Civil conflict and firm recovery: Evidence from post-electoral crisis in Côte d'Ivoire*

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Abstract

This paper examines how firms recover after a civil conflict. Thanks to a rich firm-level database, we follow surviving enterprises before, during and after the 2011 post-electoral crisis in Côte d'Ivoire. Our main findings are summarized as follows. First, a partial recovery is achieved one year after the crisis (half of firm losses are recouped). However, three years after the end of the crisis, the level of productivity is ten percent lower than the year before the crisis. Second, we show a wide heterogeneity in recovery across firms (within the same industry). Young and local firms are more able to rebound after the crisis. In addition, credit-constrained firms are less resilient, highlighting the importance of access to credit in post-crisis periods. Finally, the recovery is higher for labor-intensive firms but firms relying on skilled workers face a lower resilience.

Keywords: Political violence; Firm; Recovery; Africa; Labor

JEL classification: D22; L25; N47; O12

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1 Introduction

More than half of all elections held in Africa experienced some form of violence before or after election day (Burchard, 2015). Despite a large body of literature on the consequences of civil conflicts on socio-economic outcomes (e.g., education, health, wellbeing, and economic activity), our knowledge about the implications of conflicts on firms and entrepreneurship remains limited, mainly due to a lack of data. Firm-level analysis helps to understand how conflicts affect economic activity and how policymakers may attenuate any negative effects. Recent articles have pointed out that firms suffer during conflicts (Dupas and Robinson, 2010; Camacho and Rodriguez, 2013; Amodio and Di Maio, 2018, among others). Few works, however, have examined whether and how firm recover after a civil conflict (exceptions discussed below are Collier and Duponchel, 2013; Ksoll et al., 2014). A better understanding of how firms rebound after a shock is of prime importance in allowing policymakers to effectively formulate policies that strengthen firm resilience in post-conflict countries.

This paper examines how firms recover after a short civil conflict in Côte d'Ivoire. While armed conflicts disrupt firm activity in the short-term, the persistent post-conflict effects are less evident (especially for short episodes). On the one hand, the disruption of business and the destruction of (human and physical) capital may be too limited to have a profound or long-term effect.[1] In addition, a rebound of economic activity may occur after a conflict due to reconstruction and/or because the crisis has had a "cleansing" effect. On the other hand, even short-lived conflicts may have long-term effects due to the loss of specific assets (Collier and Duponchel, 2013) or delayed investments or hiring decisions (Baker et al., 2016). Furthermore, conflicts negatively affect human capital accumulation (education and health) and social cohesion (Hjort, 2014), impeding firm growth in the long-term.

The Ivorian context is especially appropriate for our objective. From the 1990s, there were ethnic and political tensions, that peaked in 1999 with conflicts that led to the First Ivorian Civil War from 2002 to 2007. The 2010 post-electoral crisis occurred in the

[1] Even strong physical destruction may have limited long-term impact, as documented in the literature on the impact of bombing (Davis and Weinstein, 2002; Miguel and Roland, 2011). Evidence from the literature on the consequences of natural disasters also points out that local events have a limited impact on global activity (Cole et al., 2017; Strobl, 2012).

context of this prior unrest. It was relatively short (less than 6 months) but devastating (resulting in more than 3,000 deaths and over 700,000 displaced persons) and followed by a relative quiet period (Figure 1).

To examine firm recovery, we benefit from an accurate firm-level dataset of all formal Ivorian firms operating before, during and after the post-electoral crisis. We follow non-financial small and medium enterprises (defined as firms with less than 100 workers) from 2009 to 2014. We track the evolution of the labor productivity of surviving firms before (2009-10), during (2011) and in the three years after the electoral crisis (2012-14). We exploit heterogeneity across firms to examine factors impacting firm resilience, dedicating special attention to the inputs (labor and capital) beyond usual firm characteristics (sector, age, size, ownership). Indeed, recent papers have shown that the input channel is of prime importance in explaining how violence affects firm dynamics.[2]

Our main results can be summarized as follows. First, our analysis indicates that firms had only partially recovered three years after the crisis. The level of labor productivity decreased by 20% during the crisis. One year after the conflict, half of the losses was recoup. However, three years after the crisis, the level of labor productivity remained ten percent lower than prior to the crisis. Second, we show a wide heterogeneity in recovery across firms (even within the same industry). Small (in terms of employees) and local entreprises recovered, contrary to large and foreign firms. Furthermore, credit-constrained firms suffered more and were less able to recover than non-credit constrained firms. Interestingly, the access of capital played a role after the crisis but did not help firms to limit losses during the conflict. Finally, the role played by the reliance on labor in process of production (before the crisis) in recovery is ambiguous. On the one hand, labor-intensive firms outperformed their counterparts both during and after the crisis. On the other hand, firms relying on skilled workers and on managers were less able to rebound. These results are robust to sensitivity tests, including alternative measures of

[2]Theoretically, the negative impact of violence may transit through three main channels: (i) availability and cost of inputs (labor, capital, intermediate goods); (ii) demand channel (contraction of demand, access to output markets); and, (iii) uncertainty (inducing firms to postpone hiring and investment decisions and adopting risk mitigating strategies). As explained in the following, we lack data to test the two latter channels. Indeed, the literature on the consequences of conflicts and violence on firms often focuses on input channel (certainly due to lack of data). Firms suffer from limited access to inputs during conflicts, whether they are the labor (Collier and Duponchel, 2013; Ksoll et al., 2014), capital and investment (Singh, 2013) or intermediate goods (Amodio and Di Maio, 2018; Klapper et al., 2013).

dependent and interest variables, alternative definitions of the crisis period, and additional econometric specifications taking into account sample selection and spatial heterogeneity.

Our research contributes to a burgeoning literature on the consequences of interpersonal violence and civil conflict on firms. Recent works show that civil war and criminal acts seriously disrupt business activities by reducing the performance of surviving businesses (e.g., Dupas and Robinson, 2010; Klapper et al., 2013; Amodio and Di Maio, 2018; Rozo, 2018), by inducing a stronger exit (Camacho and Rodriguez, 2013) and by spurring the growth of the informal sector (Bozzoli et al., 2013).[3] However, to our knowledge, only two papers have examined how firms perform in the wake a crisis. Ksoll et al. (2014) point out that the impact of Kenya's 2008 post-electoral crisis on the flower industry was short-lived. Despite widespread worker absenteeism due to the crisis, firms were able to rebound within several days. Collier and Duponchel (2013), however, document that five years after the end of fighting in Sierra Leone, the business of firms located in the most affected areas still lagged. The authors explain the lack of firm resilience by a "*forgetting by not doing*" effect where skilled workers lose their skills due to a prolonged period of inactivity.

Our paper extends the scant literature on firm recovery outlined above by providing more robust evidence allowed by the inclusion of the universe of formal firms (contrary to Ksoll et al. (2014)) and the exploitation of information on firms before, during and after the crisis (contrary to Collier and Duponchel (2013)). In addition, we reconcile findings from both studies, as well as provide new results. An important difference that may explain the contradictory conclusions between Collier and Duponchel (2013) and Ksoll et al. (2014) is the duration of the conflict. In our analysis, we exploit a short crisis (few months) but one that occurred in a highly unstable country. In this context, we highlight that even a short event may have a persistent effect on firm performance in the medium run. In addition, both papers focus on the importance of workforce. Our work documents that the relationship between labor and resilience is rather complex, helping to explain contradictory findings from both papers. Our results indicate that labor-intensive

[3]Until recently, the literature on the economic consequences of political violence has been dominated by cross-country analyses (Alesina et al., 1996; Cerra and Saxena, 2008). First researches employing firm-level data has employed market valuation and document that consequences of conflict is heterogenous (Abadie and Gardeazabal, 2003; Guidolin and La Ferrara, 2007). However, these studies focus exclusively on listed firms and neglect the large majority of firms, especially in developing countries.

firms, that often rely on unskilled labor (such as those in the flower industry examined by Ksoll et al. (2014)) are more likely to recover as their workers are easily replaceable with little to no productivity costs (learning by doing is achieve in several hours or days). However, for firms that rely on more complex production processes or on skilled workers, replacing departed employees can have significant productivity costs as new workers are unable to immediately be as productive as well as former ones. In addition, re-hiring skilled workers has a limited effect due to the "forgetting by not doing" effect (Collier and Duponchel, 2013) because skills depreciate over time (Edin and Gustavsson, 2008). Finally, our paper sheds light on the importance of capital access to strengthen resilience after a shock. This finding indicates that financial constraints are not only important in normal times (Ayyagari et al., 2008; Beck et al., 2005; Beck and Demirguc-Kunt, 2006) but also after the occurrence of a shock.

Our article also contributes to the analysis of recovery after a conflict by providing a microeconomic analysis of this process. There is quite a lot of controversy in the literature regarding the long-term effects of civil conflicts on economic activity.[4] Usual Solow growth model implies that a destruction of production factors has a temporary effect and countries catch-up with a more rapid accumulation of physical and human capital. Several empirical investigations give support to this view by focusing on major wars or bombing episodes (Organski and Kugler, 1977; Davis and Weinstein, 2002; Miguel and Roland, 2011). However, recent macroeconomic studies point out that recovery is partial after a civil conflict (Cerra and Saxena, 2008; Mueller et al., 2017). The recovery process is rarely investigated at the micro-level despite its importance to better understand channels through which recovery occurs. One exception is Serneels and Verpoorten (2015) who document that six years after the conflict in Rwanda, households and localities that experienced more intense conflicts are lagging behind in terms of consumption. Our work contributes to this literature by focusing on firm's ability to recover. We provide evidence in line with the partial recovery. Even if firms were more able to rebound in the short-term, they do not experience a complete recovery. Obviously, our contribution is limited by the time dimension but show than even after three years firms do not expe-

[4]We do not discuss a large literature on long-term effect of civil conflict on human capital through its negative consequences on (child) health and education (see Verwimp et al., 2018, for a recet overview).

rience quicker gains in labor productivity. Finally, in a different context Vonyó (2017) also highlights the importance of skilled labor in recovery by comparing performance of Eastern and Western Europe after the Second World War.

Our work finally adds to a small body of literature focusing on political crises in Côte d'Ivoire. Several papers have investigated the impact of the first Ivorian civil war (1999-2005) on economic and social outcomes. The first Ivorian crisis had a detrimental impact on child health (Minoiu and Shemyakina, 2012, 2014) and on the education level (Dabalen and Paul, 2014). Closest to our paper is Klapper et al. (2013) who study the effects of the first Ivorian crisis on firms. They find a loss of productivity of approximately 20%, which decline was still strong for foreign companies or companies employing foreign employees, as well as for companies in sectors that rely on imported inputs. However, the authors focus on short-term effects (the first Ivorian crisis had not ended in 2003). We confirm their main results regarding the role of firm characteristics (age, size, foreign or domestic) and extend them by showing that dependence on inputs explains differences in resilience across firms.

The paper proceeds as follows. Section 2 describes the political context in Côte d'Ivoire. Section 3 presents the dataset used in the empirical section. Section 4 discusses the methodology. Section 5 presents baseline results and robustness checks. Section 6 discusses our main findings. The last section concludes.

2 Context

2.1 The first political crisis (1999-2007)

Côte d'Ivoire is a West African country, with a diverse population of more than 26 million (in 2017). It is a regional center of migration and foreigners account for one quarter of the inhabitants (even more in Abidjan). The country has about sixty ethnic and linguistic groups. Following its independence in 1960, Côte d'Ivoire enjoyed twenty years of continuous economic prosperity characterized by sustained economic growth. Politically, Côte d'Ivoire is a presidential system and was governed by Félix Houphouët Boigny (FHB) after its independence. Following the death of FHB on 7 December 1993, Henri Konan

Bédié (President of the National Assembly) was appointed president. The economic challenges for the new president were substantial, and included managing the devaluation of the CFA franc and implementing austerity measures and economic liberalization reforms. Despite an ambitious five-year program, social difficulties associated with structural adjustment programs remained and the economy failed to rebound.

On Christmas Eve 1999, Henri Konan Bédié was deposed from power by General Robert Gueï (former army Chief of Staff) following a coup d'état. Presidential elections were held a year later. Laurent Gbagbo, the historical opponent of FHB, rose to power following violent clashes between his supporters and those of General Gueï. These tensions, coupled with changes in economic ideology (from free-market to socialist) and the development of the concept of "ivoirité" to exclude northerners and foreigners reinforced the social and political divide.

This situation led to the failed coup d'état of September 2002 and the assassination of General Gueï. The failed coup turned into a rebellion and the country was divided into two parts: the central, northern and western zones were controlled by the rebel forces of the Patriotic Movement of Côte d'Ivoire (MPCI), led by the former student union leader Guillaume Soro while the southern zone was controlled by the national army in support of Laurent Gbagbo.

After a peak in violence in November 2004 (following the bombings of the French base in Bouaké), tensions diminished in 2005, as indicated in Figure 1. A durable peace agreement was signed in 2007 (Ouagadougou agreement). The zone of confidence established in 2002 between Soro's rebel forces in the north and Gbagbo's forces/supporters in the south was dismantled. Soro became the head of government and Gbadbo remained president. Between 2005 and 2010, the country experienced a relative period of calm, a "no war and no peace" situation characterized by increased uncertainty and sporadic small clashes (McGovern, 2011).

