneurs are more reluctant to apply for bank loans and are more likely to rely on informal finance, even though banks do not appear to discriminate against them. While insightful, these studies have mainly focused on gender bias against female managers. Given that female workers account for more than 40% of the labor market in a representative international sample,[1] and given that gender bias is a social phenomenon rather than a constraint on managerial occupations, it is important to ask whether there is an employee-based gender gap in credit markets.

Using a pooled cross-sectional dataset from the World Bank Enterprise Survey of around 31,000 firms during 2009-2018, we examine the impact of female production workers on manufacturing firms' access to trade credits across 81 countries. Conceptually, gender bias can distort the allocation of trade credits through two channels. First, in a gender-biased environment, suppliers may misperceive a buyer's ability based on the sex composition of its workforce, and misallocate credits accordingly (Sarsons, 2017, 2019; Duflo, 2012). Since trade credit markets often involve frequent site visits by credit suppliers (Petersen and Rajan, 1997), firms with more female production employees in factories or plants may be perceived as incompetent and less likely to succeed in the product market (i.e., statistical discrimination).[2] As a result, they are offered less trade credit relative to firms with lower shares of female production workers.[3] This does not imply

[1] The number is calculated using the World Bank Enterprise Survey in 2018. The sample includes 133,731 firms from 137 countries across the world.

[2] Site visits in general involve collecting information on human resources (HR), including recruitment and training. Moreover, speaking to employees and asking about their work environment is often encouraged during a visit by some industry standards. This allows suppliers to collect information on employee demographics, including gender.

[3] Petersen and Rajan (1997) stress that the supplier of trade credit may visit the buyer's plant or factories more often than formal financial institutions would in order to obtain information on the buyer's credit quality. Although financial

that female workers underperform their male peers in manufacturing industries but rather emphasizes the misperception held by lenders due to gender bias. Second, gender norms favoring males may affect trade credit allocation through altering suppliers' preferences or "tastes" (Becker, 1957; Goldin, 2014). Jayachandran (2015) and Dhar et al. (2018) show that deeply held preferences that discriminate against women can explain a non-trivial part of the gender gap in many economic outcomes. Therefore, suppliers may choose to allocate more credit to firms with a larger fraction of male employees simply due to preference. Note that these channels stress that suppliers may allocate trade credit based on misperceptions and biased preferences, rather than customer (borrowing) firms' ability.

Identifying the causal impact of gender bias on firms' access to trade credits is challenging. First, contemporaneous components of gender bias, such as those extracted from the World Value Survey, and the patterns of firms' access to informal finance may be codetermined by the current stage of economic development, the quality of institutions and other unobservable country characteristics. In addition, the specific patterns of firm financing and performance may further exacerbate the gender beliefs held by a society. Both problems can make it difficult to draw causal inferences from gender bias to firm access to trade credits. Indeed, results from existing studies are largely mixed. While Asiedu et al. (2013) document a negative link between female entrepreneurs and access to finance in Sub-Saharan Africa, for example, Aterido et al. (2011) show that such relationship disappears once firm or individual characteristics are added.

We exploit two distinct sources of plausibly exogenous variations in gender bias in an attempt to establish causality. The first is based on a well-established insight in economics that countries with a heritage of plough agriculture exhibit weaker beliefs about the equality of men and women today (Alesina et al., 2013a, 2018; Boserup, 1970). The economic reasoning is that the practice of plough agriculture generated a division of labor along gender lines, where men specialized in work outside the home in the fields and women specialized in housework. This is because plough agriculture requires substantial upper body strength and bursts of power to control the plough, which gives men an advantage relative to women. Societies featuring traditional plough agriculture have thus developed beliefs that the natural place for women is at home, and

institutions may also collect similar information, trade credit suppliers can get such information faster and at lower cost via the normal course of business.

such beliefs have persisted even after these societies moved out of agriculture. Alesina et al. (2013a) construct a measure of ancestral plough agriculture from the Ethnographic Atlas (Murdock, 1967), which reports information on whether societies traditionally used the plough on 1,265 ethnic groups prior to industrialization. We use the population-weighted country average of this measure, provided in Alesina et al. (2013a), as our first proxy for gender bias. Since the adoption of plough agriculture may be endogenous to the pre-industrial level of economic development, we supplement this measure with (1) a predicted probability of plough adoption using land suitability for crops that benefit more from plough agriculture, and (2) a measure of aboriginal plough adoption prior to European contact (Alesina et al., 2013a, 2018).

Our second measure of gender bias is extracted from survey responses by descendants of US immigrants on a question about the appropriate role of women in society. In particular, we use gender beliefs that US descendants have inherited from their ancestors who immigrated to the US as a proxy of gender bias in their country of origin. As emphasized by Putnam (2000) and Guiso et al. (2006) that social capital is transmitted by family from parents to children, the gender beliefs of a US descendent are a good proxy for the gender beliefs of their immigrant ancestors, and by extension a good proxy for the inherited component of gender beliefs in the country of origin today. This methodology was pioneered by Algan and Cahuc (2010) to study the effects of inherited trust on growth and first applied to research on gender bias by Ongena and Popov (2016). While this measure is not confounded by home countries' time-invariant characteristics, it may suffer from the selective migration problem. That is, the initial conditions in the home country at the time of immigration, such as war, political turmoil and economic depression, could codetermine both the current financing patterns of firms in the home country and the inherited gender beliefs of descendants of US immigrants. To address this concern, we focus on the gender beliefs of descendants that are at least two generations apart from the first immigrants. This mitigates the effect of specific country of origin shocks and allows us to construct a cleaner measure of inherited gender bias. As stressed by Paulson and Osili (2008), ancestral beliefs of US immigrants decline over time, implying that the results from using this measure provide a lower bound of the effects of inherited gender bias on the function of informal credit markets.

We then use these plausibly exogenous measures of gender bias in a difference-in-differences framework that compares access to trade credits of manufacturing firms with high and low shares of female production employees in countries with strong or weak gender bias. This

framework allows us to flexibly include country-year and industry-year fixed effects to control for country and industry time trends, as well as the influence of time-invariant factors, such as legal origins (La Porta et al., 1997, 1998, 2000), the quality of institutions (Hall and Jones, 1999; Acemoglu et al., 2001), the extent of fractionalization (Alesina et al., 2003) and geography (Sachs, 2003; Rodrik et al., 2004).

We discover that, in highly gender-biased countries, manufacturing firms with more female production workers have less access to trade credits. Our estimates imply that, moving from countries with low (e.g., Czech Republic) to high gender bias (e.g., Slovenia), access to trade credits (as a share of purchased material inputs or services) of firms that have a higher share of female production workers is 6.33 percentage points lower than that of their otherwise similar counterparts with fewer female production employees.[4] Given that our sample mean of trade credits, defined as the ratio of material inputs or services paid after delivery, is 44%, this estimate is economically substantial. Our results are robust to different model specifications, sample selection, alternative measures of gender bias and various assumptions about the variance-covariance matrix.

An important threat to our identification strategy is that firms may endogenously choose their workforce composition. For example, if firms with little demand for trade credits hire more female employees in countries with higher gender bias, then our estimates are not capturing the effects of gender bias. We employ three strategies to address this concern. First, we saturate our model with a large set of firm characteristics that may be correlated with both access to trade credits and share of female employees. Second, we employ propensity score matching (PSM) to construct a sample where, for each treated firm (i.e., a firm with high female share), we assign a control firm (i.e., a firm with low female share) that is very similar to the treated in terms of observable characteristics. Results from this propensity score matched sample are similar to our main estimates. Finally, we gather data on a new sample of firms from the Business Environment and Enterprise Performance Survey (BEEPS) IV and V and show that our findings are robust to a panel estimation with firm fixed effects. This allows us to control for all time-invariant firm-level characteristics. While PSM and panel estimation are useful, they have their own disadvantages.

[4] This interpretation is based on the estimates in column (4) Table A13.

For example, PSM does not address omitted variable concerns arising from unobservable firm characteristics. The panel estimation may potentially suffer from a small sample bias. Our next set of analyses aim to complement these tests.

To alleviate any remaining concerns that omitted firm characteristics bias our results, we perform several cross-sectional analyses that examine whether the impact of gender bias on firms' access to trade credit varies across different scenarios in a theoretically consistent manner. For example, as emphasized by a large body of literature on development economics, the impact of gender bias is stronger when resources become scarce (e.g., Jayachandran and Pande, 2017; Jayachandran and Kuziemko, 2011). This suggests that if firms with more female workers receive fewer trade credits due to gender bias, then this relationship should be more pronounced in industries that face higher unexpected credit shortages. From the International Monetary Fund Primary Commodity Price System, we obtain and match time-series data on major international commodity price indices to our sample. We find that our results are mainly driven by firms in industries that have just suffered from unexpected price reductions from international commodity markets. Since the unexpected credit shortages are not correlated with, and therefore exogenous to, firm characteristics and decisions, this evidence supports our main results that firms with more female production workers have less access to trade credits in highly gender-biased countries. Relying on a similar economic reasoning from the finance-growth literature (e.g., Rajan and Zingales, 1998), we also conjecture, and find, that the relationship between gender bias and access to trade credits is driven by industries that are more dependent on external credits for technological reasons.[5]

[5] Following Rajan and Zingales (1998), we construct a measure of industrial dependence on external finance (EFD). This is calculated as the fraction of capital expenditures not financed with a firm's internally generated cash flows. Rajan and Zingales (1998) invent and calculate this measure at the 3-digit ISIC level using data from the United States during the 1980s. They argue that financial markets are relatively frictionless in the United States and therefore EFD calculated this way measures the varying degrees to which firms depend on external finance across industries for technological reasons.

It is important to note that dependence on external finance is used to measure a relatively more resource-limited environment where the effects of gender bias are found to be particularly strong (Jayachandran and Pande, 2017; Jayachandran and Kuziemko, 2011). Dependence on external finance is well-suited in this setting because it incorporates both the long- and short-term financing needs of a firm. Specifically, capital expenditures (the first component) capture a firm's long-term investment needs, while cash flows from operation (the second component) cover short-term liquidity needs. Indeed, as emphasized by Petersen and Rajan (1997), variables that proxy for a firm's finance demand should incorporate its investment opportunities, liquidity and access to finance from financial institutions. Measures that only capture one part of the financing needs are therefore less suitable in this study.

The next cross-sectional test is based on a well-established insight in social psychology that the impact of gender diversity (i.e., having more women on corporate boards or in the workforce) on firm outcomes may vary depending on the industry involved (e.g., Cejka and Eagly, 1999; Glick, 1991). In a recent study, for example, Cumming et al. (2015) find that female board directors reduce corporate fraud and, more importantly, this relationship is largely driven by firms in male-dominated industries, where a masculine personality is viewed as necessary for success. We relate this finding to our setting and conjecture that if firms receive fewer trade credits due to gender bias, then this link should be more pronounced in male-dominated industries where gender prejudice is supposedly stronger (Cejka and Eagly, 1999; Glick, 1991). This is indeed what we find: our results are largely driven by firms operating in male-dominated industries. Taken together, the evidence thus far suggest that our main estimates are unlikely to be completely driven by endogenous female employees share due to the presence of omitted variables and reverse causality.

A remaining concern relates to potential measurement errors in the share of female production workers. That is, suppliers of trade credits may not obtain accurate information on firms' workforce composition. The presence of such measurement errors can bias our estimates in either direction if they are systematically correlated with firm characteristics. To alleviate this concern, we first note that suppliers of trade credits frequently visit borrowing firms' plants or factories to collect information relevant to their business decision-making (Petersen and Rajan, 1997), including on workforce composition. We argue and provide some empirical support that suppliers use such information in trade credit allocation decisions. In particular, we conduct two cross-sectional analyses where we differentiate firms based on (a) the frequency at which they interact with their suppliers, and (b) the extent to which they can be visited with low costs. We find that our results are mainly driven by firms that frequently interact with their suppliers and firms that are located in places with relatively lower site visit (transportation) costs, consistent with our argument. We also test and discover that the negative impact of gender bias is not present in bank financing, which, as emphasized in Petersen and Rajan (1997), involves few site visits.[6] In

[6] Petersen and Rajan (1997) stress that suppliers of trade credit may visit the buyer's plant or factories more often than formal financial institutions would in order to obtain information on the buyer's credit quality. If suppliers of trade credits obtain borrowers' workforce information via site visits, then we would expect the impact of female workers on firm access to external finance would be stronger in trade credit markets. In other words, we would not expect to see similar empirical patterns in bank financing.

sum, results from these three sets of analyses provide empirical support that (a) suppliers obtain borrowers' information via frequent business interactions, and (b) our baseline findings are not completely driven by measurement errors in the share of female workers.

