WORKING paper

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Oil Shocks and Their Impact on Corporate Profitability, Productivity, and Credit Risk:

Firm-Level Evidence Over Two Decades

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ABSTRACT

I study the impact of oil price shocks to non-financial firms over two decades using a highly granular firm-level dataset. I show the impact of these price shocks to key financial and operational metrics, including value added, employment, real wages, labor share, profit margins, dividend payments, productivity, and credit risk. I highlight the asymmetric effects of oil price increases and decreases. A one standard deviation increase in the weighted oil price shocks leads to a €396 decrease in per capita productivity (in 2024 euros), and a 0.30 percentage point increase in the probability of default, while there is no significant effect in the case of oil price decreases, leading to persistent effects of oil price increases in the medium term. I also show heterogeneous effects of oil price increases across firm size and energy intensity. This paper has implications for policymakers, especially those concerned with financial stability (bank stress-testing, climate stress-testing, macro-financial modeling), and competitiveness, and more generally for those studying climate transition risks.

Keywords: Oil Shock, Oil Price, Raw Materials, Value Added, Wage Bill, Labor Share, Profit Margin, Default, Productivity, Climate Risk, Transition Risk, Physical Risk, Credit Risk.

JEL classification: D33, E32, G3, G33, G35, Q41.

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NON-TECHNICAL SUMMARY

Climate change is likely to put upward pressure on commodity prices. Indeed, climate change is increasing the intensity and frequency of severe weather events, affecting agricultural yields and ultimately the price of food commodities. Similarly, the energy transition is likely to weigh on commodity prices by shifting demand towards equipment that requires large amounts of raw materials (e.g. electric vehicles, wind turbines).

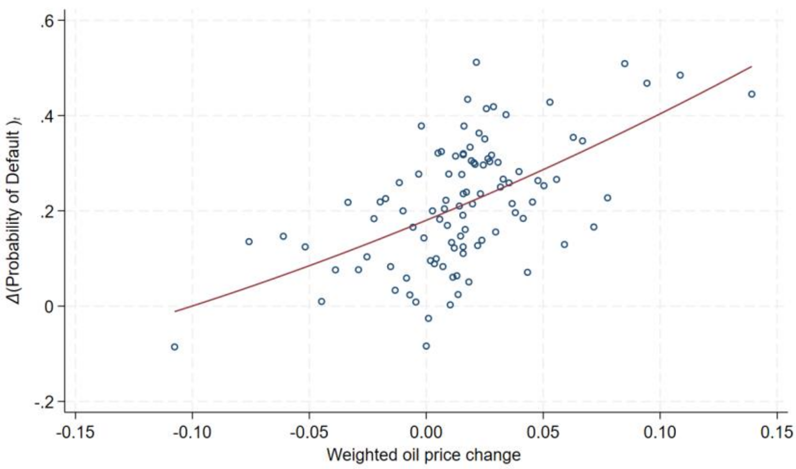
Faced with these growing risks on commodities, it is worth looking at the way in which firms deal with them: how do firms cope with shocks to commodity prices? What are the consequences of commodity shocks in terms of profitability, productivity or credit risk? Answering these questions enable to better assess the ability of firm to cope with the climate transition and, more broadly, with commodity shocks, whatever their origin (energy crisis, natural disasters).

To address these issues, I focus on the raw-material-intensive sectors (manufacturing). However, each sub-sector consumes very specific raw materials: agricultural raw materials are mainly consumed by the food industry and not by metallurgy. So, I focus on shocks that directly or indirectly affect all raw materials, and thus all manufacturing sectors, namely shocks to fossil commodities. Indeed, most raw material production depends on fossil resources. Then, I build a shift-share instrument to explain the dynamics of firms' financial ratios: the share part of the instrument (the exposure) is the firm's dependence on raw materials. The shift part (the shocks) are fluctuations in crude oil spot prices.

Based in this framework, I show the impact of oil price shocks to key financial and operational metrics, including value added, employment, real wages, labor share, profit margins, dividend payments, productivity, and credit risk (see Figure 1). I highlight the asymmetric effects of oil price increases and decreases. A one standard deviation increase in the weighted oil price shocks leads to a €396 decrease in per capita productivity (in 2024 euros), and a 0.30 percentage point increase in the probability of default, while there is no significant effect in the case of oil price decreases, leading to persistent effects of oil price increases in the medium term. I also show heterogeneous effects of oil price increases across firm size and energy intensity.

This paper has implications for policymakers, especially those concerned with financial stability, competitiveness, and more generally for those studying climate transition risks.

Figure 1. The Relationship between Weighted Oil Price Shocks and Credit Risk



Note: The figure shows the bin-scatter plot of the change in firms' probability of default (y-axis) depending on oil price shocks weighted by firm's dependence on raw materials (x-axis).

L'impact de chocs de prix du pétrole sur les marges, la productivité et le risque de crédit des entreprises : Une analyse au niveau entreprise sur deux décennies

RÉSUMÉ

Cet article étudie l'impact de chocs de prix du pétrole sur les entreprises non financières au cours de deux décennies en utilisant des données d'entreprises très granulaires. L'article analyse l'impact des chocs pétroliers sur la dynamique des principaux indicateurs financiers et opérationnels, notamment la valeur ajoutée, le partage de la valeur ajoutée, l'emploi, les salaires, les marges bénéficiaires, les dividendes, la productivité et le risque de crédit. L'article souligne les effets asymétriques des hausses et des baisses des prix du pétrole : il montre qu'une augmentation d'un écart-type du prix du pétrole (pondéré par la dépendance de l'entreprise aux matières premières) entraîne une diminution de la productivité du travail de 396 euros par salariés (en euros de 2024) et une augmentation de 0,30 point de pourcentage de la probabilité de défaut. En revanche, les variations à la baisse du prix du pétrole ne donnent lieu à aucun effet significatif, ce qui conduit à des effets persistants des hausses de prix du pétrole à moyen terme. L'article montre également l'hétérogénéité des effets d'une augmentation du prix du pétrole en fonction de la taille de l'entreprise et son intensité énergétique. Cet article a des implications pour les décideurs publics, en particulier ceux s'intéressant à la stabilité financière (stress-tests bancaires, stress-tests climatiques, modélisation macro-financière), à la compétitivité, et plus généralement ceux étudiant les risques liés à la transition climatique.

Mots-clés : choc pétrolier, prix du pétrole, matières premières, valeur ajoutée, partage de la valeur ajoutée, masse salariale, marge bénéficiaire, défaillance, productivité, risque climatique, risque de transition, risque physique, risque de crédit.

1 Introduction

Climate change and climate change mitigation policies are expected to put upward pressure on prices (NGFS, 2024; Del Negro, Di Giovanni, and Dogra, 2023; Coenen, Lozej, and Priftis, 2024), in particular raw material prices (Schnabel, 2022a; Schnabel, 2022b). Indeed, the physical risks associated with climate change make extreme weather events more likely or more severe (McSweeney and Tandon, 2024), affecting crops and putting pressure on food prices (Schnabel, 2022a). The shift in demand towards a low-carbon economy is also likely to weigh on mineral and energy production (Valckx et al., 2021; Kim et al., 2021).

When faced with raw material price shocks, firms seek to adjust their output. But frictions – such as low elasticity of substitution between inputs (Boehm, Flaaen, and Pandalai-Nayar, 2019), wage rigidities (Babecký et al. (2010)) or dividend payment constraints (Waters (2018) and Lintner (1956))– may hamper this adjustment, limiting firms' ability to absorb input price shocks and thus affecting their profitability, productivity or even survival.

Understanding how firms cope with inflationary pressures based on past experiences of high inflation in commodity markets is therefore crucial for policymakers. Indeed, it is of great interest to understand: (i) to what extent do commodity supply shocks affect firms' raw material costs? (ii) To what extent do supply shocks to raw material costs propagate within the firm? That is, to what extent is the firm's value added affected when faced with an increase/decrease in raw material costs, and to what extent is the allocation of value added substantially changed? To what extent do the real wage, the number of employees, and the dividend payment change?

And (iii), ultimately, are there implications for labor productivity and credit risk? Despite the significant interest of this topic, there is no paper, to the best of my knowledge, that provides a complete and consistent picture of this issue. The aim of this paper is to fill that gap.

To carry out this work, I rely on a unique dataset of firms' financial statements covering two decades, and focus on raw-material-intensive sectors (manufacturing). The dataset is unique in terms of the scope of firms it covers – from very small firms (SMEs) to the largest firms – and in terms of the level of detail in the firm-related information.