< Insert here Figure 1 >

2.2 The second political crisis (2010-2011)

After five years of postponement, presidential elections were held in 2010 (in accordance with the Ouagadougou agreement). After a peaceful first round, the contestation regarding final second round (November, 28^{th}) results were contested and both finalists claimed victory: Alassane Ouattara[5] was recognized by the Independent Electoral Commission (CEI), the UN as an independent observer and the international community while Gbagbo was declared the winner by the Constitutional Council, which annuled certain results proclaimed by the CEI. Thus, Côte d'Ivoire found itself with two presidents Alassane Ouattara and Laurent Gbagbo and two governments (headed by Guillaume Soro and Gilbert Aké Ngbo, respectively).

From January to April 2011, Abidjan was the scene of numerous clashes between soldiers of the pro-Ouattara "Invisible Commando" and Laurent Gbagbo's armed forces. In western and northern Côte d'Ivoire, pro-Ouattara forces supported by the brotherhood of the Dozos (traditional hunters) organized and advanced towards Abidjan (see Figure A1 displaying the march on Abidjan). The pro-Ouattara forces gradually seized several cities in the country and entered Yamoussoukro on March, 30^{th}. The next day, the Republican Forces of Cote d'Ivoire surrounded Abidjan. After several days of intense fighting and surrender, Laurent Gbagbo and his wife were arrested on April, 11^{th} in the presidential residence in Cocody (Abidjan). Gbagbo was taken prisoner in the north of the country before being referred to the International Criminal Court (Netherlands) and charged with crimes against humanity. Alassane Ouattara was instated as President of the Republic of Cote d'Ivoire on May 21, 2011, and recognized by the international community.

Despite its short duration, the 2011 post-electoral crisis had profound human consequences. According to the National Commission of Inquiry, the civil conflict killed 3,248 people (see Table A1), particularly in the southern (Abidjan, Lagunes) and western parts (Bas-Sassandra, Montagnes) of the country. In addition, the post-electoral crisis caused the displacement of nearly 735,000 persons (recall that Abidjan is a center of internal and

[5]Finishing third in the first round, Henri Konan Bédié (former president) endorsed Ouattara for the second round. Alassane Ouattara was the former prime minister under FHB. He was disqualified from the 2000 Presidential Election due to the new electoral code stating that both parents must be Ivorian to run (Alassane Ouattara was suspected to be Burkinabe).

regional migration).[6] Several families fled the country by any means, a state of emergency was declared and thousands of foreign nationals were evacuated (including nearly 12,000 French nationals).

The post-electoral crisis also had significant economic consequences in the short-term. Ivorian cocoa was under embargo. Many banks, especially in Abidjan, were closed for several months, there was a shortage of medicines, the country's main refinery was no longer able to buy crude oil and was at a standstill, which resulted in fuel and food shortage (sugar, meat, oil, ...) whose prices skyrocketed. In short, the economy was at a standstill. Since 2012, the country has experienced relative political stability and economic recovery and has had one of the highest growth cycles in the world (more than 8% on average per year). This renewed economic momentum was mainly driven by an improvement in the business environment, ambitious investment plans and renewed dynamism in agricultural.

3 Data

3.1 Dataset

Our analysis is based on firm-level data from the register of formal enterprises in Côte d'Ivoire from 2006 to 2014. The register, collected by the National Institute of Statistics (*Institut National de Statistiques, INS henceforth*), covers the universe of enterprises operating in the formal sector in Côte d'Ivoire. It includes public, local private and foreign-owned firms operating in all industries (agriculture, manufacturing, trade, construction, services and finance). The unit of observation is the firm; but almost all firms in Côte d'Ivoire are single-establishment firms (Klapper et al., 2013).

The register collects two types of information. First, we obtain general information on firms including year of creation, location (city), industrial sector (two-digit), legal status (limited liability, public company or other status), ownership structure (public; private; foreign), and the number of employees. Interestingly for our investigation, the *INS* not only provides the number of employees but also the number of managers or white collars

[6]The International Displacement Monitoring Centre has advanced the figure of one million displaced persons (http://www.internal-displacement.org/countries/cote-divoire).

workers ("cadres" in French) and the number of permanent and temporary workers. In addition, the database reports basic financial information extracted from balance sheets (such as total assets and debt structure) and income statements (such as total sales, value added, profit, taxes paid, total payroll). All financial data are deflated using the GDP deflator (year base = 2009).

One advantage of this dataset is that companies continued to be monitored during the crisis. It should be noted that *INS* checks firm-level information to detect irregularities. As a consequence, we are confident with the accuracy of data. Despite its richness, the database comes with some shortcomings. First, firms are theoretically identified by a unique identifier. However, we observe some discrepancies in the dataset. The same identifier is sometimes employed for two observations that appear to apply to different firms. To detect any possible irregularities, we develop a procedure described in Appendix B. According to this procedure, we recode 462 firms (less than 2% of the firms). Second, informal firms are not included in the database. We are therefore blind to firm dynamics in the informal sector and the migration between the formal and informal sectors. Finally, while our dataset allows us to follow post-entry performance of existing firms, it provides limited information on firm entry. Some firms enter the dataset after their registration, as indicated in Table 1 (differences between the stock of firms (first column) and flows of entries and exits).[7] We are theoretically equipped to disentangle "real entries" and the registration of existing firms (by comparing the year of creation and the first year in which the firm appears in the dataset). However, the year of creation is based on a declaration by the firm that the *INS* cannot check.[8] In addition to dataset discrepancies, a new law in 2012 blurred the effect of post-crisis conditions on firm entry.[9] It should be

[7]Before 2008, formal firms in Côte d'Ivoire transmitted their financial statements to both fiscal authorities (mandatory) and to the INS (not mandatory). As a result, some firms were registered with the fiscal authorities but not included in the INS dataset. In 2008, a single window was created to facilitate the transmission of data. Since 2010, the INS has begun to cooperate with the new institution to retrieve data on all formal firms.

[8]A simple observation of entries points out that some entries defined as real entries are subject to caution. For instance, some new firms entered with more than 100 employees.

[9]In 2012 an administrative order has been adopted to facilitate the creation of new firms through a unique guichet or window (*Centre de Promotion des Investissement en Côte d'Ivoire, CEPICI*) and a reduction in the number of procedures (Article 4 of order number 2012-867, 6 September 2012. As a result, we fail to disentangle the impact of the end of the post-electoral crisis and the impact of the 2012 law in explaining the sharp increase in the number of entries after 2012.

noted that the new legislation may explain the sharp increase in firm exits because new firms are more likely to exit.

< Insert here Table 1 >

3.2 Sample

Our main objective is to investigate firm resilience following the 2011 post-electoral crisis in Côte d'Ivoire. In doing so, we follow a cohort of small and medium private non-financial corporations operating from 2009 to 2014 (surviving firms). Below we discuss the reasons justifying for choosing this period and the sample of firms retained in the analysis.

3.2.1 Period

A first critical point for analyzing firm resilience consists in defining proper pre-crisis and post-crisis periods. Although we have data from 2006, we exclude 2006, 2007 and 2008 in our analysis. This decision is based on the recent history of Côte d'Ivoire (see Section 2). The first Ivorian crisis was officially over in 2007 but combat was terminated in 2005, as indicated in Figure 1. We face a trade-off to select the pre-crisis period: Choose sufficient periods (at least one) before the crisis that does not overlap with the post-crisis period of the first Ivorian crisis. We make the choice to consider 2009 and 2010 as the pre-crisis period (benchmark). The first year considered (2009) is three years after the end of the first Ivorian crisis, which allows us to assume that all of that conflict's post-crisis effects have occurred before this date. We consider 2010 as a pre-crisis year because the post-electoral conflict began in the end of the year and weakly affected firms during 2010, as indicated in Figure 2.

Turning to our post-crisis period, an ideal set-up involves a period without conflict. While we observe some events after, their intensity had largely decreased. In addition, economic activity regained renewed dynamism and vigor just after the post-electoral crisis of 2011 (from 2012 onwards). As a consequence, we consider the years from 2012 to 2014 as the post-crisis period (we are limited to the final year by data availability).

3.2.2 Sample of firms considered

As our main interest involves firm resilience, we follow a cohort of surviving firms from 2009 to 2014. We consider only firms operating in 2009 and do not include new firms. Indeed, as explained above, we cannot investigate firm entry due to data discrepancies (false entries) and the adoption of a new law in 2012 to facilitate entrepreneurship.

We apply some additional filters. We drop public and semi-public firms (190 firms) as these firms are potentially related to political power and their business can be influenced by electoral cycles. We also drop firms operating in finance (549 firms) because financial corporations differ in many aspects to non-financial corporations. Finally, we exclude firms in domestic work and extraterritorial business due to the limited number of firms in each sector (one firm only in each).

We then withdraw large firms, defined as those having more than 100 employees in 2009 (367 firms). Small and Medium Enterprises account for 65% of employment and 55% of GDP (OECD, 2016). The exclusion of large firms is justified for several reasons. First, large firms are more likely to be connected with political leaders that may impede (for those close to Gbagbo) or improve (for those close to Ouattara) their resilience. Second, a political crisis is not exogenous for larger firms. Their performance may affect the economic situation and therefore have an impact on the occurrence of the post-electoral shock (at least at the local level). Finally, this decision is also data-driven. For unexplained reasons, we observe that the number of employees of many (large) firms presents an unexplained hike in 2013 (the number of employees doubled or tripled in 2013 and returned to their "normal" levels in 2014).

Our sample is reduced to 5,217 firms (see Panel B of Table 1), including 839 new firms (we assume that all entries are real entries in this year). By design, we have no entry after 2009 and no exit before 2010. The number of exits is the highest in 2010, which could be explained by the market churning insofar as new firms have a higher probability of leaving the market. The number of firms included in the analysis is reduced because some variables are not available (especially information on employment). In addition, for our econometric analysis, we exclude extreme values for financial data (top and bottom percentiles) and for firms with negative value added (because we employ a logarithm of

labor productivity).

3.3 Variables

3.3.1 Productivity

Our aim is to study how firms operating in 2009 were able to rebound after the 2011 post-electoral crisis. In line with previous works (Hallward-Driemeier and Rijkers, 2013), our preferred measure of firm performance is productivity. Indeed, firms in developing countries suffer from misallocation reflected in differences in terms of productivity and firm size (Hsieh and Klenow, 2009; Restuccia and Rogerson, 2017). We focus on labor productivity, defined as value added per worker. An advantage of labor productivity is the possibility to break out its components (value added and workers). Due to the lack of data on stock of capital for more than two thirds of firms, we do not consider the total factor productivity (TFP) in the baseline analysis. However, robustness checks point out that our findings are unaltered when we consider TFP instead of labor productivity (see Section 5.3).

The value added has been deflated using the GDP deflator and translated in euros using the official exchange rate. The number of workers is obtained by taking the total number of employees plus one (the manager and/or owner). We consider the number of permanent and temporary workers. Temporary workers are often employed in Africa to adjust production. The share of permanent workers increases with firm size. As a result, employing the number of permanent workers instead of total workers biases labor productivity results by increasing the labor productivity findings for small firms and reducing the labor productivity findings for large firms.

3.3.2 Input usage

A major contribution of this paper consists in scrutinizing which firms were best able to rebound. According to the literature, three main channels may affect a firm during and after a crisis: (i) input channel (availability and cost of inputs); (ii) demand channel (contraction of demand and access to output markets); and, (iii) uncertainty channel (inducing firms to postpone hiring and investment decision). Ideally, we would investigate

each channel. Unfortunately, our dataset allows us to test the input channel exclusively.[10] However, existing papers point out that constraints on inputs play a major role during a crisis. We thus focus on labor and capital.[11]

For labor, we focus not only on the share of labor in the production process but on its composition. We firstly consider the importance of labor in the production process. In doing so, we compute the cost of labor (total payroll) relative to total sales. We expect that firms that dedicate a larger share of their revenues to pay wages are more dependent on labor (irrespective of its composition) in the production process. As indicated in Table A2 in the Appendix, tertiary activities (tourism, transport, services to enterprises, education and health) rely more on labor in their production process than other sectors do.

We then consider two proxies to capture differences in the composition of labor. First, we consider the share of managerial staff ("cadres" in French) to total workers. Firms with a higher relative share of managers rely on a more complex production process that necessitates more coordination than other firms. We expect that these firms are more dependent on a few workers (managers) to maintain their level of productivity. Second, we consider the average wage by dividing total wages paids by the number of total workers. The average wage is often employed to gauge the skill level of the workforce (Cole et al., 2017). One might raise concerns that average wage is correlated with labor productivity but across-firm correlation is far from perfect ($\rho = 0.36$). Turning to differences across industries, Table A2 indicates that extractive industries, transport and services to enterprises are sectors that employ a larger share of managers than other sectors. This statistic confirms that managers play an important role in industries with a complex production process. Interestingly, these industries, along with electricity, are also those that pay a higher average wage.

We then focus on access to capital. We consider two measures of quantity and two

[10] We do not gain access to data such as the export status of firms or investments that would allow us to test any channels other than the input channel.