Although we use two largely exogenous measures of gender bias and include country fixed effects in our empirical analyses, it is worthwhile to stress that our results are not driven by other country-level characteristics that are found to be important to trade credits in the literature, such as national culture (El Ghoul and Zheng, 2016; Zheng et al., 2012, 2013), the quality of the legal system (Johnson et al., 2002a; La Porta et al., 1997, 1998, 2000), property rights protection (Johnson et al., 2002b; Beck et al., 2003) and financial development (Demirguc-Kunt and Maksimovic, 2002; Beck et al., 2008). In a robustness check, we control for these country-level characteristics and allow them to have differential impact on access to trade credits in high- and low-female-share firms. Our results after controlling for the effect of these variables remain unchanged.

A natural question to ask, following the results, is why manufacturing firms hire female production employees if they are associated with less access to trade credits. We propose several potential explanations. First, firms may be trading off access to trade credits for lower labor costs and less managerial burden. Across the world, women are often offered lower salaries compared to their otherwise similar male peers (Blau and Kahn, 2004; Blau and DeVaro, 2007), because reproductive and domestic responsibilities, such as childcare, lower their bargaining power against their employers.[7] A closely related explanation is that hiring female workers reduces managerial burden. In a report by Clean Clothes Campaign,[8] for example, a Bangladeshi factory worker states that firms do not care about demands raised by female employees, while they must give some consideration to demands raised by men. This can increase firms' managerial tasks and work-related costs, therefore leading firms to hire more female workers. We assemble data on the unit cost of labor, measured as a firm's total cost of labor divided by the total number of employees, to test whether firms with a higher share of female production workers have lower costs of labor. We discover that firms with more female workers indeed have a smaller unit cost of labor. We also

[7] A US survey conducted by Pew Research Center on working-age adults reveals that 35% of women are reportedly paid a lower salary compared to their male colleagues. For more details, see https://www.pewresearch.org/fact-tank/2018/03/07/women-in-majority-male-workplaces-report-higher-rates-of-gender-discrimination/.
[8] See https://cleanclothes.org/issues/gender.

test the employee-based gender effects on other firm outcomes, and we find no detectable impact on firm sales growth, profit margin and capacity utilization. These results imply that, on average, the impacts of female employees on firm access to trade credit and on labor costs cancel each other out, generating a sustainable dynamic equilibrium among female employees, access to trade credits and labor costs.

The rest of the paper is organized as follows. Section 2 discusses this paper's contributions and relation to the existing literature. Section 3 describes data and empirical methodology. Section 4 presents results. Section 5 performs various robustness checks and presents some suggestive evidence on firm outcomes, while Section 6 concludes the paper.

2. Related literature and contributions

This paper is closely related to the literature on the cross-country determinants of access to trade credits. While the literature mainly focuses on the impact of formal institutions, such as the legal environment (e.g., Demirgüç-Kunt and Maksimovic, 2002; Johnson et al., 2002b), property rights protection (e.g., Beck et al., 2008) and the extent of political control over private economy (e.g., Chen et al., 2020), El Ghoul and Zheng (2016) show that national cultural factors, such as collectivism, power distance, uncertainty avoidance and masculinity, plays a key role in shaping the function of trade credit markets. We build on this literature by documenting that a social norm that favors males, another important informal institution, also determines the operation of trade credit markets, and such impact operates through employees, a previously ignored firm aspect.[9]

This paper differs from, but complements, a growing body of empirical literature on the gender gap in financial markets. While insightful, existing studies only focus on formal financial markets.[10] In particular, scholars find that female entrepreneurs and owners are less likely to apply for bank loans (Cavalluzzo et al., 2002; Buvinic and Berger, 1990) and more likely to rely on informal finance (Richardson et al., 2004; Ongena and Popov, 2016), even though banks do not appear to discriminate against females (Carter et al., 2007, Aterido et al., 2011; Bruhn, 2009). Our

[9] There is a large number of influential studies on trade credits that focus on a single country; for example, the US (e.g., Petersen and Rajan, 1997; Giannetti et al., 2011), the UK (e.g., Atanasova, 2007; Cunat, 2007), China (e.g., Cull et al., 2009; Ge and Qiu, 2007) and Vietnam (e.g., McMillan and Woodruff, 1999).

[10] Another related stream of literature studies the impact of female directors on firm outcomes (e.g., Adams and Funk, 2012; Adams and Ferreira, 2009; Sila et al., 2016; Chen et al., 2019).

study complements this literature by examining the gender gap in access to trade credits, which is the most important source of short-term finance for manufacturing firms (Petersen and Rajan, 1997; Fisman and Love, 2003; Klapper et al., 2012).

Our study is also closely related to recent work by Ongena and Popov (2016). Using a similar identification strategy, the authors find that firms led by female entrepreneurs are less likely to use bank loans and more likely to resort to informal finance. Our paper is distinct in two important aspects. First, while Ongena and Popov (2016), like many others, focus on female entrepreneurs, we study the impact of female workers. Since gender norms are an aspect of society (Stulz and Williamson, 2003; Guiso et al., 2004), it is important to expand the investigation from focusing only on managers and business owners to a wider scope of occupations, such as employees. According to the latest statistics from the World Bank,[11] female employees account for more than 47% of the global labor market, whereas only 16% of managers are female.[12] Second, our findings shed light on the supply side impact of gender bias, while Ongena and Popov (2016) highlight the demand side effects. In particular, an important insight from Ongena and Popov (2016) is that female entrepreneurs choose to opt out of loan applications and rely on informal finance. Our results, on the other hand, show that firms with more female workers are offered fewer trade credits, regardless of their demand for finance.[13] Our paper also adds to this literature by providing additional causal evidence on gender gap and firm financing outcomes. While Ongena and Popov (2016) establish causality by extracting an exogenous component of gender bias from survey responses by descendants of US immigrants, we exploit historical plough adoption as an additional exogenous measure of gender bias. Based on the well-established insight in economics (Alesina et al., 2013a, 2018; Boserup, 1970), this measure is not confounded by the impact of modern economic and institutional determinants.

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[11] See https://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS.

[12] Focusing on gender bias based on employee composition is also more relevant in our setting because one of our key measures of gender bias, the historical adoption of the plough, is founded on the notion that women should stay home while men work on production jobs outside home (Alesina et al., 2013a, 2018; Boserup, 1970).

[13] Furthermore, even if firms' demands for informal finance are kept constant, female entrepreneurs may still be offered more trade credits in high gender-bias countries, because they may be perceived to be very highly skilled due to tougher selection rules for executive positions compared to otherwise similar male counterparts. The differential selection rules for females versus males may be less of a concern for regular, rank-and-file positions, which is consistent with our findings. Indeed, an extensive literature on gender gaps documents that female managers are more likely to face tougher selection rules compared to average female employees (e.g., Blau and DeVaro, 2007; Blau and Kahn, 2016).

To the extent that we measure gender bias using country-level inherited gender beliefs and plough agriculture, this paper is related to an important strand of literature that studies the impact of institutional characteristics on the function of credit markets (e.g., El Ghoul and Zheng, 2016; Zheng et al., 2012, 2013; Johnson et al., 2002a, b; La Porta et al., 1997, 1998, 2000; Beck et al., 2008, 2003; Demirguc-Kunt and Maksimovic, 2002). In an insightful work, for example, Ghoul and Zheng (2016) show that firm access to trade credits is positively associated with several dimensions of national culture, such as collectivism, power distance, uncertainty avoidance and masculinity. We add to this literature by documenting the independent impact of gender beliefs, another important dimension of national culture, on trade credit provision.[14]

This paper also speaks to the literature that examines various frictions on the function of the financial market. For example, Djankov et al. (2007) investigate the role of information asymmetry in shaping the function and development of financial markets (Jaffee and Russell, 1976; Stiglitz and Weiss, 1981). La Porta et al. (1997, 1998, 2000) assess the relationship between the extent of the legal constraints on managerial moral hazards and firm financing patterns across the world. We, consistent with Ongena and Popov (2016), Stulz and Williamson (2003) and Guiso et al. (2004), show that gender bias exerts a significant impact on the function of credit markets, and offer relevant policy implications to alleviate this friction.

Lastly, we contribute to the literature on the consequences of unequal gender beliefs.[15] For example, Blau and Kahn (2004) show that labor market discrimination towards females had deleterious effects on closing the US gender pay gap in the 1990s. Using a unique employer survey, Blau and DeVaro (2007) reveal that women across occupations have a lower probability of being promoted than men, even conditional on job-specific ratings of performance and ability. This paper extends this line of work by providing evidence that gender bias favoring males can also disrupt the allocative function of financial markets.

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[14] Relatedly, our study also speaks to the literature that investigates the impacts of cultural beliefs on economic outcomes. While the majority of the line of research focuses on trust (e.g., Guiso et al., 2006, 2009; Algan and Cahuc, 2010; Aghion et al., 2010; Tabellini, 2008) and social capital in general (Putnam et al., 1994; Barr and Serra, 2010), we add to this literature by addressing another important cultural dimension, unequal gender belief, and its impact on the financial markets.

[15] Jayachandran and Pande (2017) find that gender beliefs that favor males can lead to differential allocation of food between daughters and sons, and this in turn contributes to the gender gap in stunting globally. Ramakrishnan et al. (2011) show that girls with congenital heart disease receive less treatment than boys due to gender bias. For literature reviews, see Duflo (2012) and Jayachandran (2015).

3. Data and empirical strategy

3.1 Plough-based measures of gender bias

Our first set of gender bias measures are obtained from Alesina et al. (2013a, 2018) and based on a well-established economic insight that countries with a plough agriculture heritage have weaker beliefs about the equality of men and women today (Alesina et al., 2013a, 2018; Boserup, 1970). The underlying economic mechanism is the following: (1) plough agriculture requires significant upper body strength and bursts of power to control the plough; (2) men have an advantage in terms of upper body strength and therefore tend to work outside home while women work at home; (3) this generated gender beliefs that the natural place for women is within the home, and such beliefs have persisted even if societies move beyond agriculture. Alesina et al. (2013a, 2018) construct a measure of historical adoption of plough agriculture from the Ethnographic Atlas (Murdock, 1967), which has information on whether societies traditionally used the plough on 1,265 ethnic groups prior to industrialization. We use a population-weighted country-level version of this measure (*Plough*) as our first proxy for pre-determined gender bias.

However, the historical adoption of the plough may be endogenous to the level of economic development and/or the quality of institutions at adoption. We address this concern by using two additional plough-based measures that are arguably less confounded by economic, institutional and political factors. First, we follow Alesina et al. (2013a, 2018) to construct a predicted plough adoption measure using land suitability for cultivating crops that potentially benefit more or less from plough agriculture. According to Pryor (1985), crops that require large tracts of solid, flat land to be prepared in a short period of time benefit more from the use of a plough relative to crops that can be cultivated on shallow, sloped or rocky soils over a longer period of time. Based on this insight, Alesina et al. (2013a) construct two variables, *Plough positive crops* and *Plough negative crops*, which measure the average land suitability for crops that benefit more or less from adopting the plough, respectively. We regress historical plough adoption (*Plough*) on the suitability of these crops, along with other important covariates, such as a measure of agriculture suitability (*Agriculture suitability*), an index of tropical climate (*Tropical climate*), an indicator of the existence of large domestic animals (*Large animals*), and measures of pre-industrial political institutions (*Political hierarchies*) and economic development (*Economic complexity*). Following Alesina et al. (2013a), we then use the linear prediction from this model as our first complementary

measure (*Predicted plough*) of gender bias. We also use a measure of aboriginal plough adoption prior to European contact as our second alternative (Alesina et al., 2013a, 2018). Table 1 presents the summary statistics on the plough-related variables (Panel A) and shows the results of the predicting regression.[16] Note that after merging with the World Bank Enterprise Survey, we have these measures for 91 countries. We then drop the countries with fewer than 30 firm observations to ensure meaningful estimations. This leaves us with 81 countries. Figure 1 shows the distributions of these measures on a world map. Table A2 in the online appendix presents a list of these countries and tabulates the number of observations in each country and the value of these plough-based measures of gender bias.