Since the consumption of raw materials is highly dependent on the sector of activity (e.g. the agro-food industry is heavily dependent on food commodities, while metallurgy is not), I focus on shocks that directly or indirectly affect all raw materials, and thus all manufacturing sectors, namely shocks to fossil commodities. Indeed, all raw material production depends directly[1] or indirectly[2] on fossil resources, whatever the raw material: food, fossil or mineral.[3] I therefore focus on raw material shocks originating in the crude oil spot market.

Since the input costs paid by a firm, and, more generally, the dynamics of financial statement components are endogenous to the firm, I first need to address this endogeneity issue. To tackle this, I use a Bartik (shift-share) instrument. The share part of the instrument (the exposure) is the firm's dependence on raw materials. The shift part (the shocks) are fluctuations in crude oil spot prices. I thus explain

[1] In agriculture, for example, heating systems for greenhouses and pumps for irrigation systems often rely on fossil fuels.

[2] Always using agriculture as an example: the production of fertilizers uses hydrogen from natural gas.

[3] See Pimentel, Patzek, and Cecil (2007), Kim et al. (2021), and Baffes and Mekonne (2025)

the dynamics of firms' financial ratios on the basis of this Bartik instrument.

With this setting, (i) I first show that oil price shocks affect firms' raw material costs and firms' value added: oil price rises (resp. falls) increase firms' raw material costs, and decrease (resp. increase) firms' value added. Up to this level, oil price rises and falls have relatively similar (symmetrical) effects. From this level onwards, asymmetries appear: the impact of oil shocks on firms depends on the type of oil price shock (increases vs. decreases).

(ii) In the case of oil price increases: (a) there is a change in the allocation of value added. The higher the oil price increase, the larger the increase in the labor share. This is due to the rigidity of the wage bill (a rigidity both in terms of wages and the number of employees), while profit falls, leading to an increase in the labor share. (b) Since the fall in value added is not accompanied by an adjustment in the number of employees, labor productivity falls when oil prices increase. And (c) more generally, there is a deterioration in financial ratios, leading to an increase in the probability of default. To give some figures, a one standard deviation increase in the Bartik instrument (weighted oil shocks) leads to a €266 decrease in per capita productivity (in 2000 euros; that is, €396 in 2024 euros), and a 0.30 percentage point increase in the probability of default.

(iii) When oil prices fall, it works the other way round but with a weaker and nonsignificant effect on the labor share, no significant effect on labor productivity and a weak effect on the probability of default.

This first set of results is for an average firm. I then break down the analysis by firm size. Since the first results showed that only oil price increases had significant effects, I focus the analysis on price increases. I show that the adjustment mechanisms are different for small and large firms. Large firms are much more raw-material-intensive and therefore more exposed to commodity price shocks. The mechanisms described above –oil price rises lead to an increase in the labor share, a decrease in labor productivity and an increase in the probability of default– apply more specifically to large firms. Conversely, small firms are less raw-material-intensive and more labor-intensive. Their adjustment involves a reduction in subcontracting and external staff: they bring the work back in-house (by slightly increasing the quantity of work per employee, but not the number of employees). In the end, for small firms, there is no significant effect after an oil price increase, regardless of the variables: labor productivity or probability of default. This result is counterintuitive, but is due to the fact that large firms are much more exposed to raw-material shocks due to their high dependence in raw materials.

Finally, I run local projections (Jordà, 2005; Jordà and Taylor, 2024) to analyze the dynamics in the medium term. I show that the effects of oil price increases persist in the medium term: this is consistent with (i) a significant impact of oil price increases, and (ii) no significant impact of oil price decreases. More specifically, the effects follow a U-shape: an analysis of the duration of the effects shows that the decline in productivity peaks one year after the shock and disappears after 2-3 years.

Related literature. A first contribution of this paper is part of a long-standing literature analyzing the impact of oil shocks on the economy. This literature began at least in the late 1970s (Hamilton, 1983; Hooker, 1996; Hamilton, 1996; Lee and Ni, 2002; Kilian and Park, 2009). As most U.S. recessions were preceded by a rise in oil prices, the literature has examined the impact of oil price shocks on macroeconomic growth (Hamilton, 1983). More recently, interest in the impact of oil price shocks has been revived, particularly at central banks, due to (i) the energy crisis triggered by the Russian invasion of Ukraine and (ii) the growing interest in analyzing the impact of climate change risks (Clerc et al., 2021; ESRB, 2023). Assessing the impact of these shocks requires a comprehensive and coherent understanding of the channels and magnitude of the effects on corporate financial ratios.

Some papers analyze the pass-through of energy prices (Lafrogne-Joussier, J. Martin, and Mejean, 2023; Dedola, Kristoffersen, and Zullig, 2021; Cavallo, Lippi, and Miyahara, 2023; Fontagné, P. Martin, and Orefice, 2024). Fontagné, P. Martin, and Orefice (2024) also analyzes competitiveness effects: it reports a decline in competitiveness following an increase in energy prices, as well as a decline in production, exports and employment. Other studies focus on the impact of commodity supply shocks on the credit risk of specific borrowers: oil-exporting countries (Bouri et al., 2018; Filippidis, Filis, and Kizys, 2020), energy firms (Sengupta, Marsh, and Rodziewicz, 2017), or listed firms (Capasso, Gianfrate, and Spinelli, 2020; Delis, De Greiff, and Ongena, 2019). Thus, to the best of my knowledge, there is no paper that provides a complete and consistent picture of the impact of oil supply shocks: that is, an analysis of the propagation of the shock from firms' inputs to their stakeholders together with the impact on financial ratios (from expense items to value added, value added allocation, profit margin, real wage, employees, external staff, dividend payments, productivity and credit risk), at different time horizons and depending on the energy dependence and the size of the firm – from small firms, which generally fall outside the scope of most corporate finance studies to large firms–. This information, provided in this paper, is of major interest for bankers and policymakers analyzing the ability of firms to absorb supply shocks (for competitiveness or financial stability issues: bank stress-testing, climate stress-testing, macro-financial modeling), and more specifically, for policymakers studying the impact of climate change and transition scenarios (Dimitrov et al., 2024; Allen et al., 2020).

This paper also contributes to the literature analyzing the dynamics of productivity. Empirical studies have investigated the reasons for the procyclical behavior of labor productivity: e.g. the rigidity of labor input relative to output (Hall, 1988), labor hoarding (Fay and Medoff, 1985). My study contributes to this literature by documenting productivity cycles due to oil shocks, I highlight in particular the asymmetric effects of oil price shocks on all key financial ratios –on productivity as well as on value added, value added distribution, profit margin and default probability–, leading to cycle of deterioration of these indicators that persists up to 2 years after the shocks. Recent studies have addressed the heterogeneity of productivity dynamics across firm characteristics, such as balance sheet weakness (Giroud and Mueller, 2017) and firm long-run growth (Baily, Bartelsman, and Haltiwanger, 2001), or between booms and recessions (Kehrig, 2015). I add to this literature by showing that, following an oil shock, the effects depend on firm size and energy dependence, with more energy-dependent firms responding more strongly.

Section (2) presents the conceptual framework used in the paper, section (3) presents the data, section (4) gives the intuition of the results through stylized facts, section (5) presents the results and section (6) concludes.

2 Identification Strategy

2.1 The basic framework

On the basis of a simplified accounting identity, the value added of a firm f in year t, denoted $VA_{f,t}$, is defined as the firm's sales, $SA_{f,t}$, less the firm's purchases and operating expenses, here split between the cost of raw materials $RM_{f,t}$ and other costs, denoted $OC_{f,t}$:

$$VA_{f,t} \equiv SA_{f,t} - (RM_{f,t} + OC_{f,t}) \tag{1}$$

Dividing by the sales and taking the first difference makes it possible to relate changes in value added (per euro of sales) with changes in raw materials costs (per euro of sales).[4] Since value added can be further broken down into the wage bill $W_{f,t}$ and profit $P_{f,t}$, it is possible to relate changes in the profit margin –described in standard textbooks (Zimmerman, 2010) and used by investors (e.g. Campbell, 2016,Waters, 2018)– with changes in the raw material costs per euro of sales.

$$\overbrace{\Delta(\text{Profit margin})_{f,t} + \Delta\left(\frac{W}{SA}\right)_{f,t}}^{\Delta\left(\frac{VA}{SA}\right)_{f,t}} + \Delta\left(\frac{OC}{SA}\right)_{f,t} \equiv -\Delta\left(\frac{RM}{SA}\right)_{f,t} \tag{2}$$

In a similar way to Chang et al. (2014) and Lé and Vinas (2024), the accounting identity (2) is used to set the system of equations (3a) and (3b).

$$\begin{cases} \Delta\left(\frac{VA}{SA}\right)_{f,t} = \alpha_{VA} + \gamma_{VA} \times \Delta\left(\frac{RM}{SA}\right)_{f,t} + \epsilon_{VA,f,t} & \text{(3a)} \\ \Delta\left(\frac{OC}{SA}\right)_{f,t} = \alpha_{OC} + \gamma_{OC} \times \Delta\left(\frac{RM}{SA}\right)_{f,t} + \epsilon_{OC,f,t} & \text{(3b)} \end{cases}$$

[4] I use either "per euro of output" or "per euro of sales" throughout this paper.