[11] In a previous analysis, we also consider intermediate goods by computing their cost (difference between sales and value added) to sales. However, results are highly unstable and do not allow us to draw a clear-cut conclusion.

measures of prices. First, we build the debt ratio by dividing the sum of (short-term and long-term) financial debt to total assets. Firms with a larger debt ratio are assumed to be less credit constrained than their counterparts (the use of equity is rather limited in Côte d'Ivoire). We also compute the ratio of trade credit to total debt (financial debt and trade credit). The theory of trade credit is unclear: trade credit may act as a substitute or a complementary of formal finance. Nonetheless, the substitution role of trade credit is heightened in a context of scarcity of funds following a financial crisis (Carbo-Valverde et al., 2016) or in countries with under-developed financial markets as Côte d'Ivoire (Fisman and Love, 2003). We therefore assume that firms relying more on trade credit to finance their activities are more financially constrained than their counterparts.

Next we try to assess the cost of lending for firms. In doing so, we compute the financial cost defined as financial expenses to total revenue, and the implicit interest rate computed as the ratio of financial expenses to total debt. Credit-rationed firms are therefore those with a limited debt ratio, a higher level of trade credit and higher financial costs. Table A2 (Panel B) points out that extraction, construction and services to enterprises are the least credit constrained industries.

Contrary to the existing literature, we focus on differences in input across firms operating in the same industry. A usual approach consists in comparing firms operating in different industries (Hallward-Driemeier and Rijkers, 2013; Klapper et al., 2013). For instance, if access to capital is the main channel by which a crisis has affected firms, we expect that firms operating in sectors relying on external capital will suffer more than their counterparts. Considering industry-level indicators implicitly assumes that all firms in the same industry face similar constraints. We raise doubts about the homogeneity assumption. First, the literature on firm productivity in developing countries sheds light on heterogeneity between firms within the same industry due to differences in access to inputs (Restuccia and Rogerson, 2017). Second, our dataset does not provide fine-grained industries (two-digit). Third, our data, displayed in Table A2, point out that differences in input usage across firms in the same industry are substantial. In the Appedix, we document that more than 95% of variations in input usage are explained by within-industry

variations rather than between-industry variation (see Table A3).[12]

To account for differences across sectors, we normalize input usage using the average of the sector. Specifically, for each input, we create a dummy equal to 1 if the firm value exceeds the mean of the sector where the firm operates, as follows:

$$X_{ij(t_0)} = \begin{cases} 1, & \text{if } x_{ij(t_0)} - \bar{x}_{.j(t_0)} > 0; \\ 0, & \text{otherwise.} \end{cases}$$

where $x_{ij(t_0)}$ is the value for each input for firm i in sector j before the crisis (i.e., in 2009) and $\bar{x}_{.j}$ the average in the industry j at the same period (t_0). In other words, our measure takes the value of 1 if a firm relies more on the input considered than firms in the same industry do.

4 Methodology

4.1 Presentation

Our main objective is to analyze the impact of the input mix in firm resilience. In doing so, we consider a simple fixed effects model with interactions as follows:

$$Log(LP)_{ijt} = \alpha_i + \beta_1 AFTER_t + \beta_2 AFTER_t \times X_{ij(t_0)} + \beta_3 AFTER_t \times C_{ij(t_0)} + \varepsilon_{ijt} \quad (1)$$

where $Log(LP)_{it}$ denotes the log of labor productivity.[13] $AFTER_t$ is a dummy taking the value of 1 for years after the occurrence of the crisis (from 2011 to 2014) and 0 before the crisis (2009 and 2010). We interact the $AFTER_t$ dummy with our dummies for input ($X_{ij(t_0)}$), as described above. These input dummies are measured in 2009, i.e. before the

[12] To quantify the importance of within-industry and between-industry variations in the use of input, we regress our different measures of input usage on industry dummies. We consider several specification including all observations available in the dataset and only firms included in our sample (all years or only in 2009). Results are insensitive to different specifications, as indicated in Table A3. Industry dummies capture variation between industries, while the unexpected part refers to within-industry variations. These dummies explain less than 5% of variation for input usage, except for cost of labor to sales (8%). It should be noted that firm characteristics (age, size, location and foreign-ownership) have a limited explanatory power of input usage, except for average wage (the four variables explain 13% of variations).

[13] Over the sample considered, 15.4% of all observations reported a negative value of value-added and are therefore excluded in regressions.

crisis (t_0).

To control for confounding factors impacting both input usage and resilience, we include interactions between the $AFTER_t$ dummy and firm characteristics measured in 2009 ($C_{ij(t_0)}$). Firm characteristics include firm size (in terms of assets and workers, both in logarithm form), firm age, a dummy for foreign-owned firms, a dummy for firms located in Abidjan and a dummy for each industry. Table 2 documents that one quarter of firms are foreign-owned. The average firm size is 12 workers and firms are 7-years old on average. Almost all firms (more than 90%) are located in Abidjan. Enterprises operate mainly in services, especially in trade (36%) and services to enterprises (21%), followed by construction (12%) and manufacturing (10%).

< Insert here Table 2 >

4.2 Discussion and limitations

One might be surprised by the simplicity of the econometric model. We discuss our main choices below.

First, we consider input usage and firm characteristics before the crisis because our aim is to investigate whether initial differences impacted firm performance during and after the crisis. The best way to do so consists in using initial values (before the crisis). Furthermore, employing time-varying control variables may induce a simultaneous bias insofar as the crisis may affect both the dependent and independent variables.

Second, contrary to previous works (Collier and Duponchel, 2013; Camacho and Rodriguez, 2013), we do not exploit spatial heterogeneity in crisis exposure. As indicated in Table A1, the majority of firms are located in Abidjan which was strongly affected by the crisis.[14] Unfortunately, we are unable to exploit richer information on locations within Abidjan (Abidjan is divided in 10 municipalities). Indeed, neither the INS dataset on firms nor the ACLED database on conflicts provide precise location (e.g., municipality) within Abidjan. As a result, we focus on before/after analysis and assume that the

[14]It should be noted that data on conflicts at the local level are extracted from the ACLED database, which provides the location of events. However, information reported should be treated with caution because the ACLED reports fewer events/fatalities than the more complete data provided by the National Commission of Inquiry (see Table A1).

treatment (crisis) is common for all firms, irrespective of their location. We relax this assumption in robustness checks.

Third, one might note that the $AFTER_t$ dummy captures all changes that occurred during crisis and after post-crisis periods and may account for factors unrelated to crisis/postcrisis events during the same year. However, we expect that the post-electoral crisis was the biggest shock occurring in Côte d'Ivoire over the period.

Finally, our identification strategy relies on the assumption that we control for all characteristics affecting both input usage and a firm's ability to rebound after a shock. This motivation explains why we control for firm characteristics (age, size, ownership, etc.) that could affect the input mix in 2009, as well as resilience. In addition, the inclusion of firm fixed effects allows us to control for time-invariant (unobserved) firm characteristics, such as skill level of managers, network or internal organization of the firm (e.g., management practices). Unfortunately, we cannot control for time varying unobserved characteristics. However, we expect that this issue does not disqualify the analysis. To bias our findings, unobserved factors should not only be related to resilience but also correlated with input usage in 2009. In theory, this possibility exists. The most probable explanation induces a change in company management between 2009 and 2014.[15] However, to be statistically detectable this situation should concern many enterprises that is unlikely, at least because many SMEs in developing countries are family firms with few changes in top management and firm organization over time (Carillo et al., 2019).

5 Results

5.1 The net impact of the crisis

Table 3 scrutinizes the evolution of labor productivity and its components (value added and the number of workers) for active firms (2,748 firms) from 2009 to 2014 per year. In Table 3, we display the mean, quartiles and median for the three variables, by year. We see an increase from 2009 to 2010 of labor productivity and its components. However,

[15]For example, a bad manager has been replaced by a good manager (or the vice versa). The bad manager should be less able to attract skilled workers and obtain loans. Therefore, we should note that companies with less capital and skilled labor-intensive activities outperform after the crisis due to this change in manager (or vice versa).

labor productivity, as well as value added and the number of workers, decreased in 2011. The impact of the crisis was significant for labor productivity, which shrank by 23%. Interestingly, the amplitude of this drop is close to that observed by Klapper et al. (2013) in the first Ivorian crisis. The recovery seems imperfect for labor productivity. Even if on average the level of labor productivity in 2014 is superior to that in 2009, the labor productivity cannot attain the level of 2010 at the end of the period of observation. Meanwhile, the impact of crisis on value added and workers seems more temporary (one year for value added and two years for employment).

< Insert here Table 3 >

To provide more direct evidence, we run a simple fixed effects model with the $AFTER_t$ dummy.[16] To gauge the impact of the crisis, we firstly consider the pre-crisis period (2009 and 2010) and the crisis year (2011). We then add post-crisis years one by one (2012, 2013, 2014). Results, displayed in Table 4, confirm the raw statistics. The level of labor productivity decreased by 20% during the crisis. There was a rapid recovery one year after the crisis (in 2012) but the level of labor productivity remained ten percent lower three years after the crisis. We then investigate the impact of the post-electoral crisis on labor productivity components, namely value added and the number of total workers. The negative impact of the crisis on value added is temporary, as documented in Panel B. The number of workers was not really impacted by the crisis and continued to expand over time (Panel C). The difference in evolution between value added and the number of workers explains the global negative trend on labor productivity. We document that our findings are robust to the use of growth (columns (5-8)) instead of level for all variables (labor productivity, value added and the number of workers). In addition, these findings are in line with a macroeconomic analysis documenting a net rebound in Côte d'Ivoire after the post-electoral crisis.

< Insert here Table 4 >

[16]The specification is Eq. 1 without interactions as follows: $Log(LP)_{ijt} = \alpha_i + \beta AFTER_t + \varepsilon_{ijt}$

5.2 The heterogenous impact of the crisis

Our main aim consists in investigating differences in resilience across firms, according to their initial conditions. Table 5 presents the results of our baseline model (Eq. 1) including interactions between firm characteristics and input dependence before the crisis. Before focusing on input, we briefly discuss the results regarding firm characteristics. The column (0) reports the results when we keep only interactions with firm characteristics. Despite differences in period coverage and measurement of productivity, our findings are very similar to those obtained by Klapper et al. (2013) for the first Ivorian crisis. First, even if xenophobia was less explicit in the second Ivorian crisis, we see that foreign firms also suffered more than their local counterparts during the second episode. Foreign firms which are more externally oriented and therefore require access to foreign markets, are more sensitive to disturbances in infrastructure and logistic chains.

Second, the impact of firm size is ambiguous but also in line with econometric results produced by Klapper et al. (2013) (see Table 7 in their paper). Larger firms measured by the number of workers suffered more than small ones. However, we find the opposite sign for sales. At the same time, the smallest companies (less than 10 employees) were able to rebound faster than the others. Several explanations can be put forward. First of all, small structures are more flexible to face an uncertain future. They are more oriented towards local markets, making them less sensitive to infrastructure disruptions, have a much simpler structure and management, which allows them to adapt more immediately to market variations and logistics problems.

There is a weak difference between older and younger firms and between firms in Abidjan and those elsewhere in terms of labor productivity. Finally, we see that there is a limited difference across sectors. Firms in the trade sector and in extraction suffered more during and after the crisis than firms in other sector. On the opposite side of the spectrum, firms operating in hotels experienced a positive increase of labor productivity.

< Insert here Table 5 >

We now focus on how input dependence before the crisis has impacted a firm's ability to rebound after the crisis. We first concentrate on workforce by using one measure of

labor intensity in the production process (staff cost) and two measures of labor composition (share of managers and average wage). In addition to the net impact reported in Table 5, we present the impact on labor productivity components (value added and the number of workers) in Table 6. Panel C of Table 6 distinguishes the impact between the crisis year (2011) and the post-crisis period (2012 to 2014). In both tables, results regarding labor are reported in columns (1) through (3).

First, we document that firms that relied more on labor before the crisis, irrespective of composition were more resilient than their counterparts, as indicated in column (1) of Table 5. To make sense of our estimation, we plot the impact of the crisis for a hypothetical average firm in Figure A2.[17] In the first bar, we show that the average firm suffers from a 10% contraction of labor productivity (all input dummies are set to zero). In the second bar, companies relying on labor experience an increase by 45% (we change the dummy for labor-intensive firms from 0 to 1). Table 6 (Panels A and B) indicates that firms with higher staff costs increased their productivity after the crisis because they experienced an increase of value added and a contraction of employment. In addition, Panel C shows that labor intensive firms suffered less than other firms during the crisis (in 2011) as well as after the crisis.

However, results displayed in columns (2) and (3) point out that the composition of the workforce matters. Firms relying more on managers and that had more skilled workers (higher average wage) than other firms suffered more than other firms both during and after the post-electoral crisis. The level of productivity for firms relying on managers decreased by 20% after three years and by 40% if we refer to average wage as a proxy of skilled workers, according to our computation, displayed in Figure A2. For both measures of labor composition, we observe an increase in the number of workers for firms relying *ex ante* on managers and/or skilled labor (Table 6, Panel A, columns 2-3). Meanwhile, the value added grew slower (managers) or decreased (average wage). In addition, we document (in Panel C of Table 6) that these enterprises not only suffered more during the crisis but were less able to rebound after ward.

[17] In doing so, we consider a hypothetical firm taking the mean value for each variable (age, size, etc.). We then consider how the net impact of the crisis is changed when we switch the dummy from zero to one for input staff (second bar).