[Insert Figure 1 and Table 1 Here]

3.2 Plough-based measures of gender bias

To construct our second measure of gender bias, we use the General Social Survey (GSS) over the period of 1972-2016. In particular, we exploit the survey responses by descendants of US immigrants on a question about the appropriate role of women in society. Following Ongena and Popov (2016), we focus on the variable "FEFAM", which reports the survey responses to the statement "It is much better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family." Responses are given on a scale from 1 to 4, denoting "Strongly agree", "Agree", "Disagree" and "Strongly disagree", respectively. We construct an indicator, *Traditional gender roles*, that equals one if the respondent chose "Strongly agree" or "Agree", and zero if the respondent chose "Disagree" or "Strongly disagree".

As in Ongena and Popov (2016), we construct a measure of inherited gender bias (*Inherited gender bias*) by regressing *Traditional gender roles* on an assortment of individual specific factors, including age, age squared, education, gender, religion, employment status and country-of-ancestry indicators. We then use the estimated coefficients on the country of origin dummy variables as the measure for inherited gender bias. We focus on gender beliefs of descendants that are at least two generations apart from the first immigrants, to mitigate the concern that the initial political and institutional conditions in the home country at the time of immigration could

[16] As discussed later, after merging with the World Bank Enterprise Survey, we have observations for 90 countries.

codetermine both the current financing patterns of firms in the home country and the inherited gender beliefs of descendants of US immigrants. Paulson and Osili (2008) emphasize that ancestral beliefs of US immigrants decline over time, suggesting that the results from using this measure provide a lower bound of the effects of inherited gender bias. Our results are also robust to the use of answers of all respondents in the survey, regardless of what generation immigrants they are, as in Ongena and Popov (2016).

Table A3 in the online appendix reports the pooled ordinary least squares (OLS) estimates of the inherited gender bias in the first two columns, with standard errors clustered at the country-of-origin level. These estimates are largely consistent with Ongena and Popov (2016). We find that inherited gender bias decreases with education and income. Males have more biased gender beliefs than female respondents. Protestant, Jewish and Muslim groups have a higher gender bias than atheists (the reference group), while Catholic and other religious groups have a lower gender bias. Finally, employed people in general hold more biased gender beliefs, while unemployed and retired people have less gender bias than the reference group (inactive persons).

3.3 Sample and key firm-level variables

Our firm-level variables are from the World Bank Enterprise Survey (WBES) over 2009-2018. The Survey provides detailed information on a pooled cross-sectional sample of 136,887 firms in 139 countries. After restricting our sample to manufacturing firms and merging with the plough data in Alesina et al. (2013a), the inherited gender bias data and other industrial characteristics data, our sample is reduced to 30,559 manufacturing firms in 81 countries.[17] We conduct most of our analyses on this sample. Table A2 in the online appendix provides a list of these countries, the number of observations in each country and the value of our plough-based measures of gender bias. For the sample that uses the inherited gender bias measure, we have around 9,900 firm-level observations from 15 countries. This is comparable to the 17 countries used in Ongena and Popov (2016). Due to space constraints, we report our results from this sample in the online appendix. Table A4 in the online appendix shows a list of these countries and tabulates the number of

[17] Since our sample does not include important Western economies such as the United Kingdom and the United States, we caution readers about extrapolating our results outside our sample. In other words, our results may not apply to those important Western countries.

observations in each country and the value of the inherited gender bias. In Table 2, we report the summary statistics for all variables used in the analysis.

[Insert Table 2 Here]

Our key interest variable, *Female*, is calculated as the share of female production employees in a firm. As shown in Table 2, the share of female production employees ranges from 0 to 1, with a mean of 0.17 and a standard deviation of 0.24. Across our sampled countries, Pakistan and Iraq have the lowest average shares of female production employees (0.01 and 0.03), while Albania and Cambodia have the highest shares of female employees[18] (mean 0.44 and 0.48). The share of female non-production employees (*Female_non*) also exhibits great variations, with a mean of 0.08 and a standard deviation of 0.11. We also construct a dummy indicator, *Female_DV*, that equals one if firms have an above-median value of *Female*, and zero otherwise. Figure 2 presents the world distributions of these measures.

[Insert Figure 2 Here]

We use accounts payable (*Accounts payable*) from the Enterprise Survey as the main measure of trade credit. It is calculated as the fraction of material inputs or services paid after delivery in the previous year. As stressed by Petersen and Rajan (1997), this measure, compared to accounts receivable, provides information on trade credit supplies that is less confounded by demand factors. To illustrate, trade credit contracts typically state a discount date, a due date and the amount of discount for payment by the discount date.[19] If firms make payment by the discount date, they receive a discounted purchase price. Because accepting trade credits that can be repaid within the discount date incurs no cost for firms, it dominates paying cash even if firms have no demands for trade credits *ex ante*. Thus, accounts payable is a proper measure for the supply of trade credits.[20] As shown in Table 2, *Accounts payable* has a mean of 43.87% and a standard deviation of 36.54%. This suggests that, on average, 43.87% of material inputs or services

[18] See Table A1 in the online appendix.
[19] For example, a contract that specifies 2%, 10 days and 30 days means the buying firm receives a 2% discount if they make payment within 10 days (the discount date); payments made after 10 days, but within 30 days, will be the full amount; additional penalties may apply after 30 days (Smith, 1987; Petersen and Rajan, 1997).
[20] Our results, however, are robust to the use of *Accounts receivable* as the measure of trade credits. These results are tabulated in Table A19 and Table A20 in the online appendix.

purchased by our sampled firms are offered as trade credits. Figure 3 plots the distribution of the country-level average of trade credit provision.

[Insert Figure 3 Here]

The Enterprise Survey also provides information on other firm attributes. Whenever feasible, we condition our analyses on the following firm-specific traits: *Firm size* indicates whether a firm has fewer than 20, between 20 and 99, or more than 100 employees; *Firm age* equals the number of years since a firm began operation; *CEO experience* equals the tenure of a firm's CEO; *Ownership concentration* equals the share of a firm owned by the largest owner; *State* (*Foreign*) equals the fraction of a firm owned by the state (foreign investors); *Business group* is an indicator that equals one if a firm belongs to a business group, and zero otherwise; *Export* is an indicator that equals one if a firm has a positive share of sales exported outside the country, and zero otherwise; *Industry sales growth* is the median value of firms' sales growth within an industry in each year; *Product competition* equals the number of competitors of a firm's main product; *Female CEO* is an indicator that equals one if a firm's CEO is female, and zero otherwise; *Profit margin* is the ratio of profit over total sales in the previous year; *Collateral share* equals the value of collaterals over the value of loans; *Credit line* is an indicator that equals one if a firm has at least one credit line open from a financial institution, and zero otherwise.

We also use the following firm characteristics from Enterprise Survey to examine various alternative explanations of the results: *Interaction frequency* is an indicator that equals one if firms purchase inputs from and interact with their suppliers every 20 days (the sample median value) or more frequently, and zero if they do so at a longer time interval; *Unit labor cost* is calculated as the total labor costs divided by the total number of employees in a firm, measured in 2010 US dollars; *Sales growth* equals the rate of sales growth for a firm in the last three years; *Applied for a loan* is an indicator that equals one if a firm applied for a loan from a financial institution in the previous year, and zero otherwise; *No need for a loan* is an indicator that equals one if a firm reports that it did not apply for a loan in the previous year because it did not need it, and zero otherwise; *Working capital financed by banks* is the share of a firm's working capital currently financed by banks; *Investment financed by banks* is the share of a firm's financial investment currently financed by banks; *Capacity utilization* is the share of current output over the maximum output possible using the current inputs.

Table A5 in the online appendix presents the summary statistics by female share and shows the differences between high and low female share firms. Many of the differences are statistically significant and are possibly correlated with access to trade credits. For example, high female share firms tend to be larger, younger and more likely to have a female CEO and be involved in exporting. We make sure to control for these firm characteristics in our analyses and, as we discuss later, we employ four additional strategies to mitigate the influence of these variables on our main results, including the use of a propensity score matched sample, an exogenous macro credit shock and two industrial heterogenous analyses that are consistent with theoretical predictions.

3.4 Industry-level characteristics

We measure industry-level characteristics using data from multiple sources. Our first variable, *Commodity price shock*, which measures unexpected credit shortage in an industry, is constructed in the following steps. We first obtain time-series data on major international commodity price indices from the International Monetary Fund Primary Commodity Price System (IMF-PCPS). We then match the available price indices, and their respective percentage change from the previous year, to industries in our sample, based on the industry descriptions[21] and survey year. For example, we match the food price index from the IMF-PCPS to "Food manufacturing industry" in our sample (ISIC code 311-312). Similarly, we match beverage and iron ore price indices to "Beverage industries" (ISIC code 313) and "Iron and steel basic industries" (ISIC code 371), respectively. We successfully match the international commodity price indices to 24 out of 29 manufacturing industries to our sample.[22] Table A6 in the online appendix provides detailed matching between the IMF-PCPS prices indices and our sampled industries. In the last step, we let commodity price shock equal one if an industry has experienced a price reduction relative to the previous year based on the matched price index, and zero otherwise. This indicator captures the unexpected price changes in international commodity markets and therefore creates a source

[21] Our industry-level measures are calculated based on the 3-digit International Standard Industrial Classification (ISIC) system, revision 2.

[22] We cannot find appropriate global commodity price indices for "Manufacture of pottery, china and earthenware", "Manufacture of glass and glass products", "Manufacture of other non-metallic mineral products", "Manufacture of electrical machinery apparatus, appliances and supplies" and "Manufacture of professional and scientific, and measuring and controlling equipment not elsewhere classified, and of photographic and optical goods". Their ISIC codes are 361, 362, 369, 383 and 385, respectively.

of time-variant, exogenous variations in credit shortages of firms in a given industry. As shown in Table 2, 48% of manufacturing industries in our sample experienced a credit shortage during 2009-2018.

We next construct two variables that measure female/male dominance in an industry, following Cumming et al. (2015). Specifically, we let *Female dominated* equal one if an industry has been characterized as female-dominated in Cumming et al. (2015), and zero otherwise. Female-dominated industries include manufacturers of textile, manufacturers of biological products and medicine, foods and beverages, hotels, tourism, retail, radio, film and television, and publishing. Another measure, *Female industry*, equals one if an industry has a higher than sample median value of female share, and zero otherwise.

Following the finance-growth literature (e.g., Rajan and Zingales 1998), we also construct a variable, *EFD*, that measures an industry's dependence on external finance. Dependence on external finance is calculated as the fraction of capital expenditures not financed with a firm's internally generated cash flows. Rajan and Zingales (1998) first construct this measure at the 3-digit ISIC level using data from the United States during the 1980s. They argue that financial markets are relatively frictionless in the United States, and therefore the measure calculated this way captures the varying degrees to which firms depend on external finance across industries for technological reasons. We obtain the measure of industrial dependence on external finance from Rajan and Zingales (1998) and let *EFD* equal one if an industry has an above-median value, and zero otherwise.

3.5 Country-level characteristics

When we assess the relationship between cross-country variations in gender bias and firm access to trade credits, we control for many country-level characteristics. In particular, we focus on institutional factors that are found to be important to trade credits in the literature, so that we can examine the independent link between gender bias and the function of informal credit markets. Our first country-level variable is *Masculinity*. This measures the degree to which a country values male assertiveness over female nurturance. In an important study, Ghoul and Zheng (2016) find that trade credit provision is significantly higher in countries with strong masculinity. Following Ghoul and Zheng (2016) and Zheng et al. (2012), we obtain the *Masculinity* index from Hofstede

(2001). Our second measure is *Formalism*, which measures the efficiency of a country's court system. Johnson et al. (2002a) find that well-functioning courts encourage firms to develop new relationships with suppliers, thereby facilitating the function of informal credit markets. The third variable is *Creditor rights*, which measures the quality of legal protection on creditors. A large body of literature finds that better legal protection of creditors promotes the development of financial markets (e.g., Djankov et al., 2007; La Porta et al., 1997). We obtain data on *Formalism* and *Creditor rights* from La Porta et al. (2008). Next, *Property rights* measures the quality of a country's private property rights protection. An extensive strand of research shows that property rights protection facilitates the function of financial markets (e.g., Johnson et al., 2002b; Beck et al., 2003; Levine, 2005). We obtain the data on property rights protection (*Property rights*) from The Heritage Foundation.[23] Lastly, *Private credits* is the ratio of a country's private credit to GDP and is obtained from the World Bank's World Development Indicators. Summary statistics are presented in Table 2.