This system of equations can be further broken down into equations (4a) to (4c) by decomposing the value added:

$$\begin{cases} \Delta\Big(\dfrac{W}{SA}\Big)_{f,t} = \alpha_W + \gamma_W \times \Delta\Big(\dfrac{RM}{SA}\Big)_{f,t} + \epsilon_{W,f,t} & \text{(4a)} \\ \Delta\Big(\text{Profit margin}\Big)_{f,t} \equiv \Delta\Big(\dfrac{P}{SA}\Big)_{f,t} = \alpha_P + \gamma_P \times \Delta\Big(\dfrac{RM}{SA}\Big)_{f,t} + \epsilon_{P,f,t} & \text{(4b)} \\ \Delta\Big(\dfrac{OC}{SA}\Big)_{f,t} = \alpha_{OC} + \gamma_{OC} \times \Delta\Big(\dfrac{RM}{SA}\Big)_{f,t} + \epsilon_{OC,f,t} & \text{(4c)} \end{cases}$$

So far, this framework measures the sensitivities of value added and its components to raw material shocks. However, this framework is not causal. To address the endogeneity issue between the changes in raw material costs and the changes in value added, I use a Bartik (shift-share) instrument built in the spirit of Dedola, Kristoffersen, and Zullig (2021) to explain changes in value added.

2.2 The Bartik instrument

The Bartik instrument relies on the following argument: the firm's dependence on raw materials is defined as the sum of the costs related to each of its raw material inputs, scaled by sales:

$$\Big(\frac{RM}{SA}\Big)_{f,t} \equiv \frac{\sum_c^C [p_{c,f,t} \times q_{c,f,t}]}{SA_{f,t}} \tag{5}$$

Where $p_{c,f,t}$ is the price and $q_{c,f,t}$ the quantity of input c purchased by firm f at time t, and C is the set of inputs.

The change in the cost of raw materials per euro of sales between $t-1$ and t is then:

$$\Delta\Big(\frac{RM}{SA}\Big)_{f,t} \approx \sum_{c}^{C}\Big[\Big(\frac{p_{c,f,t-1}\times q_{c,f,t-1}}{SA_{f,t-1}}\Big)\times gr(p_{c,f,t})\Big]+\sum_{c}^{C}\Big[p_{c,f,t-1}\times\Delta\Big(\frac{q_{c,f,t}}{SA_{f,t}}\Big)\Big] \quad (6)$$

On the right hand side of Equation (6), the ratio $\frac{p_{c,f,t-1}\times q_{c,f,t-1}}{SA_{f,t-1}}$ is the cost paid by firm f for a given raw material c at time $t-1$, and $gr(p_{c,f,t})$ is the growth rate of the price that firm f faces for raw material c between $t-1$ and t. The second term of Equation (6) represents the firm's adjustments in input quantities and output prices and quantities. The price change $gr(p_{c,f,t})$ can be decomposed as the sum of an idiosyncratic price shock and a price shock common to all firms. The common shock comes, at least in part, from global commodity markets, especially from the oil market. Indeed, the fossil resource matters for the production of both fossil and nonfossil raw materials: the production of nonfossil raw materials is indeed highly dependent on fossil resources. For example, the production of maize, the most widely produced cereal in the world (FAO, 2023), requires energy and fossil resources (through fertilizers, fuel for machinery, pesticides, irrigation etc.), and these depend mainly on oil and natural gas (Pimentel, Patzek, and Cecil, 2007; Baffes and Mekonne, 2025). The same dependence exists for mineral production (e.g. see (Kim et al. (2021, p.198)) for the case of copper).

I therefore construct a Bartik instrument $Z_{f,t}$ whose "share" part (the exposure) is the dependence of the firm on raw materials measured as its raw material costs per euro of sales before the shock. Following the convention in the literature (Goldsmith-Pinkham, Sorkin, and Swift, 2020), the firm's exposure to the shock is the first observed value in the dataset (t_0). The "shift" part is the raw material price fluctuation. Since raw material production is highly dependent on fossil resources, especially oil and gas, I focus on raw material shocks stemming from the oil market: namely the change in the crude oil price calculated *à la* Davis and Haltiwanger (1992). The oil price taken into account is that of Brent crude oil, as this is the reference price in Western Europe. Therefore, the Bartik instrument is:

$$Z_{f,t} = \left(\frac{RM}{SA}\right)_{f,t_0} \times gr\left(\text{Oil Price}\right)_t \tag{7}$$

The main equation used in the empirical analysis is:

$$\Delta\left(\frac{Y}{SA}\right)_{f,t} = \beta_Y \times Z_{f,t} + X_{f,t-1} + \alpha_f + \theta_{s,t} + \epsilon_{f,t} \tag{8}$$

The variable $\Delta\left(\frac{Y}{SA}\right)_{f,t}$ is the first difference (between $t-1$, the year before the oil price change, and t, the year of the oil price change) in the ratio of Y over sales. The numerator Y is a variable from the income statement, such as value added, the wage bill, profit or other costs. The variable $Z_{f,t}$ is the Bartik instrument. The variables $X_{f,t-1}$ are a set of one-year lagged controls measured at firm level: (i) the share of cash holdings over total assets, to control for the firm's liquidity level, (ii) leverage, to control for the firm's indebtedness, and (iii) the logarithm of total assets, to control for the firm's size. All estimations are carried out with (iv) firm fixed effects α_f, to control for the firm's unobservable characteristics, and (v) industry-by-year fixed effects (2 digits), $\theta_{s,t}$, to control for yearly shocks at industry level, in particular demand shocks. All the standard errors are clustered at the firm level.

The empirical strategy tests whether firms' differential exposure (i.e. firms' differential dependence on raw materials) to common shocks (i.e. price changes on a global commodity market, namely the crude oil market) leads to differential changes in outcomes. The source of identification is the differences between firms in their dependence on raw materials in the first observed year (Goldsmith-Pinkham, Sorkin, and Swift, 2020). The validity of this instrument is based on the assertion that neither the firms' initial dependence on raw materials nor unobserved variables correlated with it directly predict the outcome of interest conditional on controls (Baum-Snow and Ferreira, 2015, p.50): this holds because the firm fixed effects capture any firm-specific factors that may have affected both the initial dependence and the current outcomes (Fontagné, P. Martin, and Orefice, 2024).

The coefficients β_{VA}, β_W and β_P of Equation (8) are the coefficients of particular interest in this analysis. The coefficient β_{VA} describes the impact of energy shocks on value added: a 1 percentage point (pp) change in the weighted oil price (the Bartik instrument) results in a β_{VA} pp change in value added per euro of sales. Since the accounting identity is maintained (see Equation (9)), the coefficients β_W and β_P describe the transmission of the fall (or increase) in value added to the profit margin and the wage bill per euro of output.

$$\beta_{VA} = \beta_W + \beta_P \tag{9}$$

Since the profit can be further decomposed into the dividend $D_{f,t}$ and a residual part hereafter called *net cash flow* $CF_{f,t}$ (or *internal cash flow*), and the wage bill can be decomposed into the average wage $\omega_{f,t}$ and the number of employees $L_{f,t}$, the propagation of the shock can thus be analyzed in detail up to all stakeholders in the firm.

Finally, in building this identification strategy, I choose to normalize variables by the firm's sales in Equation (2). Scaling the income statement variables by sales has several advantages. First, it makes it possible to compare firms of different sizes. Second, it controls for the two channels of adjustment that the firm can rely on: price adjustment (the pass-through of input prices to customers) and quantity adjustment. The 2022 energy crisis is an illustration of both situations: see Lafrogne-Joussier, J. Martin, and Mejean (2023) for the first case, and Reuters (2022) and Albert et al. (2022) for the second case. These channels of adjustment are not distinguished at this stage, but are considered in a complementary analysis in which I analyze the extent to which the propagation of shocks varies according to firm size (a proxy for the firm's bargaining power). Third, this framework makes it possible to directly highlight the dynamics of a key variable of interest for investors and firm managers: the profit margin (see Equations (2) and (4b)).[5]

3 Data

The analysis carried out in this paper relies on FIBEN –*Fichier Bancaire des Entreprises*), a database of firms' tax statements managed by the Banque de France– to assess firms' credit ratings. Data are available from 1990 to 2022. The reporting is carried out yearly at the legal entity level (unconsolidated accounts). The database is particularly interesting due to its broad coverage: it accounted for 72% of corporate value added in 2018 (see Lé and Vinas (2024) for more details on FIBEN).