< Insert here Table 6 >

It is often accepted that financial access is an important driver of firm growth. Next, we investigate how financial constraint affects firm dynamics in after a political crisis. In doing so, we employ two measures of quantity and two measures of price. We assume that less credit constrained enterprises have a higher level of debt ratio, a lower level of trade credit and lower financial costs. As previously, these characteristics are measured before the crisis (in 2009) and we control for firm fixed effects and interaction with firm characteristics (age, size, location and industry) to limit endogeneity issues (see Eq 1).

Results, displayed in Table 5 (columns 5-6) and in Figure A2, point out that credit-constrained firms faced a greater decline in labor productivity. Results are insensitive to the measure of credit-constraint employed, except that the interaction with financial costs have the expected sign but are not always statistically significant. Interestingly, results on labor productivity components reported in Table 6 (Panels A and B) are also consistent. Firms with a better access to credit before the crisis expanded both in terms of value added and in terms of employment.

Econometric results from Panel C of Table 6 document that access to finance was crucial during the post-crisis period. Put differently, credit-constrained firms did not suffer more during the crisis than unconstrained ones but were less able to rebound when the crisis was over. This finding is consistent with the fact that banks closed during the crisis in Côte d'Ivoire. As a result, firms with better banking relationships could not exploit them during the crisis. However, in the following years, these firms were privileged by banks in access to funds.

5.3 Robustness checks

We run several robustness checks to assess the sensitivity of our results. Results are displayed in the Appendix. First, we test whether our findings are sensitive to the measure of productivity in Table A4. In the first three rows, we change the measurement of labor productivity by modifying the denominator (in Panels A and B) and using variations of labor productivity in Panel C. In Panel D, we consider total factor productivity (TFP) instead of labor productivity. The TFP has the advantage of better proxying pure

productivity shock because it is a residual that contains any information not captured by observed inputs (labor and capital). However, computation of TFP requires data on capital and labor. We exploit the data on tangible capital assets that are available for only one third of firms and use the applied approach developed by Olley and Pakes (1996). Despite a sharp reduction in observations, our results are strongly robust when we consider the logarithm of TFP.

Second, in Table A5, we consider alternative dependent variables based on accounting results (profits). In Panel A, the dependent variable is the logarithm of profit, defined as earnings before interest and taxes. We consider the ratio of gross operating surplus to sales in Panel B and the return on assets in Panel C as measures of profitability. Our econometric results are confirmed, except for the manager variable.

Third, we play with the measurement of input usage. In Panel A of Table A6, we create a dummy based on the median in the industry rather than the mean. In Panel B, we consider continuous measures instead of dummies. In both cases, our results are unchanged.

Fourth, we change our definition of pre-crisis and crisis periods. In Panel C of Table A6, we include 2008 in our pre-crisis period without altering our conclusion.[18] In the following row, we include 2010 in the crisis period. Indeed, as shown in Figure 2, the post-electoral crisis began in the end of 2010. Finally, we run a placebo test. We consider the years from 2007 to 2009 and create a crisis dummy equal to one in 2009. We expect that input dependence will not affect labor productivity before the crisis. With the exception of debt ratio (column 4), we see in Panel E that interactions are not insignificant, in line with expectations.

Fifth, we address the sample selection issue. The baseline specification suffers from a sample selection issue because we exclude exiting firms. To control for this problem, we develop a sample selection model for fixed effects panel data. In this paper we employ the three-step procedure proposed by Wooldridge (1995). Details about the method are reported in Appendix D and results are displayed in Panel A of Table A7. We document that our findings, except for proxies of labor composition, are unchanged after controlling

[18] In an unreported analysis, we consider the years from 2007 and 2010 as the pre-crisis period and our findings remain unchanged.

for sample selection. For the composition of labor, the coefficients have the expected signs but are not statistically significant at the usual thresholds.

Sixth, we restrict our sample to firms outside Abidjan in Panel B of Table A7. Despite a sharp reduction in the number of observations, our main findings for labor are unchanged. For capital, the coefficients have the same sign as in the baseline analysis but are not statistically significant (certainly due to the number of observations and/or because the bank branch network is concentrated in Abidjan).

Seventh, we exploit (limited) information on spatial heterogeneity in conflict intensity at the district level. To proxy the conflict intensity, we report the number of deaths per 100,000 inhabitants. We employ data on the number of deaths per district provided by the National Commission of Inquiry and reported in Table A1 (third column). The number of inhabitants is obtained from the last population census. The conflict variable ($CONFLICT_{it}$) takes the value of 0 before the crisis (in 2009 and 2010) and the number of deaths per 100,000 inhabitants after 2011. Conflict intensity ranges from 0 to 41.9 in the Guémon district in the West (31.8 in Abidjan). We rerun the same model as Eq. 1, except that the $AFTER_t$ dummy is removed and replaced by the $CONFLICT_{it}$ dummy. Insofar as the majority of firms are located in Abidjan, we do not expect dramatic changes; this is confirmed by results displayed in Panel C of Table A7.

Eighth, one might argue that the complex relationship between labor and resilience is explained by other channels, especially by access to output markets. Indeed, labor-intensive firms may sell their products in local markets, contrary to skilled worker/manager-intensive firms that are more dependent on national or international markets. As a result, the impact of labor on resilience could be due to limited access to markets (lower resilience for firms selling their production in remote markets). Due to lack of data (e.g., export status), we cannot directly test this hypothesis. However, we present some indirect proof against this explanation in the Appendix (Table A8). We document that the share of managers and the average wage have been negatively impacted by the crisis with an imperfect recovery but only those firms dependent on skilled workers before the crisis. This fact is in line with our main story; however, we cannot see how it could be explained by the (lack of) access to output markets.

Finally, we run several unreported robustness checks. First, we consider all firms

instead of small and medium enterprises, by including companies with more than 100 employees in 2009. Second, we test another proxy of skilled workers by using the ratio of permanent workers to total workers. The use of long-term contracts is rather scarce in Africa and concerns only a small percentage of workers. If we assume that long-term contracts are used to retain workers with specific assets (Williamson, 1979), the share of permanent workers is therefore a proxy of reliance on hardly interchangeable workers for the firm. Our findings are closely similar to those obtained when we consider the share of managers. We then include all input dummies in the same specification because different proxies might reflect the same feature in a firm's production technology (especially substitution elasticities between capital and skilled/unskilled labor) without altering our conclusion. Finally, one might argue that input dummies capture a catching-up effect, explaining why labor-intensive firms perform better than firms that rely on skilled workers. To account for this problem, we include a lagged value of labor productivity (dynamic panel) in levels or interacted with the $AFTER_t$ dummy without it altering our conclusion.

6 Discussion

Our empirical analysis provides three main findings that are discussed below.

Our first result involves the partial resilience of firms after a conflict, regardless of how short-lived. One might argue that differences in results from Collier and Duponchel (2013) and Ksoll et al. (2014) are due to the conflict duration studied. Indeed, Collier and Duponchel (2013) investigate firm resilience after a war that ravaged Sierra Leone for more than 10 years, while Ksoll et al. (2014) focus on a short-lived post-electoral crisis. The Ivorian context is a mixed situation with a short-lived violent episode but in a context of a highly unstable environment. We document in our analysis that in this context even a short-lived conflict can have a persistent effect. This finding is in line with macroeconomic evidence provided by Cerra and Saxena (2008). They point out that half of losses were recouped in terms of growth after a civil conflict. In other words, even limited events can have persistent effects on firm dynamics and should provide incentives to avoid conflicts when at all possible and at the least to develop strategies to mitigate

their consequences.

Our second main finding has to do with the complex relationship between input use and resilience. Labor-intensive firms suffered less than their counterparts, as opposed to firms relying on skilled workers (or managers). We provide a framework to explain mixed results obtained in previous works (Collier and Duponchel, 2013; Ksoll et al., 2014). As explained in Section 2, the post-electoral crisis caused large population flows. As a consequence, many enterprises witnessed a defection of their employees. However, implications of this negative labor-supply shock differed for labor-intensive firms and companies relying on skilled workers. Labor-intensive firms often employ basic technologies (less reliance on capital) and workers are easily replaceable. These firms are able to hire new workers with more or less the same level of productivity than former employees. This effect might explain why the flower industry in Kenya did not suffer too much after the 2008 post-electoral crisis (Ksoll et al., 2014). Production workers, which account for a large share of the flower industry workforce, perform relatively simple tasks (such as planting, harvesting, trimming, and packaging) which take on average less than two months for a novice to learn (Mano et al., 2011).

However, enterprises that employ a skilled workforce or that require a manager's ability to organize production suffer more than labor intensive firms when their workers leave. First, even if former employees returned to their previous job after several months, there is a *forgetting by not doing* effect highlighted by Collier and Duponchel (2013). Productivity depreciation of skilled workers induces a lower productivity level (Edin and Gustavsson, 2008). In addition, it takes time for managers to reorganize production in complex production processes (firms that rely more on managers). Second, one might expect that some of these management jobs were held by foreigners (from neighbor countries or from Europe, mainly France). Foreigners have greater mobility than local workers and some never returned after the crisis. Unfortunately, our data do not allow us to directly test these channels. As our findings in Table 6 show, skilled-labor-intensive firms have tried to hire more employees to compensate for this loss of human capital without restoring the previous level of value added. This could be explained because new employees had fewer skills or because it took time for these new workers to become productive (learning-

by-doing). For policymakers, this finding highlights the importance of developing tools to facilitate relocation of skilled workers and refresh their skills after a period of inactivity.

Our last finding regarding the role of access to capital in firm resilience is particularly interesting. A large body of literature has highlighted that finance is a driver of firm expansion in normal times. Many SMEs across the world declare themselves unable to grow due to a lack of finance. This claim is confirmed by many academic papers (e.g., Ayyagari et al., 2008; Beck et al., 2005; Beck and Demirguc-Kunt, 2006, among others). In this work, we point out that access to banking also plays a central role in a post-crisis period. A possible explanation may have its roots in the lending relationship. Firms who have previously built a strong relationship with formal lenders are more likely to be served first following a shock. The literature points out that strong bank-borrower relationships can lower the lending restrictions observed after a shock (Berg and Schrader, 2012; Bolton et al., 2016). This finding also echoes the debate on aid and financial flows in post-crisis countries (Ndikumana, 2016). Donors often face a dilemma in selecting the sectors and/or actors on which to focus their attention and funds. Our analysis points out that allocating funds to credit-constrained firms/industries helps to promote overall economic rapid recovery.

7 Conclusion

This paper examines firm resilience after a short, albeit severe, episode of political violence. While conflicts disrupt firm activity in the short-run (Dupas and Robinson, 2010; Camacho and Rodriguez, 2013; Amodio and Di Maio, 2018), their persistent impact is ambiguous. Better understanding of factors spurring or mitigating firm recovery is of prime interest in allowing policymakers to formulate effective post-conflict policies. However, our knowledge about a firm's ability to maintain resilience after a shock remains scarce and inconclusive. This paper fills this gap by examining firm recovery after the 2011 post-electoral crisis in Côte d'Ivoire.

To investigate firm resilience, we follow a cohort of (surviving) small and medium enterprises from 2009 to 2014. Besides usual firm characteristics (size, age, ownership,

etc.), we dedicate special attention to the input mix before the crisis (labor and capital), as determinants of resilience. Indeed, recent works have pointed out that the input channel is predominant in explaining heterogeneity in a firm's reactions to shocks.

This paper provides three important findings. First, on average, firms partially recover (are able to recoup half of their losses after three years). In other words, even limited events have persistent effects on firm dynamics in a context of high instability. Second, the relationship between labor and resilience is complex. While labor-intensive firms are more able to rebound, firms that rely (or depend) on skilled workers suffer more. While all firms have experienced defections in the workforce during a crisis (deaths, displaced persons, departure of foreign workers), the implications of negative supply-side labor shocks differ according to workforce composition. Labor-intensive firms certainly rely on unskilled workers who are easily replaceable. On the contrary, replacement of highly-skilled workers (such as managers) takes time to materialize in terms of productivity. Even if companies were able to re-hire or re-instate these highly-skilled workers, their skills may have depreciated due to inactivity over several months (Edin and Gustavsson, 2008; Collier and Duponchel, 2013). Third, less financially constrained firms were more resilient. This result indicates that finance is not only crucial for business in normal times but for resilience after a shock.

Our findings, together with previous studies in different contexts, provide interesting insights for policymakers. First, particular attention should be dedicated to recomposition of human capital in the event of conflict. While it would seem complex to limit workforce flight during a conflict, policymakers should facilitate the return of skilled workers and provide tools to upgrade skills after more than several months of inactivity. Many such tools exist, from tax incentives to direct interventions. Second, improving access to funds for credit rationed firms may help them to recover. This could be done by strengthening and supporting private banks as well as private equity and other lenders. Governments and donors may help lenders to re-open credit to businesses through different tools, such as loan guarantees, macroprudential instruments and monetary policies. They may also facilitate firm access to equity capital (private equity funds) and promote financing through business angels. Another option might consist of government mobilization of external funds (aid and remittances) and their allocation towards the private sector (firms

or banks).