3.6 Empirical strategy

Our empirical question is: do firms with a larger share of female production employees have less access to trade credits in highly gender-biased countries? To test this proposition, we compare access to trade credits of manufacturing firms (1) with more or fewer female production employees, and (2) in countries with high or low gender bias. In particular, we estimate the following OLS regression:

$$Trade\ credit_{f,i,c,t} = \alpha + \beta_1 Female_{f,i,c,t} \times Gender\ bias_c + \beta_2 Female_{f,i,c,t} + X'_{f,t}\Phi + \Psi + \varepsilon_{f,i,c,t} \qquad (1)$$

where $Trade\ credit_{f,i,c,t}$ is access to trade credit, measured as the share of material inputs or services paid after delivery in the previous year of firm *f* in industry *i* in country *c* at time *t*. $Female_{f,i,c,t}$ is the number of female production workers as a share of the total number of employees in a firm. $Gender\ bias_c$ is either the plough-based measures of gender bias or inherited gender bias extracted from the descendants of US immigrants. We are interested in estimating β_1,

[23] See https://www.heritage.org/index/.

the coefficient on the interaction term. We control for various firm characteristics ($X'_{f,t}$), including *Firm size*, *Firm age*, *CEO experience*, *Female CEO*, *Profit margin*, *Collateral share*, *Credit line*, *Ownership concentration*, *Product competition*, *Business group*, *Industry sales growth*, *Export*, *State* and *Foreign*. In addition, we flexibly include country, industry (at 3-digit ISIC level), survey year, country by survey year and industry by survey year fixed effects (Ψ) in the model. Table A1 in the online appendix provides detailed definitions and data sources.

Regarding inference, we cluster the standard errors at the country level, where our measure of gender bias varies.[24] Since our measure of trade credits is bounded between 0 and 100 (as a percentage of inputs or services paid after delivery), we also use a Tobit model with exactly the same control variables and fixed effects. As a placebo test, we also conduct similar tests on female non-production employees whenever possible. Given that the biased gender beliefs we specifically test in this paper are based on the notion that males should perform production work outside the home while women should stay home, we expect a less pronounced impact of gender bias on female non-production workers.

4. Results

Our main results can be briefly summarized in Figure 4, which shows that in highly gender-biased countries, firms with more female production employees on average receive substantially fewer trade credits relative to their peers with fewer female workers.

[Insert Figure 4 Here]

Figure 5 Panel A presents the results based on a sample of firms in industries that have just experienced unexpected credit shortages. It depicts a similar pattern as in Figure 4. That is, firms with more female workers have less access to trade credits in highly gender-biased countries. Panel B of Figure 5, based on firms that do not face unexpected credit constraints, does not exhibit similar patterns. This suggests that our results are mainly driven by firms under credit constraints.

[Insert Figure 5 Here]

[24] Our results are robust to other clustering strategies, such as at the country-industry level. Since our variation mainly comes from the country level, we do not report these results, but they are available upon request.

Note that, due to space constraints, we mainly focus on the results from the plough-based gender bias measure in the main text because it has more observations (30,599) from a larger number of countries (81). The results based on inherited gender bias are qualitatively similar and are tabulated in our online appendix.

4.1 Evidence from plough-based gender bias measures

Table 3 confirms the empirical patterns shown in Figure 4. We find that firms with a higher share of female production workers have less access to trade credits in highly gender-biased countries. As shown in Table 3, $Female_{f,i,c,t} \times Plough_c$ enters all regressions with negative and statistically significant coefficients at the 5% level. In column (1), we report the results from OLS regressions with our full set of control variables and fixed effects that aim to capture country-, industry- and year-level common factors that may affect both gender bias and firm access to trade credits. In columns (2)-(4), we vary the inclusion of fixed effects to account for industry- and/or country-level time trends, which may also confound our results. In column (5), we report the results from a Tobit model, where we include the full set of control variables in addition to country-year and industry-year fixed effects. Across all specifications, our estimated coefficients are very stable. The estimated economic magnitudes are also large. For example, consider the coefficient reported in column (4), our most conservative estimate. It suggests that moving from the least to most gender-biased countries (e.g., from Slovenia to the Czech Republic), firms where women make up 75% of the labor force versus to those where only 25% are female, receive 3.94 (=7.88×0.5) percentage points fewer trade credits. This is a nearly 9% drop when evaluated at sample mean (43.87%).

[Insert Table 3 Here]

4.2 Evidence from inherited gender bias

Table A7 in the online appendix presents the results from regressions using inherited gender bias. We find, again, that in high gender-bias countries, firms with more female production workers have less access to trade credits. As shown in Table A7, all coefficients of $Female_{f,i,c,t} \times Plough_c$ are negative and statistically significant at least at the 5% significance level. Similar to Table 3, we report the results from OLS regressions in columns (1)-(4), with different sets of fixed

effects in addition to the full set of firm characteristics. In column (5), we report the results from a Tobit regression, where we include the full set of control variables in addition to country-year and industry-year fixed effects. The economic magnitudes of our estimates are substantial and comparable to those estimated using the plough-related gender bias measure. For instance, consider our preferred estimates reported in column (4) of Table A7 and using the same representative countries as an example. They imply that if firms move from Slovenia, a relatively high gender-bias country, to the Czech Republic, a relatively low gender-bias country, firms where women make up 75% of the labor force versus to those where only 25% are female, receive 4.28 (=39.96×0.214×0.5) percentage points less in trade credits, which is about a 10% drop relative to the sample mean (43.87%). This magnitude is similar to the one we estimated using the plough-related gender bias measure.[25] It is important to note that since we are using two distinct sources of plausibly exogenous variation in gender bias, these estimates add further confidence to our findings.

4.3 Heterogenous analyses by unexpected credit shortages

An important concern to our identification strategy is that firms may endogenously choose how many female workers to hire. For example, if firms with little demand for trade credits hire more female production employees in countries with higher gender bias, then our estimates are not capturing the effects of gender bias. To alleviate this concern, we exploit an exogenous shock on firm credit constraints. As stressed by an extensive body of literature on development economics, the impact of gender bias is stronger when resources become scarce (e.g., Jayachandran and Pande, 2017; Jayachandran and Kuziemko, 2011). This implies that if firms with more female workers receive fewer trade credits due to gender bias, then this relationship should be more pronounced in industries that face higher unexpected credit shortages. We test this conjecture by dividing our sample based on *Commodity price shock*, which equals one if an industry has experienced an

[25] As in Ongena and Popov (2016), we match the coefficient on the Yugoslavia dummy from the regression in which we predicted the inherited gender bias score to all five countries in the sample that, by 2006, the former Yugoslavia had broken into (i.e., Bosnia, Croatia, Macedonia, Slovenia and Yugoslavia). Our results remain similar when removing Yugoslavia from the sample.

exogenous price reduction in international commodity markets relative to the previous year, and zero otherwise. We re-run model (1) in the two subsamples and tabulate the results in Table 4.

[Insert Table 4 Here]

Columns (1)-(4) show the results from industries that have just experienced unexpected credit shortages, while columns (5)-(8) present the results from the rest of the sample. Clearly, our results are mainly driven by firms that face exogenous credit constraints (columns (1)-(4)), which is consistent with our hypothesis that the impact of gender bias is stronger when resources become scarce. In fact, our evidence from columns (5)-(8) suggests that firms with more female workers do not appear to be disadvantaged in informal credit markets when credits are not constrained.

4.4 Heterogenous analyses by dependence on external finance

Following the finance-growth literature (e.g., Rajan and Zingales, 1998), we also perform split sample tests by firms' natural dependence on external finance. *Dependence on external finance* is calculated as the share of capital expenditures not financed with firms' internally generated cash flows. We conjecture that if firms with more female workers receive fewer trade credits due to gender bias, then this relationship should be more pronounced in industries that depend more on external finance for technological reasons. In Table A8 in the online appendix, we find that our results are mainly driven by firms in industries that are more dependent on external credits, consistent with our prediction.

It is worth noting that the measure of industry-level dependence on external finance is meant to capture, in relative terms, a credit-constrained environment that is not influenced by firm decisions. While the existing literature offers various important, more precise firm-level measures of credit constraints, such as the Kaplan and Zingales (1997) index, the Whited and Wu (2006) index, and the Hadlock and Pierce (2010) index, they are more or less co-determined and therefore confounded by firm decisions. Dependence on external finance, on the other hand, measures whether an industry needs external credits for technological reasons, which is unlikely to be affected by firms' choices. For example, the pharmaceutical industry is more reliant on external financing because it needs a very long period of, and a large amount of initial investments for, research and development compared to the textile industry. In addition, the fact that this measure is calculated using data from the United States highlights two additional advantages for our

empirical setting: (a) financial markets are relatively frictionless in the United States and therefore the measure captures firm natural dependence on external finance, and (b) our sample does not contain observations from the United States and thus this measure is more exogenous to firms in our sample.

4.5 Heterogenous analyses by female dominance

We perform another set of heterogenous analyses based on whether an industry is characterized as male or female dominated. These tests provide further evidence that our estimated relationship between female production workers and trade credits is indeed driven by gender bias. As stressed in the social psychology literature, the impact of gender diversity (i.e., having more females on corporate boards or in the workforce) on firm outcomes may vary depending on the industry involved (e.g., Cejka and Eagly, 1999; Glick, 1991). In an important study, for instance, Cumming et al. (2015) document that female directors reduce corporate fraud, and this relationship is largely driven by firms in male-dominated industries, where a masculine personality is seen as necessary for success. Relating this result to our paper, we conjecture that if firms receive fewer trade credits due to gender bias, then this relationship should be more pronounced in male-dominated industries where gender prejudice is supposedly stronger (Cejka and Eagly, 1999; Glick, 1991). We divide our sample based on whether an industry is female-dominated, and re-run our analyses in the subsamples. Our results are presented in Table 5.

[Insert Table 5 Here]

As shown in Table 5, the coefficients on $Female_{f,i,c,t} \times Plough_c$ are negative, statistically significant only in columns (2) and (4), where the results are based on firms in male-dominated industries. In female-dominated industries (columns (1) and (3)), this relationship is no longer statistically meaningful. Taken together, the evidence thus far suggests that our main estimates are unlikely to be completely driven by endogenous female share due to the presence of omitted variables and reverse causality.

4.6 Measurement error in female share

A remaining concern is whether, and to what extent, our results are influenced by potential measurement errors in *Female* (i.e., the share of female production workers). Because suppliers of

trade credits may not have accurate information on firms' workforce composition, our estimates may be biased in either direction depending on whether and how potential measurement errors are systematically correlated with other firm characteristics.

To alleviate this concern, we first note that suppliers frequently visit borrowing firms' factories to collect information, including on workforce composition, that is later used in their business decision-making (Petersen and Rajan, 1997). Anecdotal evidence suggests that site visits in general involve collecting information on human resources (HR), including recruitment and training. For example, Burkhart (2019) emphasizes that HR recruitment and training is one of the key areas to evaluate during a site visit.[26] In addition, speaking to employees during a visit and asking about their work environment is often encouraged by some industry standards.[27] This allows suppliers to collect information on employee demographics, including gender.[28] Moreover, Cheng et al. (2016) show that analysts can and do collect information on employees' morale during a site visit, and then use the information in their forecasting decisions. This information is likely collected through observing production processes, interacting with employees and evaluating HR records.

We then conduct three sets of empirical analyses to further assess to what extent our estimates are affected by potential measurement errors in *Female*. In the first set of analyses, we differentiate firms based on the frequency with which they interact with their suppliers. We argue that if suppliers interact more frequently with borrowing firms, they would have more accurate information on borrowers' workforce composition, and thus we expect a stronger impact of female workers on access to trade credits. If, on the other hand, suppliers obtain information on borrowers' workforce composition in ways other than site visits, then we should not observe such differential impact of female workforce on access to trade credits. To test this conjecture, we divide our sample based on *Interaction frequency*, which is an indicator that equals one if firms purchase inputs from and interact with their suppliers every 20 days, the sample median value, or more frequently, and zero if they do so at a longer time interval. We then re-run model (1) and tabulate our results in Table 6.

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[26] See https://www.intouch-quality.com/blog/5-areas-look-factory-visit/.
[27] See https://www.supplychaindive.com/news/buyer-supplier-procurement-site-visit/564768/.
[28] See https://www.industrystar.com/blog/2017/10/supplier-assessments-site-walks-plant-audits/.