The following restrictions are applied to the FIBEN database. First, only firms

[5]Another approach could be to scale by the number of employees, thus replacing value added per euro of sales in the left-hand side of Equation (3a) with labor productivity, and relating this to raw material costs per capita. However, this would make the approach more cumbersome, particularly by adding the term "sales per capita" in addition to labor productivity in Equation (2), and also adding an equation in the systems of equations.

with a 12-month accounting period are retained. Second, as the analysis focuses on raw material costs, only the most intensive sectors are kept, namely the manufacturing sectors, excluding the manufacture of coke and refined petroleum products (and the manufacture of tobacco products, which represents an average of two firms per year). Third, since balance sheet data are annual, the oil price used in the Bartik instrument must be yearly averaged. Most balance sheet dates are in December, so the oil price is based on the average price over the calendar year (that is, from January to December), and therefore I restrict the analysis to firms that end their fiscal year in December. Fourth, the number of individual firms in the database has increased over time, particularly in the first decade: it doubled in the 1990s, reaching around 20,000 observations in 2000. This is due to the ramp-up in the data collecting process during that first decade. I therefore focus on the period starting from 2000 and restrict the number of observations each year to the 20,000 largest firms in terms of sales, to give a similar weight to each year. Fifth, as the 2020-2021 health crisis gave rise to public aid, notably the Job Retention Scheme, which affected the value-added allocation, I restrict the data to 2019, and therefore run the analysis over the period 2000-2019. Finally, the main variables of interest are trimmed at 99% (and 1% when relevant). All economic variables are deflated using the consumer price index provided by the French National Institute of Statistics and Economic Studies (INSEE).

This results in a set of 245,609 observations representing 28,643 firms. The descriptive statistics are presented in Table 1. The top panel shows descriptive statistics for all observations, while the bottom panel shows statistics by firm size. Four firm sizes are defined on the basis of the four quartiles of the distribution of firm sales. The average sales are €13.8 million (in 2000 euros) and the average number of employees is 75. Beyond these averages, there is considerable heterogeneity between firms: the first decile of sales is €1.0 million, while the last decile is 30 times higher at €30.4 million. The number of employees ranges from 2 to more than 4,000, with a median of 28.

An important feature of FIBEN is its coverage of small businesses. Corporate finance studies tend to cover large firms better than small firms because of data unavailability or access difficulties. For example, studies based on Compustat data are biased towards large firms, as mentioned in Chodorow-Reich (2014, p.14). In Chodorow-Reich (2014), the median firm has sales of $500 million (in 2005 dollars) and 620 employees, compared to €3.5 million (in 2000 euros) and 28 employees in the dataset used here.

Raw material costs and value added represent around one-third of sales respectively, so other costs account for around one-third; in particular external staff and outsourcing costs amount to 8% of sales on average. Raw material costs per euro of sales increase with firm size (see bottom panel of Table (1)), from 25% for the 25% smallest firms to 38% for the 25% largest. The average labor share represents 82% of value added, and decreases with firm size, from 85% for the smallest firms to 78% for the largest (in line with Bauer and Boussard, 2020, Figure V page 135). Large firms are also more productive than the smallest ones (see also OECD, 2014; Leung, Meh, and Terajima, 2008). Cash holdings accounts for 14% of total assets on average, and equity accounts for 42%. The average profit margin is 6.5%, and remains stable regardless of firm size. In addition to these balance sheet data, the probability of default over a three-year horizon, calculated by the credit risk analyst, is added to the database, with an average value of 3.9%.

A second database, on raw materials prices, is made available by the INSEE.[6] It provides over a hundred series in euros or foreign currencies (essentially dollars) over the period 1990-2022. These data cover fossil resources and their derivatives (naphtha, heating oil, etc.), as well as agri-food resources (corn, wheat, oilseeds, etc.), and ferrous and non-ferrous metals (copper, nickel, aluminum, lead). The series are either quoted market prices or price indexes, at monthly frequency.

As mentioned above, the Bartik instrument is based on the reference price of oil in Western Europe, namely the spot price of Brent crude oil. As France is in the euro zone, I use the spot price reported in euros. As balance sheet data are annual, commodity series are averaged over the year before being merged with firm balance sheet data.

4 Stylized facts

The identification strategy developed in Section (2) uses a Bartik instrument –that is, weighted oil price changes– to analyze the impact of oil shocks on firms through the basket of raw materials used by each firm. This section provides stylized facts on the relevance of the Bartik instrument and the intuition of the results presented in Section (5).

Panels (a) and (b) of Figure (1) show the relationship between the Bartik instrument and different financial and operational metrics. Panel (a) of Figure (1) plots (i) the average weighted oil price changes over the period 2000-2019 with (ii)

[6] Available here: https://www.insee.fr/en/statistiques/series/105299226. For a direct access to the database see: https://www.insee.fr/en/statistiques/series/xlsx/famille/105299226

the average changes in firms' raw material costs per euro of sales, and (iii) the average changes in firms' value added per euro of sales. The changes in value added are presented with a "times-minus-one" transformation to be consistent with the (expected) negative relationship with the other two variables (see Equation (2) in Section (2)). Panel (a) of Figure (1) clearly shows (i) a positive relationship between the weighted oil price shocks and the change in firms' raw material costs, and (ii) a negative relationship between the weighted oil price shocks and the change in firms' value added, as expected.

The empirical analysis tests the extent to which oil shocks affect various financial indicators and, ultimately, firms' credit risk. Panel (b) of Figure (1) shows a bin-scatter plot highlighting the relationship between the change in the probability of default (y-axis) and the weighted change in the oil price (x-axis), controlling for time-sector shocks. Figure (1) shows (as expected) a positive relationship between the Bartik instrument and the probability of default: increases in oil prices lead to increases in firms' probability of default.

One question raised in this paper is how the allocation of value added by firms changes when value added is affected by a shock. Figure (2) is a bin-scatter plot showing the relationship between firms' labor share on the y-axis (defined as the wage bill scaled by value added) and the shock to firms' value added per euro of sales on the x-axis. Figure (2) shows an asymmetry: (i) when value added falls the labor share increases, (ii) conversely, when value added increases, firms' labor share remains stable. Figure (2) therefore suggests that there are asymmetries in firms' behavior depending on the type of shock to their value added (positive or negative).

These figures give a first intuition of the results to be developed in the next section.

5 Empirical results

5.1 Impacts of raw material cost shocks

The aim of this paper is to analyze the direct and indirect impact of oil shocks on firms through the basket of raw materials they use.[7] First, (i) I analyze the extent to which a shock in the spot price of crude oil affects firms' raw material costs using a Bartik instrument, defined as oil price changes weighted by the firms' dependence on raw materials. I then analyze the transmission of this shock to firms' production process, that is: (ii) to what extent do firms adjust their purchases and operating expenses when faced with these shocks? (iii) To what extent is their value added affected? (iv) Is the allocation of value added substantially changed? (v) To what extent does the real wage, the number of employees, the dividend payment, the labor share, and the productivity change? Finally, (vi) are there any credit risk implications?

The main equation is:

$$\Delta\left(\frac{Y}{SA}\right)_{f,t} = \beta_Y \times Z_{f,t} + X_{f,t-1} + \alpha_f + \theta_{s,t} + \epsilon_{f,t} \tag{8}$$

The variable $\Delta\left(\frac{Y}{SA}\right)_{f,t}$ is the first difference (between $t-1$ and t) in the ratio of Y per euro of output, i.e. per euro of sales (denoted here by SA). The numerator Y is a variable from the income statements, such as value added, wage bill, profit or expense

[7] See Section (2) for more details on the Bartik instrument and the identification strategy.

items. Scaling the income statement variables by sales has several advantages. In particular it allows comparisons to be made between firms of different sizes on key variables of interest to investors and firm managers, for example the profit margin: as shown in Panel B of Table (1), the average profit margin is very stable, at between 6.4% and 6.5% regardless of firm size, while firm sizes vary widely, with output ranging from €1.1 million euro to €44.1 million.