This study suffers from some limitations that offer pathways for future works. First, we do not investigate the impact of a crisis on firm exits because our purpose was to study firm resilience.[19] Second, we have only data on formal firms while many firms are informal in Côte d'Ivoire. The impact of conflict on informal firms is largely unknown (one exception is Bozzoli et al., 2013). Additional investigations on the impact of shocks on the informal sector and on change in the interaction between the formal and informal sectors during and after a crisis would be welcome/could be fruitful. Finally, due to the lack of data, we ignore other inputs (such as intermediate goods) despite its importance during conflicts (Amodio and Di Maio, 2018). We are also unable to investigate other channels through which conflicts affect firms (uncertainty and demand channels). A promising avenue for investigating uncertainty could be to focus on firm behavior during the 2015 elections (that occurred without violence). Future research should investigate how these additional channels shape firm resilience in Côte d'Ivoire or elsewhere.

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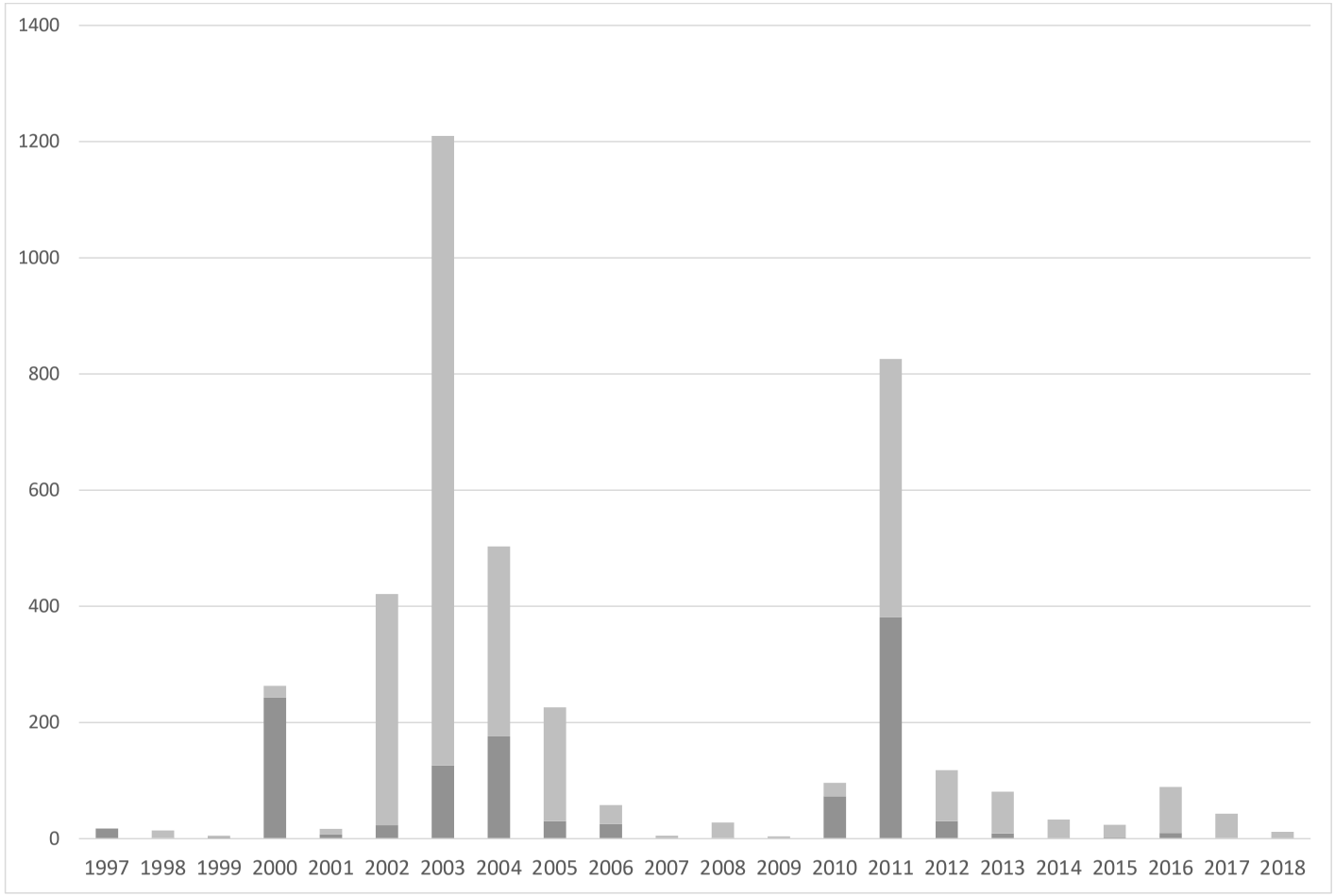
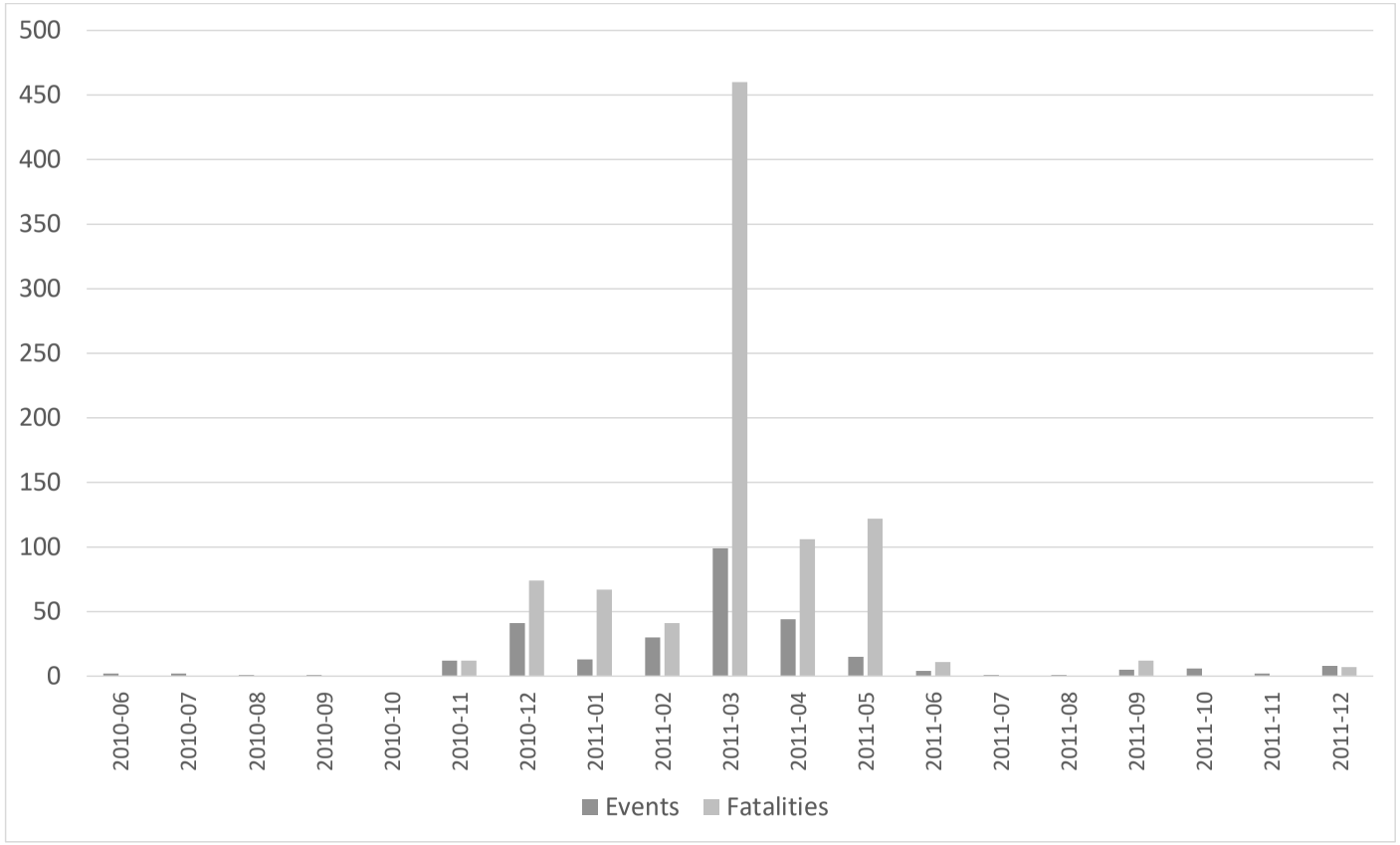
Figure 1: Number of fatalities per year (Source: ACLED)



Source: ACLED (authors' computation). Light grey refers to the number of fatalities in Abidjan and dark grey those in other cities.

Figure 2: Number of fatalities and events from June 2010 to December 2011 (Source: ACLED)



Source: ACLED (authors' computation). Light grey refers to the number of fatalities and dark grey the number of events.

Table 1: Number of firms per year

	Panel A: All firms			Panel B: Cohort 2009		
Year	Total	Entry	Exit	Total	Entry	Exit
2006	3126	263	491	1857	96	-
2007	3546	502	535	2304	250	-
2008	4,345	626	693	3,247	374	-
2009	**5,217**	**839**	**931**	**5,217**	**839**	**931**
2010	7,897	892	1107	3,343	-	320
2011	10,132	904	1506	3,591	-	386
2012	12,663	2650	2562	3,223	-	398
2013	13,868	2451	3527	2,803	-	431
2014	16,836	3694	-	2,748	-	-

Total reports the total number of firms; Entry the number of new firms; and, Exit the number of exit firms

Table 2: Characteristics of firms in 2009 (cohort 2009)

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Dependent variable					
Labor Productivity†	5,142	6,600	74,105	-256,854	4,358,134
Workers	5,142	12.10	16.37	1	101
Value added†	5,142	86,893	280,514	-282,833	4,775,070
Panel B: Input					
Staff Cost	4,642	0.21	0.31	0	4.05
Manager	4,756	0.40	1.78	0	88.55
Avg. Wage†	4,681	3,146	3,578	89.2	27,007
Debt ratio	5,075	1.37	2.44	0	36.40
Trade Credit	5,004	0.18	0.186	-1.66	0.57
Interest Rate	4,810	0.025	0.085	0	0.83
Financial Cost	4,614	0.007	0.020	0	0.19
Panel C: Control variables					
Age	5,142	7.34	9.61	0	98
Abidjan	5,142	0.93	0.26	0	1
Lim Liability	5,142	0.51	0.50	0	1
Public Company	5,142	0.11	0.31	0	1
Foreign	5,142	0.25	0.43	0	1
Agriculture	5,142	0.01	0.10	0	1
Fishing	5,142	0.00	0.04	0	1
Extraction	5,142	0.00	0.06	0	1
Manufacturing	5,142	0.10	0.31	0	1
Electricity, gas and water	5,142	0.00	0.04	0	1
Construction	5,142	0.12	0.33	0	1
Trade	5,142	0.36	0.48	0	1
Hotels and restaurants	5,142	0.02	0.13	0	1
Transport and communication	5,142	0.06	0.24	0	1
Services to enterprises	5,142	0.21	0.41	0	1
Education	5,142	0.06	0.23	0	1
Health and social	5,142	0.03	0.16	0	1
Other services	5,142	0.01	0.11	0	1

† In Deflated euros (base=2009; exchange rate 655.957 FCFA=1EUR)

Table 3: Evolution of firm size and productivity of surviving firms

Panel A: Labor productivity (in euros, deflated)

Year	Mean	1st Quart.	Mediane	3rd Quart.
2009	9,280.6	811.8	3,517.6	7,645.4
2010	11,577.6	1,099.4	3,885.9	8,762.8
2011	8,851.1	645.9	2,998.5	7,021.1
2012	8,177.8	1,257.6	3,759.4	8,312.6
2013	9,449.4	1,209.4	3,308.1	7,088.6
2014	9,304.3	1,177.7	3,754.5	7,931.9

Panel B: Value added (in euros, deflated)

Year	Mean	1st Quart.	Mediane	3rd Quart.
2009	122,663	4,192	28,964	98,133
2010	137,860	5,817	33,509	114,381
2011	120,679	3,091	24,735	91,791
2012	140,051	6,373	34,455	120,268
2013	157,997	6,995	34,891	131,822
2014	165,872	5,252	35,916	129,702

Panel C: Number of workers

Year	Mean	1st Quart.	Mediane	3rd Quart.
2009	15.05	4	7	18
2010	26.31	4	8	19
2011	19.19	4	8	19
2012	19.05	4	8	21
2013	36.49	4	9	26
2014	22.26	4	9	22

Table 4: The net impact of the crisis on labor productivity and its components

Panel A: Labor productivity (Value added per workers)								
	$Log(LP)$				$\Delta[Log(LP)]$			
	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER	-0.200***	-0.0839***	-0.0857***	-0.0691***	-0.317***	-0.0967***	-0.125***	-0.0697***
	(0.0256)	(0.0223)	(0.0214)	(0.0208)	(0.0411)	(0.0297)	(0.0259)	(0.0237)
Panel B: Value added								
	$Log(VA)$				$\Delta[Log(VA)]$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AFTER	-0.157***	-0.0212	0.0361*	0.0588***	-0.266***	-0.0462*	-0.0315	-0.0331
	(0.0246)	(0.0220)	(0.0211)	(0.0210)	(0.0380)	(0.0274)	(0.0239)	(0.0223)
Panel C: Number of workers								
	$Log(Workers)$				$\Delta[Log(Workers)]$			
AFTER	0.0199*	0.0507***	0.112***	0.124***	0.0112	0.0273*	0.0692***	0.0259**
	(0.0119)	(0.0113)	(0.0121)	(0.0123)	(0.0201)	(0.0148)	(0.0137)	(0.0121)
Obs.	5977	8024	10006	12284	5000	6804	8622	10681
# firms	2647	2647	2647	2647	2479	2479	2479	2479
Year included								
2009	x	x	x	x	x	x	x	x
2010	x	x	x	x	x	x	x	x
2011	x	x	x	x	x	x	x	x
2012		x	x	x		x	x	x
2013			x	x			x	x
2014				x				x

The dependent variable is the logarithm of labor productivity (Panel A and B), value added (Panel C), the number of workers (Panel D), and the total wage bills (Panel C). In columns (1) to (4), the dependent variable is expressed in logarithm and in difference in logarithm (growth) in columns (5) to (8). $AFTER_t$ is a dummy variable equal to one after 2011. The years from 2011 to 2014 are included one by one as indicated at the bottom of the table. Firm-level fixed effects are included and standard errors are clustered at the firm-level. The number of observations and firms refers to the models in Panels A, C and D. Standard errors are clustered at the firm-level. *, **, and *** signal significance at the 10%, 5% and 1% levels, respectively.