[Insert Table 6 Here]

As shown in Table 6, our results are mainly driven by firms that interact with their suppliers more frequently (columns (1)-(4)). The economic magnitude is larger than our baseline estimates. For example, consider the coefficient on $Female_{f,i,c,t} \times Plough_c$ in column (4). It suggests that, moving from the least to most gender-biased countries (e.g., from Slovenia to the Czech Republic), firms where women make up 75% of the labor force versus to those where only 25% are female, have 5.4 (=10.79×0.5) percentage points fewer trade credits. This is more than 10% higher than our sample mean (43.87%).

Our second sets of analyses focus on access to bank financing. As stressed in Petersen and Rajan (1997), suppliers of trade credit may visit borrowers' plants more often than formal financial institutions would in order to obtain information on borrowers' credit quality. If suppliers of trade credits indeed obtain borrowers' workforce information via frequent site visits, then we would expect the impact of female workers on firm access to external finance to be stronger in trade credit markets. Similarly, we would not expect to see similar empirical patterns in bank financing. To test this conjecture, we re-run model (1), but with firm access to bank credits as our dependent variables. As shown in Table 7, all the coefficients on $Female_{f,i,c,t} \times Plough_c$ are small and statistically insignificant. This suggests that firms with more female workers have similar levels of bank financing relative to their otherwise similar peers, even in highly gender-biased countries.

[Insert Table 7 Here]

Lastly, we perform differential analyses based on where firms are located. We conjecture that suppliers of trade credits face relatively low transportation costs in visiting sites if a borrowing firm is located in a large city, and therefore they can obtain workforce information at a relatively low cost should they need to. To test this conjecture, we split our sample based on the size of cities in which firms are located. In particular, we define cities with a population higher than the national median size of cities as large, and as small if they have a smaller population than the country median. We re-run model (1) in these subsamples and present the results in Table 8. As shown in the table, our results are largely from firms located in large cities (columns (1)-(4)). The economic size is similar to our baseline results. Consider the coefficients in column (4). Using the sample country example, moving from Slovenia to the Czech Republic, firms where women make up 75% of the labor force versus to those where only 25% are female, receive 4.82 (=9.64×0.5) percentage

points fewer trade credits. In sum, results from these three sets of analyses provide empirical support that (a) suppliers obtain borrowers' information via frequent business interactions, and (b) our baseline findings are not completely driven by measurement errors in the share of female workers.

[Insert Table 8 Here]

4.7 Suggestive evidence on firm outcomes

What are the possible consequences on firm performance? If there is an employee-based gender gap in the trade credit market, and firms with more female production employees have less access to trade credit, why do firms still hire female production workers? In this section, we provide some suggestive evidence in response to these questions.

A potential explanation for why manufacturing firms hire female production employees in highly gender-biased places is that firms are trading off access to trade credit for lower labor costs. Anecdotal evidence suggests that female workers are often paid less compared to their otherwise similar peers. For example, a US survey conducted by Pew Research Center on working adults reveals that 35% of women are reportedly paid less than their male colleagues. Relatedly, as shown in a report by Clean Clothes Campaign, firms do not often address demands raised by female employees in a gender-biased environment, while they must give some consideration to demands raised by men.[29] This can increase managerial tasks, labor and work environment related costs to the firms, therefore leading firms to hire female workers. We assemble data on *Unit labor cost*, measured as the total labor costs divided by the total number of employees in a firm, to test whether firms with a higher share of female production workers are related with lower labor costs. As shown in Table 9, we discover that firms with a high share of female production workers have a significantly smaller unit cost of labor, and this effect is homogeneous across high and low gender-bias countries. The economic magnitude of the estimate is non-trivial. Since the unit labor cost is measured in 2010 US dollars (USD), the estimate in column (1) of Table 9 suggests that, across both high and low gender-bias countries, firms where women make up 75% of the labor force pay about 955 USD (= 1909.96*0.5) less per annum than otherwise similar firms where only 25% are

[29] See https://cleanclothes.org/issues/gender.

female. This is equivalent to nearly 22% (= 955/4440.3) of our sample mean. To contextualize this estimate even more, the world average GDP per capita in 2010 was 9,551 USD, while developing countries' (including low and middle income) average in the same year was roughly 3,576 USD.[30] Since our sample comprises 81 developing countries, the sample mean of 4,440 USD is reasonably representative of the developing world.

[Insert Table 9 Here]

We also test the effects of a gender gap in informal credit markets on firm performance. As shown in Table 9, we find no impact of female employees on firm profit margin, sales growth and capacity utilization. While suggestive, these results imply that, on average, the impacts of female production employees on firms' access to trade credit and labor costs may cancel each other out, generating a sustainable dynamic equilibrium among female employees, access to trade credits and labor costs.

5. Robustness checks

5.1 Propensity score matching

In this section, we conduct an extensive set of robustness checks on our main results. To begin with, we employ propensity score matching (PSM) (e.g., DeFond et al., 2017) to construct a matched sample and re-estimate model (1). In particular, we first predict a firm's probability of being treated (i.e., high female share) with our full set of control variables in addition to country-, industry- and survey-year indicators using a logit model. We then perform a single nearest neighbor match without replacement. The caliper value is set to 0.1, although our results are robust to less conservative values used in the literature.[31] Figure A1 in the online appendix shows the distributions of the propensity scores of treated versus control firms, while Table A9 presents the results of a formal statistical test on the matching quality.

As shown in Figure A1, a substantial number of firms are on common support (i.e., 7,757 treated, 15,293 untreated). In the following analyses, we only use observations that are on support.

[30] See https://data.worldbank.org/indicator/NY.GDP.PCAP.KD?name_desc=false&locations=XO.
[31] For example, in their study of the differences in audit quality between Big N and non-Big N auditors, Lawrence, Minutti-Meza and Zhang (2011) use a caliper of 0.3.

Since we use a one-to-one (single nearest neighbor) match, we will have 15,514 (=7757*2) observations in total. The results in Table A9 suggest that, after matching, firms in the treatment and control groups are similar in terms of key observable characteristics. That is, none of the differences between the two groups are statistically meaningful.

[Insert Table 10 Here]

We next repeat our main analyses in the propensity score matched sample and tabulate the results in Table 10. As reported, *Female_DV*Plough* appears in all regressions, with a negative coefficient statistically significant at the 1% level. This is consistent with our baseline estimates. In addition, the economic magnitude of the estimates is also similar to those from our baseline models. For example, consider the coefficients in column (5) of Table 10. They suggest that if firms move from a high to a low gender-bias country (*plough*=1 to *plough*=0), firms with above-median female workers would receive 5.29 percentage points fewer trade credits compared to firms with below-median female workers. A similar style of interpretation based on the estimates from our baseline models (e.g., column (4) of Table 3) suggests a 3.94 percentage point reduction in trade credits. Table A10 in the online appendix presents the results based on the inherited gender bias measure. The estimates follow a similar pattern to those reported here. These estimates suggest that, even after flexibly controlling for firm observable characteristics, our results remain qualitatively robust.

5.2 Panel estimations with firm fixed effects

Next, we perform a panel regression with firm fixed effects to control for the impact of firm-level time-invariant unobservable characteristics. In particular, we assemble another dataset from the BEEPS, jointly conducted by the European Bank for Reconstruction and Development and the World Bank. This dataset contains similar information to the WBES on a subsample of firms that appear in both IV and V waves of BEEPS, thus allowing us to include firm fixed effects in the analysis.[32] In total, we have 620 firm-year observations on 310 firms that (1) were surveyed in both BEEPS IV and BEEPS V; and (2) have no missing values on our key outcome, treatment and

[32] This dataset has also been used by other international business scholars (e.g., Qi and Nguyen, 2020).

control variables. These firms are sampled in 2007, 2010, 2011 and 2012, from 22 countries.[33] Table A11 in the online appendix presents the summary statistics, while Table A12 shows the number of firms in and the value of the plough measures for the 22 countries.

As shown in Table A11, *Accounts payable* has a mean of 19.99%, which is substantially smaller than in our main sample obtained from the WBES (43.87%). However, *Accounts payable* has a standard deviation of 33.68%, which suggests that the in-sample variation is large. *Plough*, our measure of gender bias, ranges from 0.5 to 1, with a mean value of 0.9. This implies that the sample is formed by relatively high gender-bias countries on average.

We next replicate our main results in this panel dataset, with the inclusion of firm fixed effects. We note that due to the limited sample size and coverage of countries, we can only replicate the analysis using the plough-based measures of gender bias. In addition, two variables, namely *Collateral share* and *Credit line*, are missing in this panel dataset. Therefore, we cannot control for them in the replication analyses. We present our results in Table A13 in the online appendix.

Table A13 confirms our previous results that firms with a higher share of female production workers have less access to trade credits in high gender-bias countries, even when we include firm (in addition to other high dimensional) fixed effects. *Female*Plough*, our interest variable, enters all regressions with a negative coefficient statistically significant at the 1% level. In column (1), we report the results from OLS regressions with standard errors clustered at the firm level. In column (2), we further allow the standard errors to correlate within the same firm and across the same country. In column (3), we employ a Tobit model to account for the potential censoring issue. The results from these models are similar. The magnitude of our estimates here is quite large, probably because of the small sample size and the over-sampling of high gender-bias countries. Table A14 shows the results when we replace *Plough* with *Predicted plough*, and the estimates are similar.[34]

[33] We drop four countries that have fewer than ten observations. These countries are the Czech Republic, Lithuania, Poland and Estonia.

[34] We do not present the results from using *Aboriginal plough*, since the estimates are the same as using *Plough.* As shown in Table 2, the value of *Plough* and *Aboriginal plough* are the same in this sample.

5.3 National characteristics

Since our measures of gender bias vary at the country level, we test whether our results are robust to the inclusion of interaction terms between female share and other important country-level characteristics. We focus on institutional factors that are found to be important to the allocation of trade credits in the literature, such as *Masculinity* (e.g., Ghoul and Zheng, 2016), *Formalism* (e.g., La Porta et al., 2008), *Creditor rights* (e.g., La Porta et al., 2008), *Property rights* (e.g., Johnson et al., 2002b; Beck et al., 2003; Levine, 2005) and *Private credits*. As shown in Table A15 in the online appendix, our results are not changed due to the inclusion of additional country-level variables. This suggests that the results we find in our baseline estimates are independent of these important country-level factors.

5.4 Alternative measures of gender bias

Tables A16 and A17 in the online appendix present the results from estimating model (1) using two alternative plough-based gender bias measures. This is because the historical adoption of the plough may be endogenous to the level of economic development and/or the quality of institutions at adoption. As discussed in the data section, *Predicted plough* is predicted using the average land suitability for crops that would benefit more or less from adopting the plough, following Alesina et al. (2013a, 2018). We also use a measure of aboriginal plough adoption prior to European contact as our second alternative (Alesina et al., 2013a, 2018). The results from these alternative measures are similar to our baseline estimates, if not stronger.

5.5 Non-production female employees

We also perform a set of placebo tests using female non-production employees in model (1). Given that the biased gender beliefs we specifically test in this paper are based on the notion that men should perform production work outside the home while women should stay home, we expect no effects on female non-production workers. This placebo test can add further confidence to our main results, since it looks at the same sample, with exactly the same firm characteristics, as our main tests. If our baseline estimates are capturing a spurious relationship between gender bias and trade credits, this relationship should show up here as well. Our results are tabulated in

Table A18 in the online appendix. We find that none of the coefficients on *Female_non*Plough* is statistically different from zero, consistent with our hypothesis.

6. Conclusion

Using two plausibly exogenous sources of gender bias and unexpected credit shortages from international commodity markets, our study identifies a gender gap in access to trade credits for manufacturing firms across 81 countries. In particular, we find that, in highly gender-biased countries, manufacturing firms with a higher share of female production employees have less access to trade credits. We also show that these empirical patterns are not completely driven by firms' endogenous hiring decisions. Finally, we document that firms that hire a higher proportion of female employees, on average, have lower unit costs of labor, suggesting that firms in highly gender-biased countries are trading off access to trade credit for lower labor costs.

Combining our results with existing evidence offers important policy implications. In particular, since females are less likely to use bank loans and are more reliant on informal finance, our findings inform policymakers on regulations that direct firms led by females and/or with more female employees to formal financial systems, which do not appear to discriminate against women. This can potentially correct an important source of friction in financial markets and potentially promote economic growth.