The other variables in Equation (8) are: $Z_{f,t}$, the Bartik instrument (see Equation (7)), and a set of controls. The variables $X_{f,t-1}$ are one-year lagged controls measured at firm level: (i) the share of cash holdings over total assets, to control for the firm's liquidity level, (ii) the leverage, to control for the firm's indebtedness, and (iii) the logarithm of total assets, to control for the firm's size. All estimations are carried out with (iv) firm fixed effects α_f, to control for the firm's unobservable characteristics, and (v) industry-by-year fixed effects (2 digits), $\theta_{s,t}$, to control for yearly shocks at industry level, in particular demand shocks. All the standard errors are clustered at the firm level.

The results related to the estimation of Equation (8) are reported in Table (2). The top panel of the table shows the results using the Bartik instrument, regardless of whether the oil price is rising or falling. The bottom panel runs exactly the same regressions, on the same observations, but distinguishing between oil price rises and falls in order to analyze any potential asymmetries depending on the type of oil price shock (positive vs. negative).

In column (1) of Table (2) the dependent variable is the change in the cost of raw materials per euro of sales. As reported, a one-percentage-point (pp) change in the Bartik instrument leads to a +0.039 pp change in the firm's raw material costs per euro of sales. In other words, a one-standard-deviation of weighted oil price change results in a 0.30 pp (=7.78*0.039) change in raw material costs. This result is significant even when controlling for unobservable firm characteristics and sector-time shocks, such as demand shocks. This first result means that, when the oil price changes, in order to generate €1 in sales, the input invoice paid by the firm changes significantly and in the same direction as the oil price. As shown in panel B, there are no particular asymmetries between oil price increases and decreases at this stage.[8] In particular, as reported in column (1) of panel B, oil price increases lead to increases in raw material costs: this first result is consistent with the absence of full pass-through of input price increases *outside* energy crisis periods, as reported in the literature (Lafrogne-Joussier, J. Martin, and Mejean, 2023; Dedola, Kristoffersen, and Zullig, 2021; Cavallo, Lippi, and Miyahara, 2023).

At this stage, however, the size of these coefficients does not tell us anything about the economic impact. I now need to analyze how this shock to the cost of raw materials impacts other items. Since the conceptual framework used here preserves accounting equality (see Equation 2), the coefficient of change in the cost of raw materials per euro of output can be compared with the coefficient related to other ratios: that is, either through a change in other costs per euro of output, or through an adjustment in value added per euro of output. I examine this in the following columns in the table.

In column (2), the dependent variable is the change in value added per euro of sales. As reported, a 1 pp change in the weighted oil price leads to a (significant) -0.021 pp change in value added per euro of sales: that is, the shock to raw mate-

[8] Although the coefficient (+0.029 vs. +0.052) is smaller for oil price increases.

rial costs is largely absorbed by value added: 54% of the shock (=0.021/0.039) is absorbed by value added. This result is illustrated in Panel (a) of Figure (1), which shows (i) the average weighted changes in the oil price and (ii) the average changes in firms' value added per euro of sales over the period 2000-2019. The oil price change is displayed with a "times-minus-one" transformation in order to highlight the negative relationship between the two variables.

The dynamics of value added per euro of sales (column (2)) is broken down in columns (3) and (4) where the dependent variables are the growth rate[9] of value added and of sales. As reported in these columns, a 1 pp change in the weighted oil price leads to a -0.061 pp change in value added and a +0.046 pp change in sales. Thus, the dynamics of the numerator and the denominator contribute to the negative coefficient shown in column (2). The impact is economically and statistically significant.

The bottom panel of the table reports the same regressions, but with the oil price change broken down into price increases and price decreases to test for possible asymmetries. Overall, the results are similar when the oil price goes up or down. However, the impact on value added per euro of sales is larger when the raw material costs rises: value added per euro of sales absorbs 66% (=0.019/0.029) of the raw material shock when oil prices rise, whereas it absorbs 44% (=0.023/0.052) when oil prices fall.

More interesting is the breakdown of the change in value added per euro of sales. In columns (5) and (8), the value added per euro of sales is broken down between the wage bill per euro of sales and the profit margin (= profit per euro of sales). As

[9] Calculated *à la* Davis and Haltiwanger (1992)

reported in the top panel, a 1 pp change in the weighted oil price leads to +0.008 pp change in the wage bill per euro of sales, but to a -0.029 pp change in the profit margin. Thus, the value-added shock is mainly transmitted to the profit margin, while the wage bill per euro of sales is little affected.

I break down the wage bill into growth in real wages (column(6)) and growth in the number of employees (column(7)). There appears to be no significant impact on these two components. This is in line with the previous remark on the weak impact on the wage bill.[10] Panel B also shows that the coefficient in column (5) is small and weakly significant regardless of whether the oil price rises or falls.

Breaking down the profit margin into net cash flow per euro of sales (column (9), also called "net profit margin") and dividends (column (10) shows that dividends (per euro of sales) are less affected by changes in raw material costs than net profit margin: 67% (=0.026/0.039) of the change in input costs is transmitted to net cash flow. This result is similar for increases and decreases in raw material prices (see columns (8), (9) and (10) of panel B).

But is there ultimately a significant change in the distribution of value added? Column (11) reports the effect on the labor share, measured as the change in the ratio of the wage bill to value added. A 1 pp change in the weighted oil price leads to a change in the labor share of +0.046 pp. However, there are asymmetries. As shown in the bottom panel, the coefficients are positive for both price increases and price decreases, but only significant for price increases. In other words, there is no effect on the distribution of value added when oil prices fall, but an increase in the labor share when oil prices rise due to the decrease in the profit margin and the

[10]: That is, by comparing the magnitude of the absolute value of the coefficient -0.008 vs. +0.029.

rigidity of wages and the number of employees. This is fully consistent with Figure (2). Figure (2) is a bin-scatter plot showing the relationship between firms' labor share on the y-axis and the shock to firms' value added per euro of sales on the x-axis. Figure (2) illustrates the asymmetry reported in the bottom panel of Table (2): (i) when value added falls the labor share increases, (ii) conversely, when value added increases, firms' labor share remains stable.

Column (12) shows the results for labor productivity, measured as the change in value added per capita. A 1 pp change in the weighted oil price leads to a change in productivity per capita of €26 (in 2000 euros)[11]. Again, there are asymmetries: indeed, as shown in the bottom panel, the coefficient is significant only in the case of price increases. In other words, (i) there is no effect on productivity when oil prices fall, and (ii) when the oil price rises, the fall in productivity is due to a fall in value added (see column (3)), which is not accompanied by a change in the number of employees (column (7)). This rigidity in the number of employees is in line with the literature on labor hoarding (Fay and Medoff, 1985). As shown in column (12), when the oil price rises, a one standard deviation increase in the Bartik instrument (weighted oil shocks) leads to a €266 decrease in per capita productivity (in 2000 euros; that is, €396 in 2024 euros). Conversely, in the case of oil price decreases, the effect on value added is not strongly significant (column (3)), which may explain the negative but not significant coefficient on productivity in column (12).

So far I have focused on the dynamics of value added and its underlying components: wage bill, profit margin, number of employees, dividend. What about other

[11]In the robustness section, using a Two-Stage-Least-Square estimation shows that a 1 pp change in the raw material cost per euro of sales results in a change in productivity per capita of €675 (in 2000 euros see Table (4)).

cost items? An analysis of the dynamics of other costs shows that the adjustment to changes in raw material costs is mainly made through value added. As an example, column (13) shows the change in external staff and outsourcing costs per euro of sales. The coefficient is of second order magnitude compared to the impact on value added per euro of sales (-0.006 (see column(13)) vs. -0.021 (see column (2)). The coefficients of the other components are of a similar order (-0.004 for purchases of goods and -0.008 for "other costs", for which I have no information on the content).

Finally, in column (14), the dependent variable is the change in the firm's probability of default over a three-year horizon, as assessed internally by credit risk analysts.[12] A 1 pp change in the weighted oil price leads to a 0.022 pp change in the firm's probability of default.[13] Again, there are asymmetries in the effect between oil price increases and decreases as shown in the bottom panel of Table (2). A one standard deviation increase in the weighted oil price results in a 0.30 pp (=7.78*0.03882) increase in the probability of default, which is economically significant. For oil price decreases, the coefficient is positive (the probability of default decreases, as expected) but not significant.

Summary of these first empirical results So far, I have shown that (i) oil price shocks affect firms' raw material costs, and (ii) the change in raw material costs affects firms' value added: oil price rises (resp. falls) increase firms' raw material costs, and decrease (resp. increase) firms' value added. Up to this level,

[12] The probability of default (PD) in year t is the assessment in year t of the PD over a three-year horizon, based on (i) the firm's tax return for year $t-1$ and (ii) all impacting events occurring up to the end of year t. A conservative approach is therefore taken to define the change in PD through the oil shock in year t: it is defined as the difference in PD between year $t-1$ (before the oil shock in t) and year $t+1$ (since it uses the balance sheet in year t).