Table 5: Heterogenous impact of the crisis, baseline results

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER	-5.408***	-5.701***	-5.628***	-6.456***	-5.370***	-5.514***	-1.808***	-5.698***
	(0.290)	(0.291)	(0.291)	(0.316)	(0.295)	(0.298)	(0.159)	(0.310)
AFTER×Log(EMPL)	-0.616***	-0.663***	-0.645***	-0.647***	-0.615***	-0.618***	-0.124***	-0.615***
	(0.0218)	(0.0217)	(0.0217)	(0.0217)	(0.0219)	(0.0217)	(0.0110)	(0.0227)
AFTER×Log(SALES)	0.366***	0.423***	0.373***	0.400***	0.370***	0.369***	0.105***	0.371***
	(0.0161)	(0.0165)	(0.0161)	(0.0169)	(0.0163)	(0.0163)	(0.00864)	(0.0167)
AFTER×Log(Age)	0.0417	-0.0101	0.0564**	0.0881***	0.0386	0.0499*	0.0299**	0.0649**
	(0.0283)	(0.0285)	(0.0275)	(0.0277)	(0.0286)	(0.0284)	(0.0140)	(0.0301)
AFTER×Abidjan	-0.0481	-0.105*	-0.0290	0.0152	-0.0484	-0.0567	0.0282	-0.0342
	(0.0562)	(0.0558)	(0.0564)	(0.0571)	(0.0563)	(0.0563)	(0.0373)	(0.0566)
AFTER×Foreign	-0.0737**	-0.0923***	-0.0669*	-0.0334	-0.0735**	-0.0650*	-0.0178	-0.0774**
	(0.0360)	(0.0356)	(0.0360)	(0.0365)	(0.0361)	(0.0363)	(0.0236)	(0.0380)
AFTER×LimLiabilities	0.0947**	0.0355	0.102**	0.162***	0.0989**	0.0986**	0.0362*	0.0952**
	(0.0405)	(0.0406)	(0.0407)	(0.0413)	(0.0406)	(0.0408)	(0.0218)	(0.0416)
AFTER×PublicCompany	-0.0618	-0.143**	-0.0508	0.108*	-0.0642	-0.0526	0.0131	-0.0648
	(0.0574)	(0.0574)	(0.0569)	(0.0600)	(0.0574)	(0.0572)	(0.0306)	(0.0593)
AFTER×Agriculture	-0.0805	-0.117	-0.0684	-0.0723	-0.0665	-0.0689	-0.167*	-0.0781
	(0.194)	(0.188)	(0.200)	(0.199)	(0.196)	(0.194)	(0.0936)	(0.195)
AFTER×Fishing	0.0473	-0.0778	0.167	0.178	0.0909	0.0958	0.104	0.0866
	(0.206)	(0.203)	(0.181)	(0.169)	(0.205)	(0.238)	(0.166)	(0.242)
AFTER×Extraction	-0.714***	-0.749***	-0.695***	-0.709***	-0.678***	-0.710***	-0.231	-0.707**
	(0.253)	(0.256)	(0.252)	(0.215)	(0.253)	(0.248)	(0.146)	(0.327)
AFTER×Manufacturing	-0.0521	-0.0837	-0.0168	-0.0158	-0.0396	-0.0463	-0.0342	-0.0368
	(0.111)	(0.115)	(0.112)	(0.110)	(0.113)	(0.113)	(0.0679)	(0.115)
AFTER×Electricity	0.141	0.174	0.187	0.0416	0.174	0.154	-0.0674	0.150
	(0.249)	(0.246)	(0.248)	(0.262)	(0.255)	(0.249)	(0.123)	(0.252)
AFTER×Construction	-0.129	-0.144	-0.116	-0.0548	-0.105	-0.116	-0.0489	-0.108
	(0.119)	(0.122)	(0.120)	(0.117)	(0.121)	(0.121)	(0.0721)	(0.123)
AFTER×Trade	-0.433***	-0.513***	-0.431***	-0.428***	-0.411***	-0.416***	-0.123*	-0.397***
	(0.108)	(0.112)	(0.109)	(0.106)	(0.110)	(0.109)	(0.0675)	(0.112)
AFTER×Hotels	0.377**	0.318*	0.414***	0.422***	0.390**	0.379**	0.140	0.416***
	(0.156)	(0.165)	(0.159)	(0.154)	(0.157)	(0.160)	(0.0981)	(0.160)
AFTER×Transport	-0.0146	-0.0511	0.0303	0.0208	0.00280	-0.00235	-0.0120	-0.00151
	(0.110)	(0.115)	(0.110)	(0.109)	(0.113)	(0.112)	(0.0733)	(0.115)
AFTER×ServicesEnt	-0.119	-0.131	-0.0686	-0.0320	-0.0966	-0.113	-0.00539	-0.104
	(0.108)	(0.112)	(0.108)	(0.106)	(0.110)	(0.109)	(0.0664)	(0.112)
AFTER×Education	0.293**	0.272**	0.323***	0.407***	0.295**	0.288**	0.0928	0.278**
	(0.122)	(0.125)	(0.122)	(0.119)	(0.125)	(0.124)	(0.0714)	(0.126)
AFTER×Social	0.0765	0.0195	0.0847	0.141	0.0947	0.0914	-0.0107	0.0964
	(0.127)	(0.131)	(0.127)	(0.126)	(0.130)	(0.128)	(0.0744)	(0.131)
AFTER×StaffCost		0.555***						
		(0.0416)						
AFTER×Managers			-0.142***					
			(0.0422)					
AFTER×AverageWage				-0.351***				
				(0.0419)				
AFTER×Debt					0.140***			
					(0.0515)			
AFTER×TradeCredit						-0.0725*		
						(0.0381)		
AFTER×FinancialCost							-0.0297	
							(0.0208)	
AFTER×IntRate								-0.154***
								(0.0452)
Obs	12097	11833	11670	11521	11990	11861	11407	11175
# firms	2608	2509	2474	2443	2585	2556	2488	2417
R^2 (within)	0.18	0.21	0.19	0.20	0.19	0.19	0.18	0.18

The dependent variable is the logarithm of labor productivity. $AFTER_t$ is a dummy taken value one for 2011, 2012, 2013, and 2014 and 0 for 2009 and 2010. Within estimator (firm fixed effect) is used. Standard errors are clustered at the firm-level. *, **, and *** signal significance at the 10%, 5% and 1% level, respectively.

Table 6: Heterogenous impact of the crisis, additional results

Panel A: Value added (in log)							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.291***	0.0720*	-0.306***	0.219***	-0.101***	-0.136***	-0.227***
	(0.0406)	(0.0405)	(0.0406)	(0.0506)	(0.0354)	(0.0407)	(0.0415)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control (interactions)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	11833	11670	11521	11990	11861	11407	11175
# Firms	2509	2478	2443	2585	2556	2488	2417
R^2 (within)	0.08	0.09	0.09	0.09	0.08	0.08	0.09
Panel B: The number of workers (in log)							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	-0.263***	0.213***	0.0505*	0.0693**	-0.0302	-0.120***	-0.0710**
	(0.0246)	(0.0263)	(0.0264)	(0.0300)	(0.0243)	(0.0298)	(0.0311)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control (interactions)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	11833	11670	11521	11990	11861	11407	11175
# Firms	2509	2478	2443	2585	2556	2488	2417
R^2 (within)	0.41	0.42	0.42	0.39	0.40	0.39	0.39
Panel C: Crisis and postcrisis							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CRISIS	-5.655***	-5.494***	-6.027***	-5.229***	-5.273***	-5.297***	-5.453***
	(0.426)	(0.423)	(0.448)	(0.415)	(0.424)	(0.429)	(0.430)
CRISIS×Input	0.569***	-0.178***	-0.251***	0.0587	-0.0347	0.0221	-0.155***
	(0.0522)	(0.0535)	(0.0503)	(0.0658)	(0.0459)	(0.0513)	(0.0534)
POSTCRISIS	-5.420***	-5.366***	-6.248***	-5.115***	-5.296***	-5.213***	-5.448***
	(0.309)	(0.308)	(0.333)	(0.312)	(0.314)	(0.329)	(0.332)
POSTCRISIS×Input	0.550***	-0.137***	-0.361***	0.164***	-0.0785**	-0.0220	-0.137***
	(0.0434)	(0.0440)	(0.0441)	(0.0526)	(0.0398)	(0.0468)	(0.0480)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control (interactions)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	11833	11670	11521	11990	11861	11407	11175
# Firms	2509	2478	2443	2585	2556	2488	2417
R^2 (within)	0.22	0.20	0.21	0.19	0.19	0.19	0.19

The dependent variable is the logarithm of value added in Panel A, the logarithm of workers in Panel B and the logarithm of labor productivity in Panel C. $AFTER_t$ is a dummy taken value one for 2011, 2012, 2013, and 2014 and 0 for 2009 and 2010. $CRISIS_t$ is a dummy taken value one in 2011 and 0 otherwise. $POSTCRISIS_t$ is a dummy taking the value of 1 in 2012, 2013 and 2014 and 0 otherwise. Interactions between firm's characteristics and $AFTER_t$ dummy are included in Panel A and Panel B. Interactions between firm's characteristics and $CRISIS_t$ dummy and interactions between firm's characteristics and $POSTCRISIS_t$ dummy are included in Panel C. Within estimator (firm fixed effect) is used. In each column, interaction with $AFTER_t$ (in Panels A and B) or $CRISIS_t$ and $POSTCRISIS_t$ and each input are included. Standard errors are clustered at the firm-level. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Online Appendix

Appendix A. Additional Tables and Figures

Table A1: Firm distribution and deaths by region and main city

		Death		Regional capital		
District	Region	NCI	ACLED	City	Death†	Firms (all)
Abidjan	Abidjan	1497	453	Abidjan	443	68572
Yamoussoukro	Yamoussoukro	0	1	Yamoussoukro	1	734
Lacs	N'Zi	2	0	Dimbokro	0	187
	Iffou	6	5	Daoukro	5	77
	Belier	25	10	Toumodi	0	144
	Monorou	0	0	Bongaouanou	0	63
Comoe	Indenie-Djuablin	15	0	Abengourou	0	330
	Sud-Comoe	23	0	Aboisso	0	279
Denguele	Folon	0	0	Minignan	0	2
	Kabadougou	0	0	Odienne	0	63
Goh-Djiboua	Goh	46	2	Gagnoa	1	522
	Loh-Djiboua	26	24	Divo	0	586
Lagunes	Agneby-Tiassa	55	0	Agboville	0	268
	Me	49	1	Adzope	0	186
	Grands Ponts	101	0	Dabou	0	288
Montagnes	Tonkpi	180	26	Man	10	273
	Cavally	289	271	Guiglo	54	219
	Guemon	385	100	Duekoue	100	321
Sassandra-Marahoue	Haut-Sassandra	62	0	Daloa	0	852
	Marahoue	19	0	Bouafle	0	149
Savanes	Poro	1	0	Korhogo	0	669
	Tchologo	0	0	Ferkessedougou	0	74
	Bagoue	0	0	Boundiali	0	33
Bas-Sassandra	Nawa	146	0	Soubre	0	389
	San Pedro	125	0	San Pedro	0	1582
	Gbokle	182	0	Sassandra	0	112
Vallee du Bandama	Hambol	0	0	Katiola	0	27
	Gbeke	7	0	Bouake	0	1027
Woroba	Bere	0	0	Mankono	0	27
	Bafing	0	0	Touba	0	13
	Worodougou	0	0	Seguela	0	53
Zanzan	Bounkani	5	0	Bouna	0	32
	Gontougo	2	0	Boudoukou	0	225
				Other cities	279	3852
Total		3248	893		893	82,094

"DCI" refers to the number of deaths reported in the report of the National Commission of the Inquiry. "ACLED" lists the number of deaths from November, 1, 2010 to June, 30, 2011 reported by the ACLED. "Main cities" lists the main cities for each region. † "The number of deaths" in the sixth column is the number of deaths reported in each city by the ACLED dataset. The final column displays the number of observations for each city in the INS dataset.