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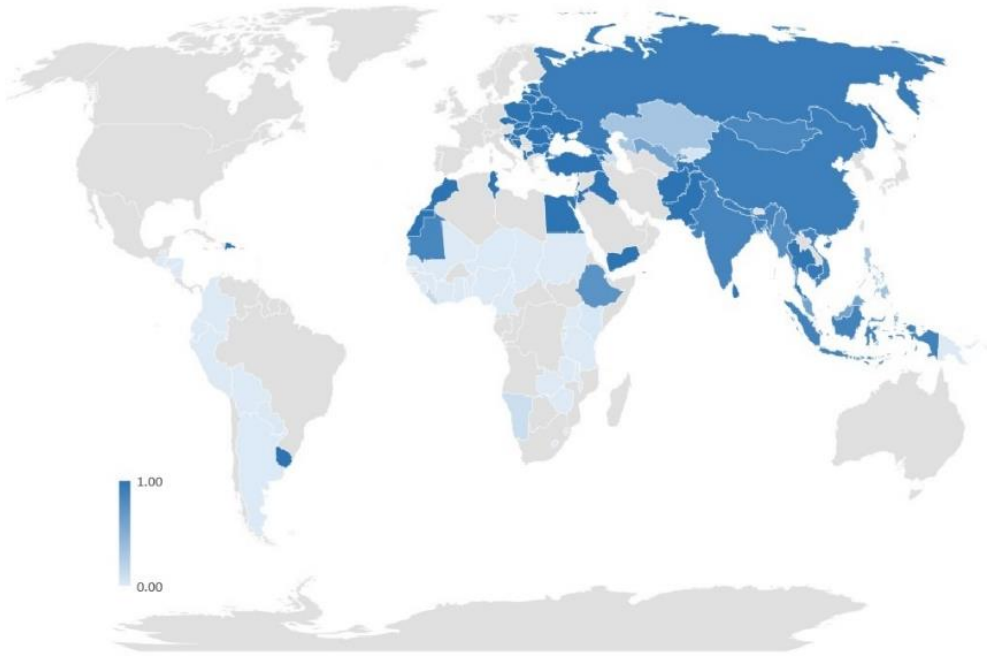
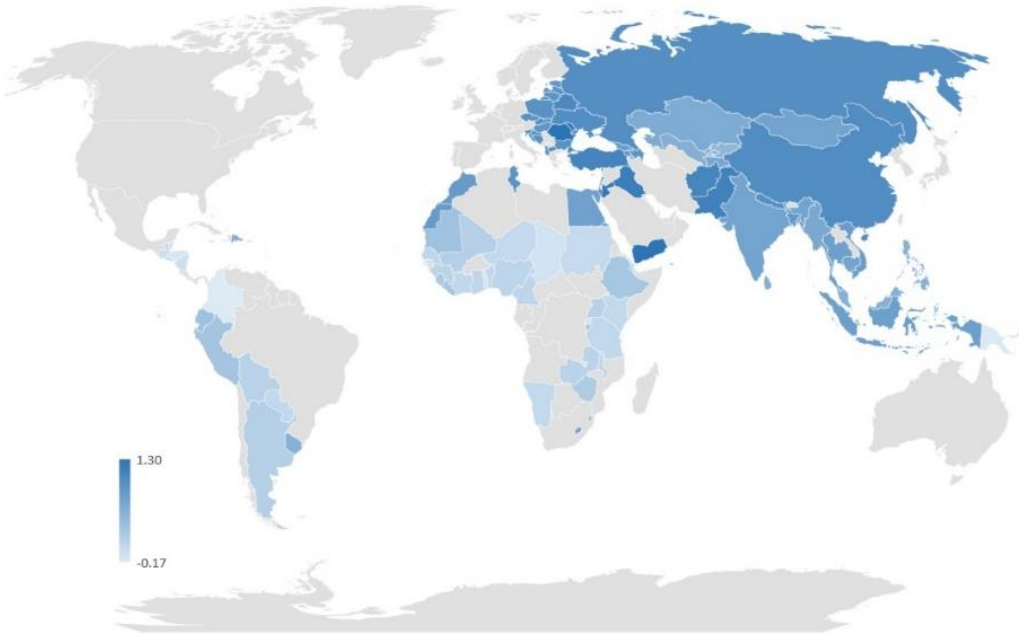
7. Figures and tables

Figure 1. Distribution of plough-based measures

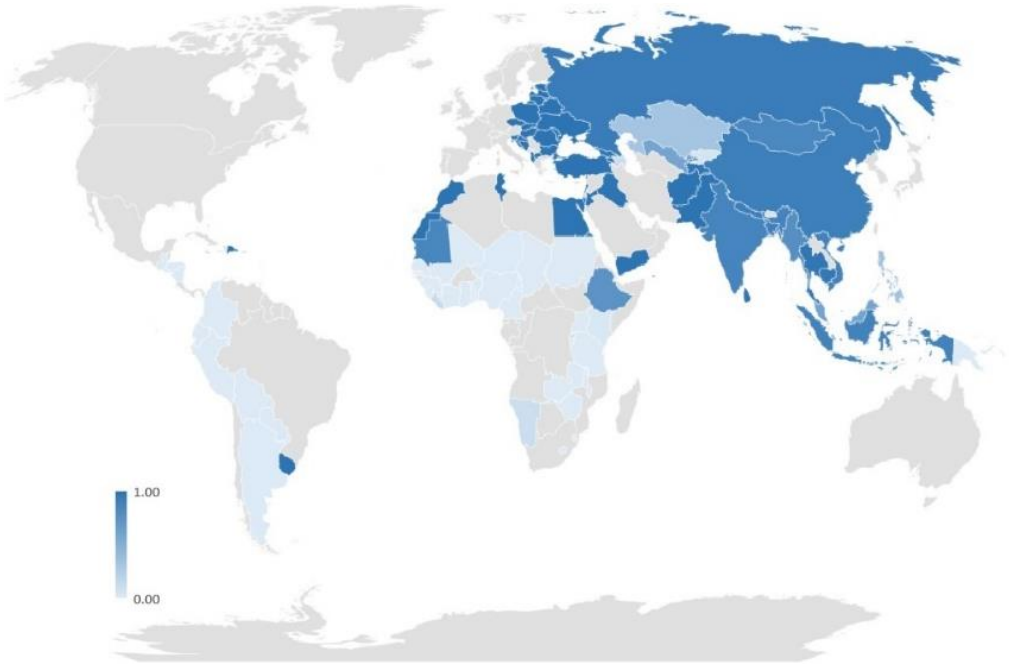
Panel A. Distribution of historical plough adoption



Panel B. Distribution of predicted plough adoption



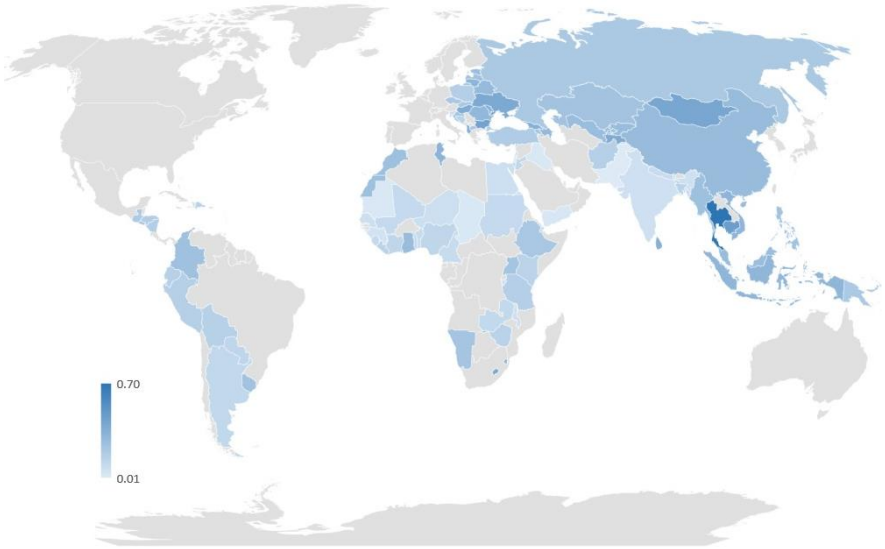
Panel C. Distribution of aboriginal plough adoption



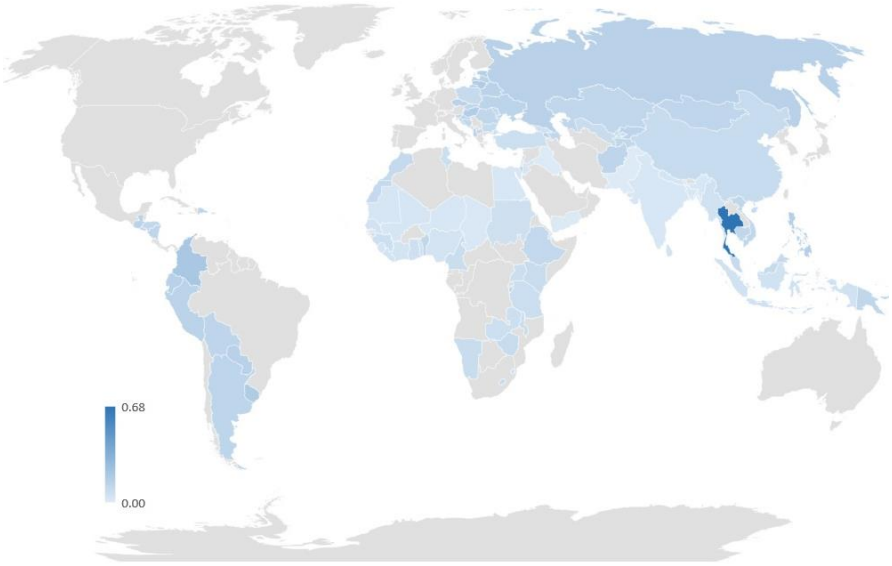
Notes: These figures plot the world distribution of plough-based measures. Panel A plots the country-average historical adoption of the plough; Panel B plots the predicted plough adoption using the average land suitability for crops that would benefit more or less from adopting the plough; and Panel C plots the aboriginal plough adoption prior to European contact. Table A1 in the online appendix and the data section in the main text provide detailed variable definitions.

Figure 2. Distribution of female employees

Panel A. Distribution of the share of female production employees

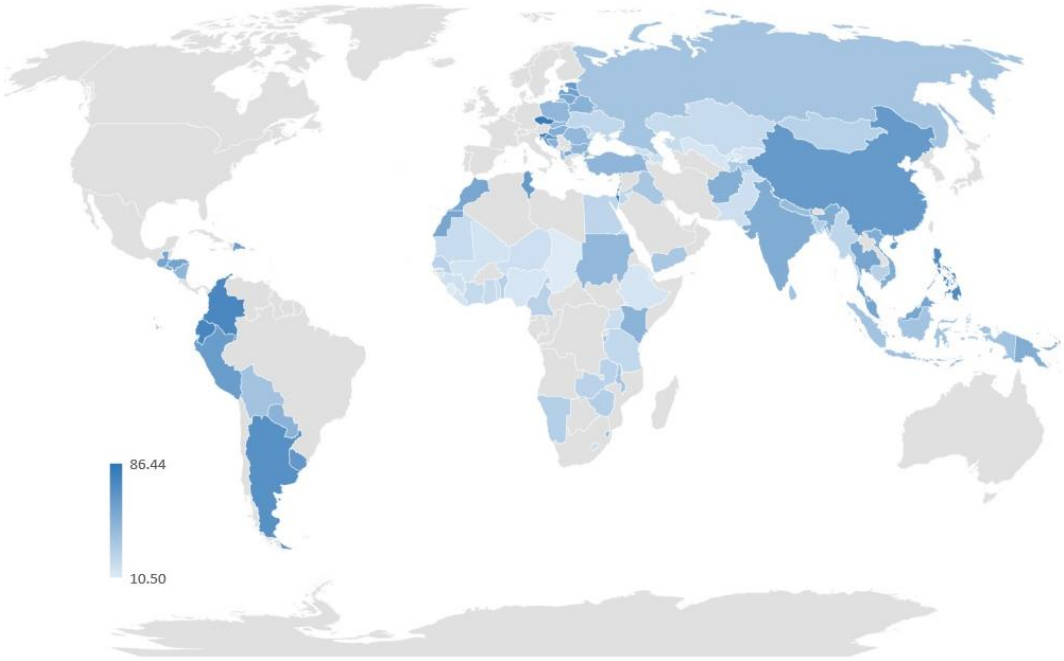


Panel B. Distribution of the share of female non-production employees



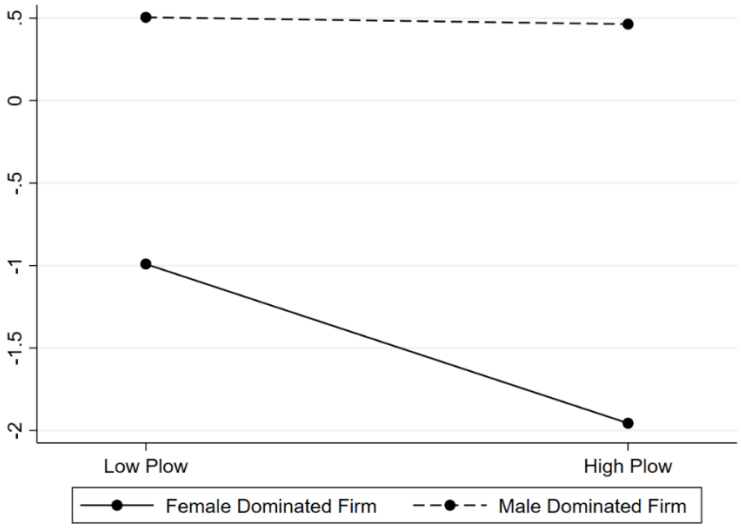
Notes: These figures plot the world distribution of female employee share. Panel A plots the distribution of shares of female production workers; Panel B plots the distribution of shares of female non-production employees. Table A1 in the online appendix and the data section in the main text provide detailed variable definitions.