[13] In the robustness section, using a Two-Stage-Least-Square estimation shows that a 1 pp change in the raw material cost per euro of sales results in a +0.57 pp change in the probability of default.

oil price rises and falls have relatively similar impacts. From this level onwards, asymmetries appear. (iii) In the case of oil price increases, there is (a) a change in the allocation of value added: the higher the oil price increase, the greater the increase in the labor share. This is due to the rigidity of the wage bill (as well as real wages and the number of employees), while the profit margin decreases, leading to an increase in the labor share. (b) Since the fall in value added is not accompanied by an adjustment in the workforce, at least in the short term, the labor productivity decreases in the event of an oil price increase. Moreover, (c) the deterioration in firm's financial ratios leads to an increase in their probability of default. (iv) In the case of oil price decreases, the mechanisms works the other way round but with a weaker and nonsignificant effect on the labor share , no significant effect on labor productivity and no significant effect on the probability of default.

The effects of oil price rises and falls are asymmetric. This is likely to lead to persistent effects, at least in the medium term. The lasting effects are analyzed in Section 5.3. Before doing so, in the next section, I test the extent to which these results depend on the size of the firm.

5.2 Breaking down the impact by firm size

Table (3) reports the same regressions as Table (2) except that the main variable of interest is now broken down by firm size. Firm size is defined through a yearly segmentation of the sales distribution in the spirit of Covas and Den Haan (2011) and Lé and Vinas (2024), based on quartiles. The size breakdown is as follows: [p0-p25),[p25-p50), [p50-p75), [p75-p100]. The size used is the size before the shock in year t.

Since the previous section showed that only increases in the price of oil have an impact in terms of labor share, productivity and probability of default, this section focuses on the price increases.

As reported in column (1) of Table (3), the impact of a weighted oil price increase on raw material costs per euro of sales ranges from +0.011 to + 0.044, but with an increasing pattern by firm size. This is consistent with the fact that the largest firms report the highest raw material costs per euro of sales compared to other firm sizes (see descriptive statistics in Section 3). It is as if the supposed market power, that large companies are expected to have fails to compensate for their high dependence on raw materials.

Column (2) shows the effect on firms' value added and highlights a clear monotonic trend in value added by firm size: the larger the firm, the greater the fall in value added. The range is from (a nonsignificant) +0.005 for the 25% smallest firms to -0.031 for the largest firms.

Why is the value added of small firms less affected? Column (13), which shows the dynamics of external staff and outsourcing costs in response to oil shocks, provides an explanation. It shows a monotonically decreasing effect with firm size: the larger the firm, the smaller the decline in external staff costs. It is as if small firms had reduced the amount of work they outsourced and decided to bring this work back in-house. This intuition is confirmed by the rising wage bill of small firms (see column (5)), which is not associated with an increase in the number of employees (column (7)), but rather with an increase in employees' income (column (6)). This is entirely consistent with an increase in the amount of work done by fewer employees. In the end, there is a positive (but not significant) impact on the labor share, and productivity is unaffected either (see column (12)) – which is consistent with the stability of the numerator, the value added (see column (3)), and the denominator, the number of employees (see column (7))–. The probability of default (column (14)) is not affected either for the smallest firms.

The mechanisms are clearly different for large firms. Their high dependence on raw materials has a strong effect on value added (see columns (2) and (3)): despite the strong increase in sales, their value added decreases. The heterogeneity of sales dynamics across firm sizes may be related to the differences in market power between firms: the larger the firm (proxy of a greater market power), the greater the sales increase. However, this does not lead to an increase in value added, as if the increase in raw material costs dominates.

Continuing with the analysis of large firms, the fall in value added leads to a shift in its allocation of value added: the wage bill is clearly stable for the largest firms (as are the real wages and the number of employees, see columns (5)-(7)), while the net profit margin falls (column (9)). As explained above, this leads to an increase in the labor share (by definition), a fall in productivity (as value added falls and the number of employees remains unchanged) and an increase in the probability of default.

These results are counterintuitive, but due to the fact that large firms are much more exposed to raw-material shocks due to their high dependence in raw materials. So, the mechanisms described in the first section of results –oil price rises lead to an increase in the labor share, a decrease in labor productivity and an increase in the probability of default– apply more specifically to large firms. Conversely, small firms are less raw-material-intensive and more labor-intensive. Their adjustment involves a reduction in subcontracting and external staff: they bring the work back in-house.

It should be stressed that all these results increase in intensity with firm size: the smallest and the largest firms represent polar opposite cases, and intermediate firm sizes experience intermediate effects.

5.3 Are the effects long-lasting?

Are these effects long-lasting? To answer this question, I use the local projection approach (Jordà, 2005). I run a series of regressions on a variable of interest at various horizons (h) after year t of the oil price shock, on the independent variable of interest at t (the Bartik instrument) and on control variables. Following (Jordà and Taylor, 2024), I use a long-difference specification rather than a level specification. Thus, I estimate the following equation for the different horizons (h):

$$y_{f,t+h} - y_{f,t} = \beta_{y,h} \times Z_{f,t} + \sum_{j=1}^{p} \rho_{f,h}.\Delta y_{f,t-j} + \sum_{j=1}^{p} \rho_{f,h}.x_{f,t-j} + \alpha_f + \theta_{s,t+h} + \epsilon_{f,t+h} \quad (10)$$

where y is the dependent variable of interest (value added per euro of sales, profit margin, labor share, productivity, or probability of default), $Z_{f,t}$ is the Bartik instrument (see Equation (7)) and $\beta_{y,h}$ is the dynamic causal effect of interest at horizon (h), that is, the impulse response function. The vector x is a set of controls: namely, the one-year and two-year lags of the Bartik instrument (so $p = 2$), and the one-year and two-year lags of financial ratios computed at the firm level (the share of cash holdings over total assets, the leverage, and the logarithm of total assets). As in the main equation, the dummies α_f are firm-level fixed effects and $\theta_{s,t+h}$ are sector-by-year fixed effects.

Figure (3) shows the impulse responses of value added per euro of sales, profit margin, labor share, productivity, and the probability of default to increases in the oil price. The dashed lines are the point estimates and the shaded area shows 95% confidence bands. Panel (a) indicates that value added per euro of sales decreases on impact and that the effect peaks one year after the shock and then persists over 2 years. Panel (b) shows similar results for the profit margin. Panel (c) indicates that the labor share increases on impact and that the effect persist over the 2 years after the shock. Panel (d) indicates that productivity decreases on impact and the effect peaks one year after the shock and then persists over 2 years. Panel (d) shows similar results for probability of default. The fact that the impact peaks after one or two years is consistent with the existence of long-term contracts for the supply of key inputs. As these contracts are gradually renewed, the impact of the shock increases, reaching a peak one year after the oil price increase.

5.4 Robustness tests

I carry out a series of robustness tests on both the estimation strategy and the dataset segmentation.

5.4.1 Two-Stage Least Squares (2SLS) estimation

First, I use a 2SLS estimation using the Bartik instrument as an IV to instrument the dynamics of firms' raw material costs per unit of sales.

The results related to Equation (8) are reported in Table (4). I run the same estimation as the in Table (2) but restrict the reporting to the key variables of interest: profit margin, labor share, productivity and probability of default.

In the bottom part of the table, I report the first-stage coefficient (testing the relevance of the IV) and the Kleibergen–Paap Wald F-statistics (weak-IV test). These statistics confirm the relevance of the IV –through a significant and positive correlation between the Bartik instrument and raw material costs–, as well as the absence of weak-IV bias problem.

Overall, the results are similar to those in Table (2), but here, the coefficients provide a direct interpretation: (i) 75% of a change in the cost of raw materials per euro of sales is absorbed by the profit margin. That is, a 1 pp change (increase, resp. decrease) in the cost of raw materials per euro of sales results in -0.75 pp change (decrease, resp. increase) in the profit margin. A 1 pp change in the cost of raw materials per euro of sales leads to (ii) a 1.2 pp change in the labor share, (iii) a €675 change in productivity and (iv) a 0.57 pp change in the probability of default.

5.4.2 Segmentation of the dataset

"Incumbents" vs. "new comers". I test the robustness of the results by splitting the data into firms that were already present at the start of the period (in 2000, see columns (1)-(4)) and those that entered during the period (from 2001, see columns (5)-(8)). As shown in columns (1) to (8) of Table (5), the main results remain unchanged.

Breaking down the analysis by sector energy-intensity. I also break down the analysis into high energy-intensive and low energy-intensive sectors based on the "energy consumption to value added" ratio (see INSEE, 2023). In France, the three most energy-intensive sectors are metallurgy, the paper and board industry, and the chemical industry.