Table A2: Input dependence by sector

	Labor					
	Staff Cost		Managers		Wage Average	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Agriculture	0.21	0.29	0.13	0.40	3,535.5	18,505
Fishing	0.23	0.34	0.13	0.26	2,943.7	4,310
Extraction	0.20	0.42	0.34	0.36	11,155.5	20,937
Manufaturing	0.20	0.30	0.12	0.29	2,878.1	5,962
Electricity	0.26	0.49	0.20	0.27	5,351.4	9,928
Contruction	0.25	0.46	0.20	1.09	2,411.0	5,809
Commerce	0.11	0.27	0.16	0.48	2,642.8	4,775
Tourism	0.29	0.31	0.09	0.21	2,190.5	5,024
Transports	0.29	0.37	0.24	0.35	4,641.2	12,612
Scx to enterprises	0.36	0.47	0.26	0.43	4,320.4	9,312
Education	0.38	0.37	0.21	0.37	1,766.4	3,968
Health	0.20	0.19	0.15	0.29	2,359.8	3,141

	Capital							
	Debt ratio		Trade credit		Financial cost		Interest rate	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Agriculture	1.14	2.24	0.11	0.17	0.009	0.021	0.018	0.053
Fishing	1.36	2.08	0.08	0.19	0.008	0.022	0.021	0.062
Extraction	2.31	4.45	0.05	0.15	0.013	0.030	0.010	0.040
Manufaturing	1.17	2.49	0.12	0.18	0.008	0.020	0.020	0.062
Electricity	1.21	2.79	0.13	0.36	0.012	0.028	0.020	0.059
Contruction	1.72	3.86	0.10	0.19	0.006	0.018	0.011	0.050
Commerce	1.12	2.60	0.15	0.23	0.005	0.014	0.020	0.066
Tourism	1.41	3.12	0.08	0.17	0.006	0.021	0.010	0.050
Transports	1.27	2.87	0.09	0.17	0.014	0.031	0.024	0.069
Scx to enterprises	1.69	3.56	0.08	0.17	0.006	0.019	0.011	0.051
Education	0.93	2.32	0.06	0.16	0.004	0.016	0.010	0.047
Health	0.97	2.21	0.08	0.16	0.006	0.017	0.020	0.066

Table A3: Input usage, between-industry vs. within-industry variation

	All Observations		Cohort (all obs.)		Cohort (in 2009) W/out control		Cohort (in 2009) With control	
Input	R^2	Obs.	R^2	Obs.	R^2	Obs.	R^2	Obs.
Staff cost	0.081	71296	0.083	26055	0.075	4687	0.081	4684
Share of manager	0.007	72345	0.004	25870	0.004	4818	0.006	4818
Share of permanent workers	0.008	72346	0.006	25870	0.010	4818	0.011	4818
Average wage	0.005	70901	0.049	25336	0.050	4732	0.129	4732
Debt ratio	0.009	80428	0.008	27846	0.007	5147	0.004	5144
Trade credit	0.007	81369	0.035	28154	0.111	5186	0.002	5183
Financial cost	0.018	71327	0.021	25938	0.024	4660	0.023	4657
Interest rate	0.007	74720	0.010	26995	0.007	4874	0.037	4871

This table reports R^2 of the model explaining input usage (each row) in different specifications including industry dummies (and firm characteristics in the last specification). The first specification considers all observations available. The second specification considers all observations for firms operating in 2009 (cohort). The two last specifications consider firms operating in 2009 at this year. Both differ by the inclusion or not of firm level characteristics (nb. of employees, sales (in log), age (in log), foreign ownership, dummy for Abidjan and two dummies for legal status).

Table A4: Robustness checks (1)

Panel A: Labor productivity measured as value added per permanent worker							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.508***	-0.0978**	-0.311***	0.141***	-0.0581	-0.0357	-0.182***
	(0.0397)	(0.0412)	(0.0390)	(0.0476)	(0.0360)	(0.0413)	(0.0428)
Obs	11822	11659	11510	11978	11849	11714	11165
R2 (within)	0.155	0.138	0.148	0.134	0.133	0.133	0.134
Panel B: Labor productivity measured as value added per total payroll							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.263***	-0.206***	0.014	0.100***	-0.034*	-0.030	-0.084***
	(0.0221)	(0.0227)	(0.0198)	(0.0227)	(0.0196)	(0.021)	(0.0223)
Obs	11512	11520	11388	11647	11520	11407	10856
R2 (within)	0.061	0.039	0.038	0.041	0.040	0.040	0.044
Panel C: Variation of labor productivity							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.452***	-0.068	-0.143**	0.010	0.008	0.033	-0.060
	(0.0581)	(0.0564)	(0.0561)	(0.0682)	(0.054)	(0.0576)	(0.0567)
Obs	10397	10238	10116	10462	10356	10302	9735
R2 (within)	0.085	0.076	0.078	0.075	0.075	0.077	0.073
Panel D: Log of total factor productivity (TFP, see Appendix C)							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.392***	-0.153**	-0.399**	0.052	-0.110**	0.055	-0.122**
	(0.0595)	(0.0643)	(0.0572)	(0.0724)	(0.0527)	(0.0535)	(0.0574)
Obs	4765	4773	4712	4827	4780	4720	4456
R2 (within)	0.175	0.158	0.173	0.156	0.160	0.158	0.148

The dependent variable is the logarithm of labor productivity defined as value added per permanent worker in Panel A, the logarithm of labor productivity defined as value added divided by total payroll in Panel B, the difference in labor productivity in Panel C, the logarithm of TFP (described in Appendix C) in Panel D. $AFTER_t$ is a dummy taking the value of 1 for 2011, 2012, 2013, and 2014 and 0 for 2009 and 2010. Within estimator (firm fixed effect) is used and control interactions are included in all specifications. In each column, interaction between firm characteristics and the $AFTER_t$ dummy are included. Standard errors are clustered at the firm level, except in Panel D (bootstrapping with 500 replications because the dependent variable is a generated variable). *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table A5: Robustness checks (2)

Panel A: Log of profit (defined as earnings before interest and taxes)							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.302***	0.0995	-0.205***	0.161**	-0.137**	-0.105	-0.110*
	(0.0703)	(0.0673)	(0.0638)	(0.0794)	(0.0570)	(0.0689)	(0.0641)
Obs	8411	8291	8181	8541	8435	8333	7947
R2 (within)	0.093	0.090	0.088	0.089	0.089	0.088	0.077
Panel B: Gross operating surplus divided by sales							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.102***	-0.0069	-0.0289***	0.0439***	-0.0161*	-0.006	-0.0306***
	(0.0137)	(0.0113)	(0.0109)	(0.0138)	(0.0094)	(0.0091)	(0.0079)
Obs	11693	11569	11426	11830	11707	11593	11031
R2 (within)	0.049	0.029	0.030	0.031	0.029	0.029	0.030
Panel C: Return on assets							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.0624	-0.0294	-0.0464	0.465***	-0.129***	-0.0034	-0.0327
	(0.0394)	(0.0419)	(0.0399)	(0.0727)	(0.0379)	(0.0410)	(0.0421)
Obs	11659	11504	11356	11835	11689	11553	11018
R2 (within)	0.016	0.013	0.012	0.032	0.016	0.015	0.012

The dependent variable is the logarithm of profit (defined as earnings before interest and taxes) in Panel A, the ratio of gross operating surplus to total sales in Panel B and the return on assets on Panel C. $AFTER_t$ is a dummy taking the value of 1 for 2011, 2012, 2013, and 2014 and 0 for 2009 and 2010. Within estimator (firm fixed effects) is used and control interactions are included in all specifications. In each column, interaction between firm characteristics and the $AFTER_t$ dummy are included. Standard errors are clustered at the firm level. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table A6: Robustness checks (3)

Panel A: Dummy based on median							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.571***	-0.124***	-0.316***	0.129***	-0.0709*	-0.0378	-0.106**
	(0.0377)	(0.0374)	(0.0445)	(0.0375)	(0.0379)	(0.0468)	(0.0504)
Obs	11833	11670	11521	11990	11861	11407	11175
R2 (within)	0.214	0.190	0.199	0.186	0.185	0.184	0.182
Panel B: Continuous measure for input							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	1.705***	-0.0534***	-5.28E-5***	0.0166*	-0.255**	-0.990	-0.541***
	(0.237)	(0.0202)	(5.31E-6)	(0.009)	(0.106)	(0.878)	(0.206)
Obs	11833	11670	11521	11990	11861	11407	11175
R2 (within)	0.223	0.189	0.203	0.185	0.185	0.184	0.182
Panel C: Including 2008 in pre-crisis period							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER*Input	0.499***	-0.157***	-0.344***	0.169***	-0.0797**	-0.0215	-0.124***
	(0.038)	(0.0396)	(0.0397)	(0.0488)	(0.0354)	(0.0407)	(0.0417)
Obs	13418	13226	13062	13573	13434	13295	12647
R2 (within)	0.183	0.168	0.178	0.164	0.162	0.162	0.160
Panel D: Including 2010 as a crisis year							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.649***	-0.127***	-0.354***	0.150***	-0.134***	-0.0440	-0.135**
	(0.0400)	(0.0414)	(0.0485)	(0.0417)	(0.0408)	(0.0494)	(0.0537)
Obs	11833	11670	11521	11990	11861	11407	11175
R2 (within)	0.317	0.293	0.304	0.286	0.284	0.287	0.277
Panel E: Placebo test							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	-0.025	-0.0655	0.0388	0.0762*	-0.115	0.0337	0.000
	(0.0531)	(0.0444)	(0.0509)	(0.0429)	(0.451)	(0.0564)	(0.000)
Obs	5809	5678	5605	5793	5723	5758	2030
R2 (within)	0.043	0.040	0.040	0.046	0.046	0.044	0.041

The dependent variable is the logarithm of labor productivity defined as value added per worker in all specifications. In Panels A and B, the measure of input dependence is modified (dummy based on median value in the industry in Panel A and continuous measure in Panel B). In Panel C, the pre-crisis period is extended to 2008. In Panel D, 2010 is considered as a crisis year. In Panel E, a placebo test is implemented (see Section 5.3). $AFTER_t$ is a dummy taking the value of 1 for 2011, 2012, 2013, and 2014 and 0 for 2009 and 2010. Within estimator (firm fixed effects) is used and control interactions are included in all specifications. In each column, interaction between firm characteristics and the $AFTER_t$ dummy are included. Standard errors are clustered at the firm level, except in Panel F (bootstrapping with 500 replications is used). *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table A7: Robustness checks (4)

Panel A: Sample selection							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.283***	-0.0236	-0.0097	0.108***	-0.0335*	-0.0334	-0.0794***
	(0.0194)	(0.0237)	(0.0199)	(0.0241)	(0.0186)	(0.0209)	(0.0233)
Lambda (p-value)	<0.01	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05
Obs	10336	10351	10294	10469	10390	10274	9903
R2 (within)	0.076	0.047	0.046	0.050	0.048	0.047	0.050
Panel B: Firms outside Abidjan							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFTER×Input	0.416***	-0.213*	-0.203*	0.159	-0.0694	-0.0989	-0.194
	(0.137)	(0.122)	(0.117)	(0.135)	(0.115)	(0.122)	(0.126)
Obs	1015	1018	1018	1018	1024	1015	1013
R2 (within)	0.280	0.276	0.275	0.273	0.272	0.268	0.273
Panel C: Exploiting spatial heterogeneity							
Input →	Staff	Manager	Avg wage	Debt	Trade C.	FinCost	IntRate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CONFLICT×Input	0.478***	-0.115***	-0.289***	0.124***	-0.0668*	-0.0214	-0.120***
	(0.038)	(0.039)	(0.039)	(0.045)	(0.037)	(0.040)	(0.041)
Obs	11833	11670	11521	11990	11861	11407	11175
R2 (within)	0.197	0.181	0.189	0.177	0.176	0.175	0.174

The dependent variable is the logarithm of labor productivity defined as value added per worker in all specifications. In Panel A, sample selection model developed by Wooldridge (1995) and described in Appendix C is used. $AFTER_t$ is a dummy taking the value of 1 for 2011, 2012, 2013, and 2014 and 0 for 2009 and 2010. $CONFLICT_{it}$ is a measure of conflict intensity at the district level (taking the value of 0 before the crisis, i.e., in 2009 and 2010). Within estimator (firm fixed effects) is used and control interactions are included in all specifications. In each column, interaction between firm characteristics and the $AFTER_t$ dummy are included (or $CONFLICT_{it}$ dummies in Panel C). Standard errors are clustered at the firm level, except in Panel A (bootstrapping with 500 replications is used). *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.