Figure 3. Distribution of trade credit provision



Notes: This figure plots the world distribution of trade credit provision. It is calculated as the fraction of material inputs or services paid after delivery in the previous year. Table A1 in the online appendix and the data section in the main text provide detailed variable definitions.

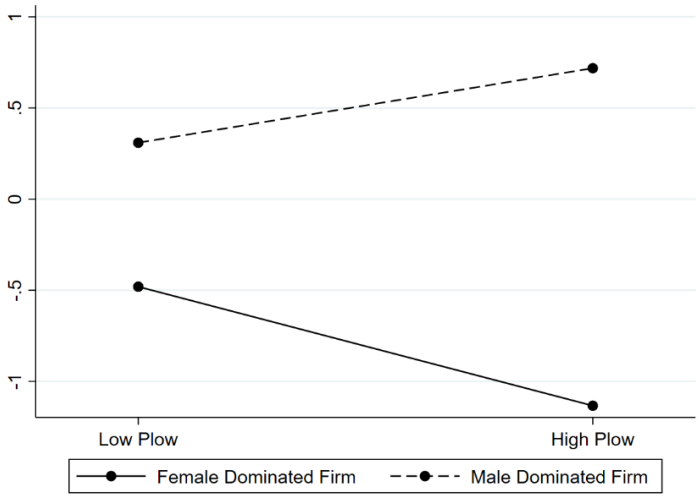
Figure 4. Female production employee, plough and trade credit



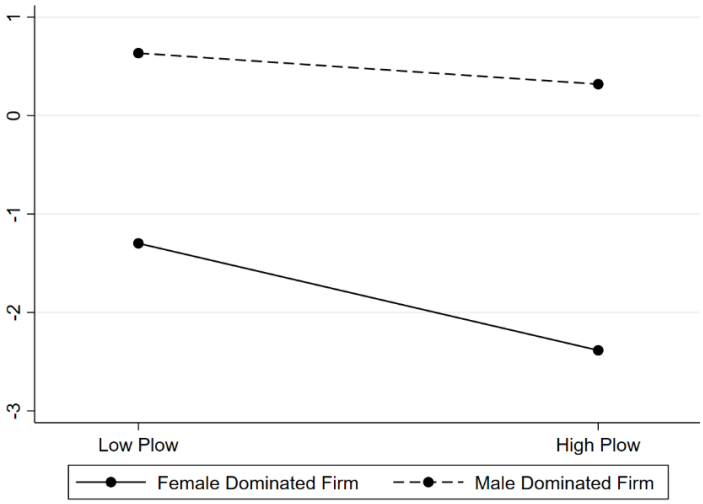
Notes: This figure summarizes the main findings of the paper. The y-axis represents firms' access to trade credits, conditional on a wide range of firm characteristics and country, industry and survey year fixed effects. These firm-level control variables include *Firm size*, *Firm age*, *CEO experience*, *Female CEO*, *Profit margin*, *Collateral share*, *Credit line*, *Ownership concentration*, *Product competition*, *Business group*, *Industry sales growth*, *Export*, *State* and *Foreign*. *High plow* includes countries with a legacy of historical plough agriculture, while *Low plow* includes countries without historical plough adoption. *Female Dominated Firms* include firms with an above-median share of female production workers, while *Male Dominated Firms* include those with a below-median share of female production employees. Table A1 in the online appendix and the data section in the main text provide detailed variable definitions.

Figure 5. Female production employee, plough and trade credit: By credit constraints

Panel A. Firms with unexpected credit shortages



Panel B. Firms without credit shortages



Notes: This figure summarizes the main findings of the paper, organized according to whether firms face unexpected credit shortages. The y-axis represents firms' access to trade credits, conditional on a wide range of firm characteristics and country, industry and survey year fixed effects. These firm-level control variables include *Firm size*, *Firm age*, *CEO experience*, *Female CEO*, *Profit margin*, C*ollateral share*, *Credit line*, *Ownership concentration*, *Product competition*, *Business group*, *Industry sales growth*, *Export*, *State* and *Foreign*. *High plow* includes countries with a legacy of historical plough agriculture, while *Low plow* includes countries without historical plough adoption. *Female Dominated Firms* include firms with an above-median share of female production workers, while *Male Dominated Firms* include those with a below-median share of female production employees. Panel A presents the results from firms that face unexpected credit shortages, while Panel B shows the results from firms without such shortages. Table A1 in the online appendix and the data section in the main text provide detailed variable definitions.

Table 1. Summary statistics on plough-based measures

Notes: Panel A of this table reports the summary statistics on plough-related measures, while Panel B reports the OLS results of regressing historical plough adoption on *Plough positive crops* and *Plough negative crops*, as well as control variables including *Agriculture suitability*, *Tropical climate*, *Large animals*, *Political hierarchies* and *Economic complexity*. We include continent fixed effects in the model. See Table A1 in the online appendix for more detailed variable definitions and data sources. *, ** and *** indicate significance at 10%, 5% and 1%. Table A1 in the online appendix and the data section in the main text provide detailed variable definitions.

Panel A. Summary statistics on plough related measures

	Obs.	Mean	Std. Dev.	Min	Max
Plough	81	0.59	0.46	0.00	1.00
Aboriginal plough	81	0.56	0.47	0.00	1.00
Plough negative crops	81	0.47	0.18	0.02	0.85
Plough positive crops	81	0.52	0.40	0.00	1.00
Agriculture suitability	81	0.56	0.31	0.00	0.98
Tropical climate	81	0.72	0.43	0.00	1.00
Large animals	81	0.95	0.14	0.03	1.00
Political hierarchies	81	3.39	0.99	1.04	5.00
Economic complexity	81	6.15	1.48	1.29	8.00
Predicted plough	81	0.59	0.40	-0.24	1.27

Panel B. Predicting historical plough adoption

	Coefficient	Standard error
Plough positive crops	0.66***	[0.00]
Plough negative crops	0.10	[0.59]
Agriculture suitability	-0.30*	[0.61]
Tropical climate	0.14	[0.32]
Large animals	-0.05	[0.84]
Political hierarchies	0.14***	[0.00]
Economic complexity	0.06*	[0.93]
Continent FE	Yes	
adj. R-square	0.78	
N	81	

Table 2. Summary statistics

Notes: This table presents the summary statistics of all variables used in the paper. Table A1 in the online appendix and the data section in the main text provide detailed variable definitions.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Firm characteristics					
Female	30,559	0.17	0.24	0	1
Female_DV	30,559	0.50	0.50	0	1
Female_non	30,188	0.08	0.11	0	1
Accounts payable	30,559	43.87	36.54	0	100
Firm size	30,559	1.88	0.78	1	3
Firm age	30,559	20.08	13.79	3	55
CEO experience	30,559	18.17	10.44	3	40
Ownership concentration	30,559	76.50	27.02	0	100
State	30,559	0.65	6.29	0	100
Foreign	30,559	5.85	21.63	0	100
Business group	30,559	1.82	0.38	1	2
Export	30,559	8.16	19.65	0	70
Industry sales growth	30,559	0.16	0.06	0.07	0.5
Product competition	30,559	22.74	27.53	4.17	122.59
Female CEO	30,559	0.12	0.32	0	1
Sales growth	27,149	0.38	0.96	-0.6	4.23
Applied for a loan	30,112	0.27	0.44	0	1
No need for a loan	21,999	0.52	0.50	0	1
Working capital financed by banks	29,792	15.63	23.99	0	70
Investment financed by banks	12,251	20.57	34.27	0	100
Collateral share	30,559	15.87	2.76	1	17
Credit line	30,559	0.38	0.49	0	1
Interaction frequency	24,425	0.51	0.50	0	1
Unit labor cost	29,937	4440.30	5601.54	0	22167.1
Capacity utilization	29,530	75.24	21.33	0	100
Profit margin	30,559	0.36	0.30	-0.11	1
Industry characteristics					
Commodity price shock	239	0.48	0.50	0	1
Female dominated	43	0.40	0.49	0	1
Female industry	43	0.53	0.50	0	1
EFD	43	0.39	0.50	0	1
Country characteristics					
Masculinity	47	46.28	10.52	9.00	66.00
Formalism	51	3.97	0.87	2.13	5.91
Creditor rights	73	1.81	1.11	0.00	4.00
Property rights	77	37.72	14.42	13.53	85.43
Private credits	71	38.41	23.44	6.08	140.70

Table 3. Female employee, plough and trade credit

Notes: This table reports the results of regressing *Accounts payable* on the interaction term of *Female* and the measure of gender bias (*Plough*), using OLS regression in columns (1)-(4) and Tobit regression in column (5). The dependent variable is *Accounts payable* from the World Bank Enterprise Survey, calculated as the share of material inputs or services paid after delivery. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country, industry, year, or country by year and industry by year fixed effects flexibly in model specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%.

Dependent variable =	Accounts Payable				
	OLS				Tobit
	(1)	(2)	(3)	(4)	(5)
Female*Plough	-8.91**	-8.74**	-8.19**	-7.88**	-7.88**
	[-2.37]	[-2.30]	[-2.22]	[-2.10]	[-2.11]
Female	1.40	1.39	0.67	0.53	0.53
	[0.71]	[0.70]	[0.34]	[0.26]	[0.26]
Firm size	4.61***	4.65***	4.53***	4.54***	4.54***
	[8.18]	[8.12]	[7.62]	[7.55]	[7.59]
Firm age	0.06***	0.05***	0.05**	0.05**	0.05**
	[2.87]	[2.84]	[2.41]	[2.36]	[2.38]
Export	0.01	0.01	0.01	0.01	0.01
	[0.30]	[0.30]	[0.38]	[0.39]	[0.39]
State	-0.05	-0.05	-0.05	-0.05	-0.05
	[-1.43]	[-1.34]	[-1.54]	[-1.48]	[-1.49]
Foreign	0.08***	0.08***	0.08***	0.08***	0.08***
	[6.35]	[6.24]	[6.41]	[6.25]	[6.29]
Industry sales growth	4.20	5.55	3.42	3.77	3.77
	[0.46]	[0.61]	[0.36]	[0.38]	[0.38]
Product competition	-0.00	-0.00	-0.01	-0.01	-0.01
	[-0.92]	[-0.91]	[-1.48]	[-1.44]	[-1.45]
Business group	-1.50	-1.64	-1.54	-1.66	-1.66
	[-1.45]	[-1.63]	[-1.45]	[-1.59]	[-1.60]
CEO experience	-0.01	-0.01	-0.00	-0.00	-0.00
	[-0.26]	[-0.18]	[-0.11]	[-0.01]	[-0.01]
Ownership concentration	-0.02	-0.02	-0.02	-0.03	-0.03
	[-1.34]	[-1.41]	[-1.46]	[-1.54]	[-1.55]
Profit margin	-0.79	-0.75	-0.88	-0.84	-0.84
	[-0.73]	[-0.69]	[-0.80]	[-0.76]	[-0.77]
Female CEO	-0.31	-0.37	-0.50	-0.53	-0.53
	[-0.40]	[-0.46]	[-0.66]	[-0.69]	[-0.70]
Collateral share	-0.11	-0.07	-0.11	-0.08	-0.08
	[-0.83]	[-0.53]	[-0.87]	[-0.62]	[-0.62]
Credit line	4.31*	4.42*	4.29*	4.39*	4.39*
	[1.74]	[1.76]	[1.74]	[1.75]	[1.76]
Country FE	Yes	No	Yes	No	No
Industry FE	Yes	Yes	No	No	No
Year FE	Yes	Yes	Yes	No	No
Country by Year FE	No	Yes	No	Yes	Yes
Industry by Year FE	No	No	Yes	Yes	Yes
R-squared	0.255	0.257	0.261	0.263	0.032
N	30559	30559	30559	30559	30559

Table 4. Gender bias and trade credit: Heterogeneous analyses by unexpected credit shortages

Notes: This table reports heterogeneous results of regressing *Accounts payable* on the interaction term of *Female* and *Plough*, presented according to whether firms face unexpected credit shortages. *Commodity price shock* equals 1 if an industry has experienced a price reduction relative to the previous year based on the matched price index, and 0 otherwise. In columns (1)-(4), we tabulate the results from firms in industries that face unexpected credit shortages, while in columns (5)-(8), we present the results from firms in industries that do not face such credit shortages. The dependent variable is *Accounts payable* from the World Bank Enterprise Survey, calculated as the share of material inputs or services paid after delivery. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country, industry, year, or country by year and industry by year fixed effects flexibly in model specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%.