As shown in columns (9) to (12) of Table (5), the main results remain unchanged: the coefficients remain significant for both groups, high energy-intensive and low energy-intensive sectors. But the magnitude of the coefficients is stronger for the most energy-intensive sectors.

Challenging the Brent crude oil price. The main instrument used is the Brent crude oil price in euro. I challenge this instrument by relying on the Brent crude oil prices in dollars or on other markets, such as Diesel-Domestic heating oil, the Fuel Oil index in euro (traded in Singapore) or other fossil price indexes. They *all* provide similar results.

6 Conclusion

This paper shows the impact of oil price shocks on profit margin, labor share, productivity and credit risk at the firm level over two decades. It thus highlights the interplay between key policy issues: the distribution of value added by firms, climate and energy concerns, and financial stability.

This work also calls for further analysis: to what extent does the amplitude of the shock (such as the 2022 energy crisis) or uncertainty about commodity prices modify these results? What would be the impact in an economy with a more flexible labor market?

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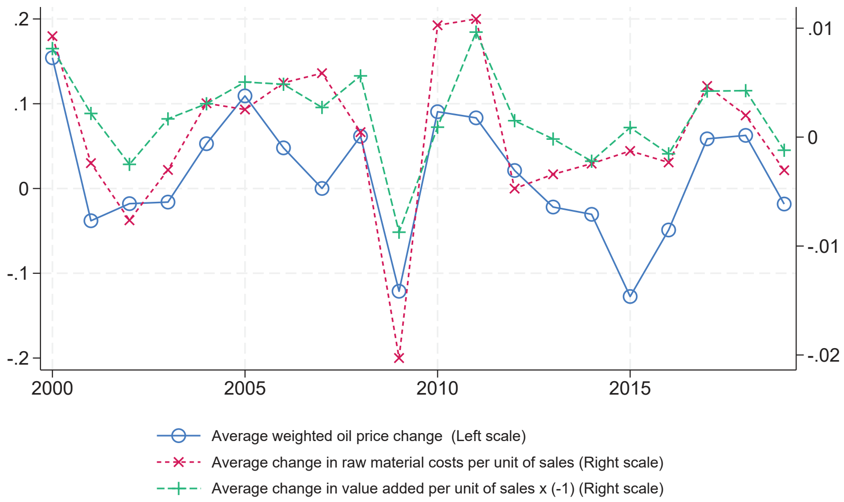
7 Figures

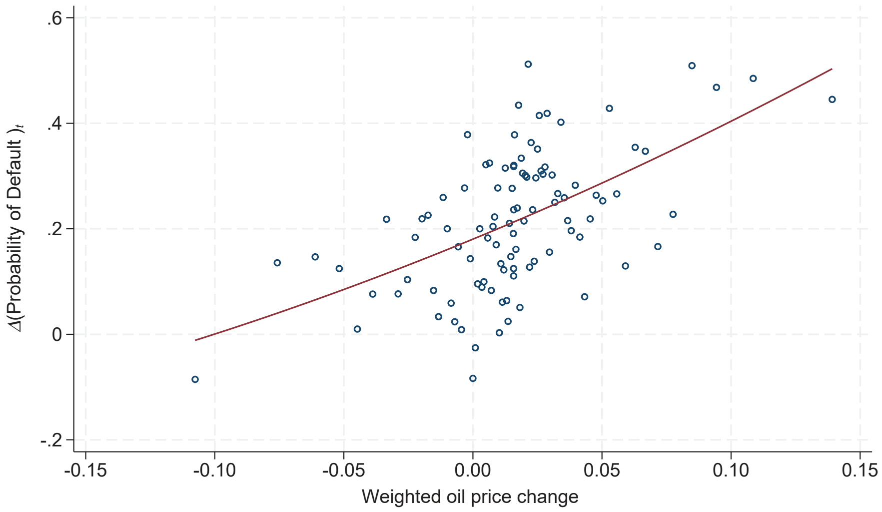
Figure 1: **The relationship between weighted oil price shocks and three financial or operational metrics**

(a) The relationship between weighted oil price shocks, raw material costs, and value added



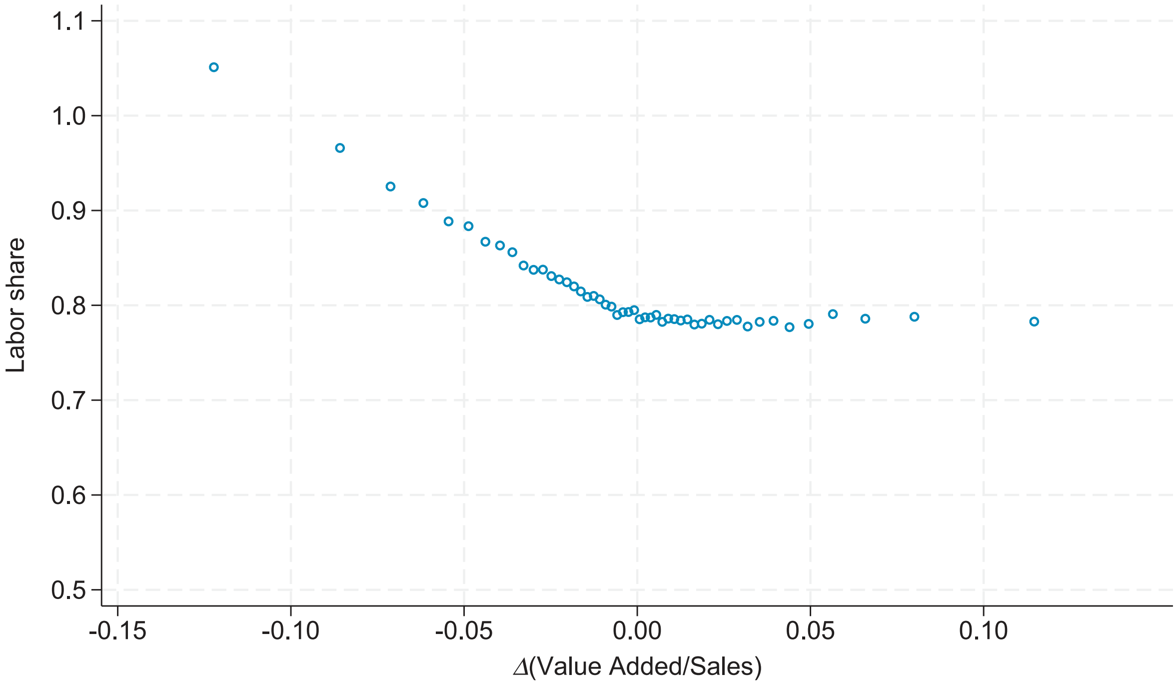
Note: Panel (a) plots (i) the average weighted change in the oil price (that is, the Bartik instrument defined in Equation (7)) over the period 2000-2019 with (ii) the average changes in firms' raw material costs per euro of sales, and (iii) the average changes in firms' value added per euro of sales. The changes in value added are presented with a "times-minus-one" transformation to be consistent with the (expected) negative relationship with the other variables.

(b) The relationship between weighted oil price shocks and credit risk



Note: Panel (b) shows the bin-scatter plot highlighting the positive relationship between the change in the probability of default (y-axis) and the weighted oil price shocks (that is, the Bartik instrument defined in Equation (7), x-axis), controlling for time-sector shocks.

Figure 2: **The relationship between the allocation of value added and the shocks to value added**

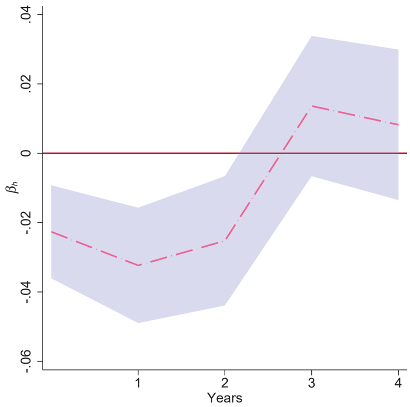


Note: This figure shows the bin-scatter plot of firms' labor share (defined as the wage bill scaled by value added) depending on the change in the firms' value added per euro of sales over two years and controlling for sector-year shocks.

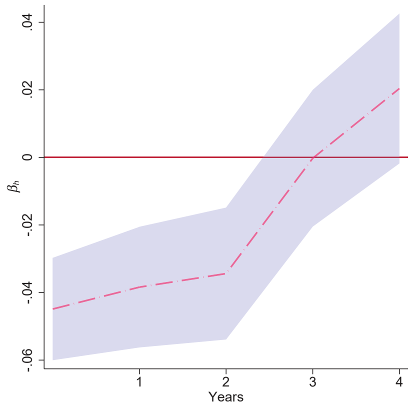
Figure 3: **The effect of oil price increase on financial ratios**

Note: Impulse responses of value added per euro of sales, profit margin, labor share, labor productivity and probability of default to (weighted) oil price shocks (increases), estimated based on Equation (10) on the period 2000-2019. Solid line: point estimate. Shaded area: 95% confidence bands.