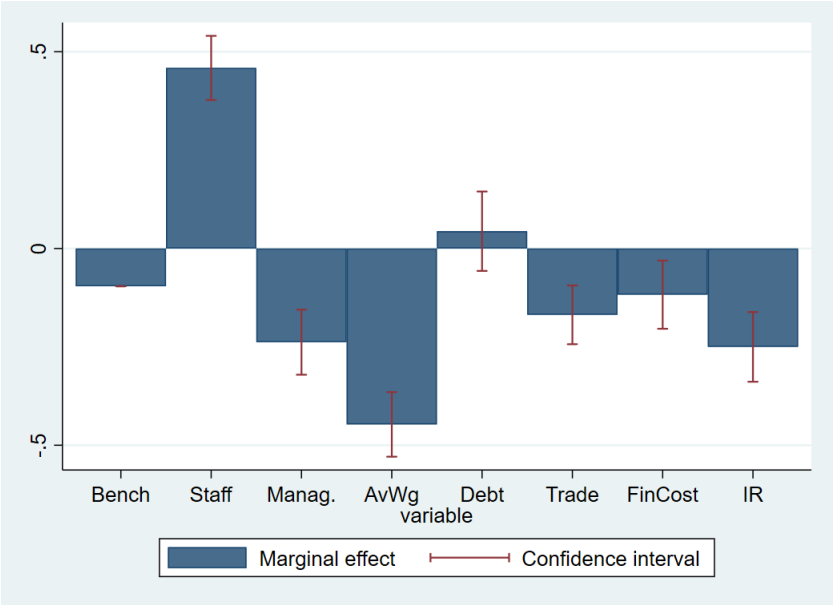
Table A8: Evolution of the share of managers and average wage

	Share of managers				Average wage			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: All firms								
AFTER	-0.145***	-0.106***	-0.0982***	-0.0921***	-302.8***	181.0***	-93.72**	-89.55**
	(0.0107)	(0.00932)	(0.00902)	(0.00943)	(36.21)	(37.26)	(38.33)	(37.44)
Panel B: High dependence before the crisis (dummy=1)								
AFTER	-0.513***	-0.461***	-0.455***	-0.453***	-849.2***	-226.9**	-909.5***	-930.5***
(dummy=1)	(0.0400)	(0.0338)	(0.0321)	(0.0338)	(94.90)	(93.70)	(96.70)	(95.28)
Panel C: Low dependence before the crisis (dummy=0)								
AFTER	-0.0322***	0.00619*	0.0154***	0.0235***	-40.18	373.0***	291.0***	305.1***
(dummy=0)	(0.00376)	(0.00350)	(0.00358)	(0.00354)	(25.59)	(31.53)	(28.66)	(27.25)
Year included								
2009	x	x	x	x	x	x	x	x
2010	x	x	x	x	x	x	x	x
2011	x	x	x	x	x	x	x	x
2012		x	x	x		x	x	x
2013			x	x			x	x
2014				x				x

The specification is the same as that employed in Table 4, except dependent variables. The dependent variable is the share of managers listed in columns (1) to (4) and the average wage in columns (5) to (8). In Panel A, we display results for all firms. In Panel B, we display results for firms relying more on managers (in columns 1-4) or having higher average wage (in columns 5-8). In Panel C, we focus on firms relying less on managers and having lower average wage. Standard errors are clustered at the firm-level. *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Figure A1: March on Abidjan (source: Wikipedia)

Figure A2: The marginal impact of AFTER dummy according to each input usage



Appendix B. Identifying false similar firms

To detect any possible irregularities, we consider six criteria: city, year of creation, sector, legal status, ownership structure and the time lag between two observations (inferior to two years). If two observations differ in at least four of the six criteria, we consider that the observations are indeed two different firms.

Let's consider the following firms (10001, 10002, 10003, and 10004) whose characteristics are shown in Table B1.

The first firm (id=10001) is a common observation in the dataset. In spite of a change in the ownership structure, we do not observe other changes that allow us to consider that the firm identified in 2010 is different from the firm operating in the following year.

The second identifier seems undoubtely to refer to more than one different firms. We lack information in 2010 and 2011 and all characteristics have changed between 2009 and 2012. In our classification, we consider these to be two separate firms because more than 4 criteria have changed and we create a new identifier (20002) for the observations after 2012.

The more complex case covers the last two situations (id=10003; id=10004). Between 2011 and 2012, many characteristics of firm 10003 changed. However, we consider that the firm referred to is the same because only three criteria of six are different (year of incorporation, ownership, and sector). For the same reason, we consider the observations of firm 10004 recover two different entities because four criteria have changed (year between two observations, year of incorporation, ownership structure and industry).

Table B1: Example of firms with a similar identifier

id	year	year incorp.	city	ownership	legal	industry	final id
10001	2009	2005	Abidjan	foreign	Other	Trade	10001
10001	2010	2005	Abidjan	foreign	Other	Trade	10001
10001	2011	2005	Abidjan	local	Other	Trade	10001
10002	2009	1995	Bouake	local	Public company	Manufacturing	10002
10002	2012	2011	Abidjan	foreign	Limited L.	Construction	20002
10002	2013	2011	Abidjan	foreign	Limited L.	Construction	20002
10003	2010	2008	Abidjan	foreign	Limited L.	Manufacturing	10003
10003	2011	2008	Abidjan	foreign	Limited L.	Manufacturing	10003
10003	2012	2011	Abidjan	local	Limited L.	Construction	10003
10004	2008	1998	Abidjan	local	Limited L.	Manufacturing	10004
10004	2011	2003	Abidjan	foreign	Limited L.	Services	20004
10004	2012	2003	Abidjan	foreign	Limited L.	Services	20004

Appendix C. Estimation of the TFP

Suppose the production function is a Cobb-Douglas function in capital K_{it} and labor L_{it}, the total factor productivity (TFP henceforth) can be estimated using the log transformation:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \mu_{it} \quad \text{, with} \quad \mu_{it} = \Omega_{it} + \eta_{it} \tag{C1}$$

with y_{it} representing the logarithm of the firm's output i in period t, nd l_{it} and k_{it}, respectively constitute the logarithm of labor and capital. The residual component is a mix of the productivity shock observed only by the firm affecting decision-making (Ω_{it}) and the unexpected productivity shock that is by definition not observed by the firm (η_{it}). In this framework, we can estimate the TFP term if β_k and β_l are known.

Estimation of TFP with traditional methods raises several methodological problems (simultaneity and endogeneity problems) because the level of productivity and inputs are likely to be correlated (Olley and Pakes, 1996; Levinsohn and Petrin, 2003). Thus, the estimation by OLS poses a problem of simultaneity. In addition, the use of a balanced panel does not consider inputs and outputs, leading to selection bias, which results from the relationship between productivity shocks and the probability of bankruptcy or business interruption. In addition, these methodological challenges may be accentuated by the fact that the company's product choices may be related to their underlying productivity (Bernard et al., 2009). Also, most of the other traditional estimators (fixed effects, instrumental variables and generalized method of moments) used to overcome these endogeneity problems have not proved satisfactory in the case of production functions, particularly because of their underlying assumptions.

Faced with these methodological questions, several estimators (parametric and semi-parametric) have emerged. Among the semi-parametric estimators, Olley and Pakes (1996) (OP) and Levinsohn and Petrin (2003) (LP) propose a semi-parametric estimator that considers simultaneity biases (and selection biases in the case of the OLS estimator). Indeed, Olley and Pakes (1996) are the first authors to propose an estimation method that explicitly considers the problem of selection and simultaneity by using a dynamic model that considers firm behavior and idiosyncratic productivity shocks. They propose a semi-parametric estimator that solves the simultaneity problem by using the compa-

ny's investment decision to replace unobserved productivity shocks. Under Levinsohn and Petrin (2003), the invertibility condition is likely to be invalidated in the presence of imperfect competition in the production markets, whereas it has no effect on the monotonicity condition under the OL method. We use the method of Olley and Pakes (1996) to estimate the overall factor productivity of the firms in our sample. Unfortunately, we cannot use the LP method because we do not have data on intermediate consumption and because of the methodological problems mentioned above.

We briefly describe the OP method used in this paper. Olley and Pakes (1996) assume that firms decide at the beginning of each period whether to continue or to stop production. If a firm decides to stop participating in the market, then it will receive a liquidation value equal to ϕ. On the other hand, if the company chooses to remain in the market by continuing to produce, it will use its factors of production (labor, capital, etc.) and set its level of investment I_{it}. Thus, the firm's results are conditioned by its stated variables at the beginning of the period, namely the capital stock K_{it}, the level of productivity ϕ_{it} and the age of the company a_{it}. This model assumes that expected productivity is defined as a function of current productivity and capital, i. e., : $E[\Omega_{(i,t+1)}|\Omega_{it}, K_{it}]$ and the company's result depends on Ω_{it} and K_{it}.

This assumes that a firm will cease trading provided that its liquidation value ϕ is higher than its expected future returns. In other words, there is a threshold level of productivity ($\underline{\Omega_{it}}$) under which a firm decides to leave the market.

The semi-parametric estimation method proposed by Olley and Pakes (1996) allows for simultaneity and selection biases to be considered, unlike traditional methods. Its application involves using the investment decision function to control the correlation between the error term and the factors of production. This is based on the following underlying assumption: future productivity is strictly increasing (Ω_{it} follows a first-order Markov process) and firms that experience positive productivity shocks will invest more during this period, for any level of capital. The investment choice of the firm I_{it} also depends on productivity (Ω_{it}), capital (K_{it}) and the age of the firm (a_{it}). Assuming positive investment, then the inverse function of the productivity shock is:

$$\Omega_{it} = I^{-1}(I_{it}, K_{it}, a_{it}) = h(I_{it}, K_{it}, a_{it}) \quad \text{, with } \partial\Omega_{it}/\partial I_{it} > 0 \tag{C2}$$

The advantage of this function is control of the simultaneity bias. By substitution C2 in C1 we get :

$$y_{it} = \beta_l l_{it} + \phi(i_{it}, k_{it}) + \eta_{it} \tag{C3}$$

With $\phi(i_i t, k_{it}) = \beta_0 + \beta_k k_{it} + h(i_{it}, k_{it})$ and $\phi(.)$ is approximated by the second-order polynomial series in capital and investment. We estimate Eq. C3 by OLS. The estimated coefficients of the variable production factor (labor) are therefore unbiased because $\phi(.)$ makes it possible to control unobserved productivity. As a result, the error term is no longer correlated with the factors of production. However, Eq. C3 does not identify β_k.

To control for selection bias, an estimate of survival probabilities is made. We know that the probability of a firm's survival at period t therefore depends on productivity, age, and capital at t-1 (as well as to their squares and cross-products). Therefore, in our implementation, we estimate the probability of survival by fitting a probit model.

We use the method of Olley and Pakes (1996) using the method introduced by Yasar et al. (2008). This approach uses a bootstrap technique to group variables by treating all observations of an individual firm as a (sub)group.

The results obtained using Olley and Pakes (1996) and the OLS method are presented in Table C1.

Table C1: Production function parameters: OP and OLS estimations

Variables	Olley and Pakes	OLS
Labor	0.610***	0.630***
	(0.130)	(0.009)
Capital	0.419***	0.338***
	(0.428)	(0.005)
Age	0.012***	0.013***
	(0.001)	(0.001)
Trend	-0.038***	-0.033***
	(0.007)	(0.006)

Standard errors in parentheses.
In the OP model SEs are bootstrapped (250 rep)
*** Significant at the 1% level.

Appendix D. Accounting for sample selection

In a first step, for each year we estimate a selection equation using a standard probit as follows:

$$Pr(s_i = 1) = \Phi(\delta X_{ij(t_0)} + \mu C_{ij(t_0)}) \quad (\forall t = 0, \ldots, T) \tag{D1}$$

where s_i is a dummy equal to 1 if a firm survived in year t and 0 if not. $X_{ij(t_0)}$ and $C_{ij(t_0)}$ are variables included in the baseline model (input usage and firm characteristics). Ideally, we should include a selection variable that affects only the selection process (i.e., exit) but not the outcome (performance of survivors). However, we fail to find a relevant selection variable in our case.

In a second step, we compute the inverse of the Mills ratio for each firm i for each year t as follows:

$$\hat{\lambda}_i = \frac{\phi(\hat{\delta} X_{ij(t_0)} + \hat{\mu} C_{ij(t_0)})}{\Phi(\hat{\delta} X_{ij(t_0)} + \hat{\mu} C_{ij(t_0)})} \quad (\forall t = 0, \ldots, T) \tag{D2}$$

where $\Phi(.)$ is the cumulative normal distribution function and $\phi(.)$ the normal density function.

Insofar as $\hat{\lambda}_i$ is computed for each period by running a probit model by period, we use a time-variant measure of the inverse of the Mills ratio ($\hat{\lambda}_{it}$) allowing us to include firm fixed effects as well as our crisis and post-crisis dummies. In a third step, we re-estimate the baseline model (Eq. 1) by adding the estimated inverse Mills ratio as covariates:

$$Log(LP)_{ijt} = \alpha_i + \beta_1 AFTER_t + \beta_2 AFTER_t \times X_{ij(t_0)} + \beta_3 AFTER_t \times C_{ij(t_0)} + \gamma \hat{\lambda}_{it} + \varepsilon_{ijt} \tag{D3}$$

According to Wooldridge (1995), a simple test to detect sample selection is based on statistical significance of the inverse of the Mills ratio. Under the null hypothesis (absence of bias) the coefficient is statistically equal to 0. If not, we need to correct for sample selection bias. In this case, we cannot use standard errors because $\hat{\lambda}_{it}$ is a generated variable. A simple way to get robust standard errors is by applying the bootstrapping method (Brownstone and Valletta, 2001).