Dependent variable =	Accounts Payable							
Sample =	Negative commodity price shock				Positive commodity price shock			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female*Plough	-10.62**	-10.43**	-12.12***	-11.94**	-6.75	-6.15	-5.16	-4.36
	[-2.40]	[-2.32]	[-2.71]	[-2.62]	[-1.60]	[-1.42]	[-1.27]	[-1.05]
Female	2.61	2.59	2.69	2.61	0.11	-0.29	-0.42	-0.99
	[1.24]	[1.22]	[1.30]	[1.24]	[0.04]	[-0.11]	[-0.17]	[-0.39]
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE	Yes	Yes	No	No	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Country by Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Industry by Year FE	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.236	0.237	0.241	0.241	0.290	0.293	0.292	0.295
N	17473	17473	17473	17473	13086	13086	13086	13086

Table 5. Gender bias and trade credit: Heterogeneous analyses by female dominance

Notes: This table reports heterogeneous results of regressing *Accounts payable* on the interaction term of *Female* and *Plough*, by the extent to which an industry is represented by females. *Female dominated* equals 1 if an industry has been characterized as female-dominated in Cumming et al. (2015), and 0 otherwise. *Female industry* equals 1 if an industry has a higher than sample median value of female share, and 0 otherwise. The dependent variable is *Accounts payable* from the World Bank Enterprise Survey, calculated as the share of material inputs or services paid after delivery. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country by year and industry by year fixed effects in all specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%.

Dependent variable =	Accounts Payable			
Sample =	Female dominated = 1	Female dominated = 0	Female industry = 1	Female industry = 0
	(1)	(2)	(3)	(4)
Female*Plough	-5.74	-17.49**	-5.86	-16.96**
	[-1.40]	[-2.48]	[-1.48]	[-2.10]
Female	-1.16	8.36*	-0.94	7.07
	[-0.46]	[1.73]	[-0.41]	[1.48]
Firm Controls	Yes	Yes	Yes	Yes
Country FE	Yes	No	Yes	No
Industry FE	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	No
Country by Year FE	No	Yes	No	Yes
Industry by Year FE	No	No	Yes	Yes
R-squared	0.280	0.250	0.276	0.243
N	15996	14563	19042	11517

Table 6. Gender bias and trade credit: The role of interaction frequency with suppliers

Notes: This table reports heterogeneous results of regressing *Accounts payable* on the interaction term of *Female* and *Plough*, by firms' interaction frequency with suppliers. *Interaction frequency* is an indicator that equals 1 if firms purchase inputs from and interact with their suppliers every 20 days, the sample median value, or more frequently, and 0 if they do so at a longer time interval. The dependent variable is *Accounts payable* from the World Bank Enterprise Survey, calculated as the share of material inputs or services paid after delivery. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country, industry, year, or country by year and industry by year fixed effects flexibly in model specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%.

Dependent variable =	Accounts Payable							
Frequency of inputs purchase =	Interaction frequency = 1				Interaction frequency = 0			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female*Plough	-10.18***	-10.17***	-10.75***	-10.79***	-7.94	-7.83	-3.46	-3.34
	[-2.66]	[-2.66]	[-2.75]	[-2.76]	[-1.42]	[-1.40]	[-0.60]	[-0.58]
Female	1.52	1.48	1.54	1.49	2.65	2.72	-1.16	-1.15
	[0.69]	[0.66]	[0.69]	[0.66]	[0.68]	[0.70]	[-0.27]	[-0.27]
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE	Yes	Yes	No	No	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Country by Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Industry by Year FE	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.233	0.234	0.239	0.240	0.250	0.250	0.258	0.258
N	12509	12509	12509	12509	11916	11916	11916	11916

Table 7. Gender bias and bank credit

Notes: This table reports heterogeneous results of regressing *Working capital financed by banks* and *Investment financed by banks* on the interaction term of *Female* and *Plough*, respectively. *Working capital financed by banks* is the share of a firm's working capital currently financed by banks, while *Investment financed by banks* is the share of a firm's financial investment currently financed by banks. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country, industry, year, or country by year and industry by year fixed effects flexibly in model specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%.

Dependent variable =	Working capital financed by banks				Investment financed by banks			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female*Plough	-1.41	-1.33	-0.62	-0.53	-3.38	-3.41	-3.46	-3.39
	[-0.92]	[-0.86]	[-0.45]	[-0.38]	[-0.88]	[-0.88]	[-0.88]	[-0.85]
Female	-0.27	-0.41	-0.61	-0.74	0.38	0.40	0.29	0.24
	[-0.22]	[-0.34]	[-0.57]	[-0.69]	[0.13]	[0.14]	[0.11]	[0.09]
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE	Yes	Yes	No	No	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Country by Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Industry by Year FE	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.338	0.339	0.340	0.340	0.246	0.246	0.243	0.244
N	29792	29792	29792	29792	12251	12251	12251	12251

Table 8. Gender bias and trade credit: The role of firms' location size

Notes: This table reports heterogeneous results of regressing *Accounts payable* on the interaction term of *Female* and *Plough*, by firms' city size. We define cities as large if they have a population higher than that of their country's median-sized city, and small cities otherwise. The dependent variable is *Accounts payable* from the World Bank Enterprise Survey, calculated as the share of material inputs or services paid after delivery. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country, industry, year, or country by year and industry by year fixed effects flexibly in model specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%.

Dependent variable =	Accounts Payable							
Sample =	Firms located in large cities				Firms located in small cities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female*Plough	-10.00**	-9.90**	-8.39**	-8.20*	-1.82	-0.92	-1.15	0.28
	[-2.42]	[-2.37]	[-2.01]	[-1.94]	[-0.32]	[-0.16]	[-0.20]	[0.05]
Female	1.82	1.76	0.42	0.25	-2.72	-3.27	-3.70	-4.71
	[0.79]	[0.75]	[0.19]	[0.11]	[-0.59]	[-0.69]	[-0.80]	[-1.00]
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE	Yes	Yes	No	No	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Country by Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Industry by Year FE	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	0.264	0.265	0.269	0.270	0.247	0.251	0.261	0.265
N	21662	21662	21662	21662	8897	8897	8897	8897

Table 9. Gender bias and firm behaviors and outcomes: Suggestive evidence

Notes: This table reports OLS results of regressing a firm's outcomes on the interaction term of *Female* and *Plough*. The dependent variable is either *Unit cost of labor*, *Profit margin*, *Sales growth* or *Capacity utilization*. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country by year and industry by year fixed effects in all specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%.

Dependent variable =	Unit cost of labor	Profit margin	Sales growth	Capacity utilization
	(1)	(2)	(3)	(4)
Female*Plough	370.52	-1.51	-0.06	0.52
	[0.56]	[-0.74]	[-0.95]	[0.35]
Female	-1909.96***	-1.88	0.01	-0.68
	[-3.14]	[-1.25]	[0.13]	[-0.70]
Firm Controls	Yes	Yes	Yes	Yes
Country FE	No	No	No	No
Industry FE	No	No	No	No
Year FE	No	No	No	No
Country by Year FE	Yes	Yes	Yes	Yes
Industry by Year FE	Yes	Yes	Yes	Yes
R-squared	0.415	0.118	0.082	0.137
N	29937	30559	27149	29530

Table 10. Gender bias and trade credits: Propensity score matching

Notes: This table reports results of regressing *Accounts payable* on the interaction term of *Female_DV* and the measure of gender bias (*Plough*) in a propensity score matched sample. *Female_DV* is a dummy variable that equals 1 if a firm has a higher than median value of *Female*, and 0 otherwise. The key explanatory variable is an interaction term of *Female* and *Plough*. See Table A1 in the online appendix for more detailed variable definitions and data sources. We include country, industry, year, or country by year and industry by year fixed effects flexibly in model specifications. We report t-statistics calculated using heteroskedasticity robust standard errors clustered at country level in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%.

Dependent variable =	Female_DV	Accounts Payable			
	PSM	OLS after PSM			
	(1)	(2)	(3)	(4)	(5)
Female_DV*Plough	-	-5.20***	-5.12***	-5.38***	-5.29***
	-	[-2.94]	[-2.86]	[-3.12]	[-3.02]
Female_DV	-	1.06	1.07	1.04	1.01
	-	[1.40]	[1.36]	[1.30]	[1.22]
Firm size	0.53***	5.53***	5.59***	5.52***	5.56***
	[24.85]	[8.24]	[8.07]	[7.74]	[7.62]
Firm age	-0.01***	0.03	0.03	0.02	0.02
	[-4.61]	[1.17]	[1.07]	[0.85]	[0.78]
Export	0.01***	0.00	0.00	0.00	-0.00
	[8.42]	[0.17]	[0.08]	[0.01]	[-0.06]
State	0.01***	-0.07	-0.07	-0.07	-0.07
	[3.29]	[-1.46]	[-1.39]	[-1.41]	[-1.37]
Foreign	-0.00	0.08***	0.08***	0.08***	0.08***
	[-1.5]	[5.03]	[4.95]	[5.02]	[4.94]
Industry sales growth	-0.14	7.52	9.51	7.54	7.50
	[-0.50]	[0.95]	[1.24]	[1.03]	[1.00]
Product competition	-0.00***	0.00	0.00	-0.00	-0.00
	[-4.09]	[0.04]	[0.08]	[-0.54]	[-0.45]
Business group	0.04	-0.78	-0.83	-0.73	-0.79
	[0.94]	[-0.82]	[-0.86]	[-0.75]	[-0.80]
CEO experience	-0.00	-0.02	-0.02	-0.01	-0.01
	[-0.06]	[-0.63]	[-0.58]	[-0.33]	[-0.27]
Ownership concentration	0.00***	-0.01	-0.02	-0.02	-0.02
	[3.84]	[-0.65]	[-0.75]	[-0.73]	[-0.83]
Profit margin	-0.08*	-1.59	-1.56	-1.92	-1.89
	[-1.69]	[-1.36]	[-1.34]	[-1.59]	[-1.56]
Female CEO	0.62***	-0.51	-0.58	-0.53	-0.59
	[13.48]	[-0.61]	[-0.68]	[-0.68]	[-0.74]
Collateral share	0.00	0.00	0.03	-0.00	0.02
	[0.25]	[0.01]	[0.19]	[-0.01]	[0.14]
Credit line	0.19***	4.45*	4.53*	4.35*	4.44*
	[5.28]	[1.88]	[1.89]	[1.85]	[1.87]
Country FE	Yes	Yes	No	Yes	No
Industry FE	Yes	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	Yes	No
Country by Year FE	No	No	Yes	No	Yes
Industry by Year FE	No	No	No	Yes	Yes
R-squared	0.071	0.252	0.254	0.258	0.260
N	30559	15514	15514	15514	15514