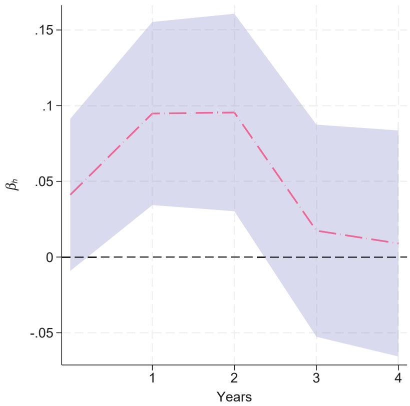
(a) Value added per euro of sales



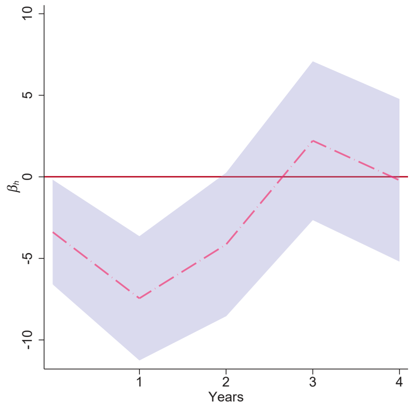
(b) Profit margin (=profit per euro of sales)



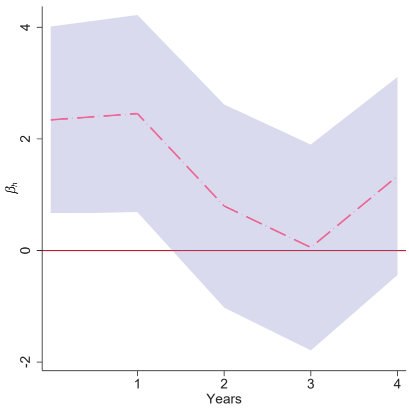
(c) Labor share



(d) Labor productivity



(e) Probability of default



8 Tables

Table 1: **Descriptive Statistics (all prices are in 2000 euros)**

Panel A: Main Descriptive Statistics — No. observations: 245,609 - No. Firms: 28,643

	p10	p50	Mean	p90	SD
Sales (M€)	1.0	3.5	13.8	30.4	37.2
Employees	9	28	75.3	172	160.9
Raw material costs / Sales	9.1%	30.7%	31.5%	54.3%	17.1%
Wage bill / Sales	13.3%	27.3%	28.5%	45.5%	12.4%
External staff and outsourcing costs/ Sales	0.3%	5.5%	8.3%	20.6%	8.7%
Value added / Sales	18.4%	34.3%	35.1%	52.8%	13.1%
Labor share (=Wage bill/VA)	56.6%	81.8%	81.7%	102.5%	21.6%
Gross average wage (K€)	25.3	34.5	36.0	48.5	9.5
Productivity (K€/head)	27.9	43.0	47.7	72.5	20.8
Profit margin	-0.8%	5.9%	6.5%	15.4%	7.0%
Change in raw material costs /Sales (p.p.)	-4.4	0.0	0.0	4.5	4.1
Change in value added /Sales (p.p.)	-5.1	-0.2	-0.2	4.7	4.2
Change in wage bill/Sales (p.p.)	-4.1	0.0	0.0	4.2	3.6
Change in profit margin (p.p.)	-5.5	-0.2	-0.3	4.9	4.6
Change in internal cash flow/Sales (p.p.)	-5.7	-0.2	-0.3	5.1	4.8
Change in dividend payment/Sales (p.p.)	-1.7	0.0	0.0	1.7	2.3
Lag(Cash holdings/Total assets)	0.2%	8.6%	13.9%	36.4%	14.8%
Lag(Equity/TA)	15.2%	42.2%	41.7%	69.0%	21.2%
Lag(Log(TA))	6.4	7.7	7.9	9.9	1.4
Weighted Brent price change	-6.05%	0.05%	1.58%	11.02%	7.78%
Probability of default	0.2%	1.6%	3.9%	12.1%	5.8%

Panel B: Average values by firm size

Firm size (=quartile of sales)	[p0-p25)	[p25-p50)	[p50-p75)	[p75-p100]
Sales (M€, in 2000 euros))	1.1	2.2	5.5	44.1
Employees	12.1	20.6	41.6	215.4
Raw material costs / Sales	25.1%	28.7%	32.9%	38.3%
Wage bill / Sales	36.2%	31.4%	26.4%	21.6%
External staff and outsourcing costs / Sales	7.0%	8.5%	9.3%	8.2%
Value added / Sales	42.7%	37.8%	33.0%	28.2%
Labor share (=Wage bill/ Value added)	85.1%	83.3%	80.8%	78.2%
Gross average wage (K€)	34.8	35.1	35.5	38.3
Productivity (K€/head)	42.8	45.1	47.7	54.3
Profit margin	6.5%	6.4%	6.5%	6.5%

Table 2: **Impact of shocks to firms' raw material costs on their value added and the value-added allocation**

	Raw Material Costs	Value Added		Sales	Value Added Components						Labor Share	Productivity	Ext. Staff, Outs.	Default Prob.
					Wage Bill			Profit						
Dependent	$\Delta(RM/SA)$	$\Delta(VA/SA)$	gr(VA)	gr(SA)	$\Delta(W/SA)$	gr(ω)	gr(N)	$\Delta(P/SA)$	$\Delta(CF/SA)$	$\Delta(D/SA)$	$\Delta(W/VA)$	$\Delta(VA/N)$	$\Delta(OW/SA)$	$\Delta(PD)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
							Panel A: Results pooling all types of oil shocks (positive vs. negative)							
Weighted oil price changes	0.039***	-0.021***	-0.061***	0.046***	0.008***	-0.007	-0.002	-0.029***	-0.026***	-0.003**	0.046***	-2.625***	-0.006***	2.232***
	(0.003)	(0.003)	(0.012)	(0.009)	(0.002)	(0.007)	(0.007)	(0.003)	(0.003)	(0.001)	(0.010)	(0.638)	(0.002)	(0.352)
Observations	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609
R-squared	0.119	0.104	0.181	0.244	0.148	0.084	0.191	0.128	0.109	0.070	0.129	0.123	0.094	0.199
No firms	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
							Panel B: Results with breakdown by type of oil shock (positive vs. negative)							
Weighted oil price increases	0.029***	-0.019***	-0.062***	0.053***	0.008**	0.005	0.002	-0.027***	-0.023***	-0.005*	0.052***	-3.423***	-0.007**	3.882***
	(0.004)	(0.004)	(0.019)	(0.014)	(0.004)	(0.012)	(0.012)	(0.005)	(0.005)	(0.002)	(0.017)	(1.074)	(0.003)	(0.676)
Weighted oil price decreases	0.052***	-0.023***	-0.061**	0.038**	0.009*	-0.023	-0.008	-0.032***	-0.030***	-0.002	0.038*	-1.572	-0.006	0.052
	(0.005)	(0.005)	(0.025)	(0.019)	(0.005)	(0.014)	(0.015)	(0.006)	(0.006)	(0.003)	(0.022)	(1.357)	(0.004)	(0.747)
Observations	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609
R-squared	0.119	0.104	0.181	0.244	0.148	0.084	0.191	0.128	0.109	0.070	0.129	0.123	0.094	0.199
No firms	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table shows the impact of oil shocks on firms through different key financial and operational metrics. The estimations are related to Equation (8). The explanatory variable is a Bartik (shift-share) instrument, where the shocks ("shift" part) are oil price shocks and the exposure to shocks ("share" part) are the firms' dependence on raw materials (first observed value in the dataset for each firm). The usual one-year lagged controls are implemented, namely: (i) the share of cash holdings in total assets to control for firms' liquidity level, (ii) leverage, to control for firms' indebtedness, and (iii) the logarithm of total assets to control for firms' size. All estimations are carried out with firm fixed effects to control for unobservable permanent characteristics of the firms, and industry(2 digits)-year fixed effects to control for industry-year shocks. The identification strategy is described in detail in Section 2. The top panel of the table shows the results using the Bartik instrument, regardless of whether the spot oil price rises or falls. The bottom panel runs exactly the same regressions, on the same observations, but distinguishing between oil price rises and falls in order to analyze any potential asymmetries depending on the type of the oil price shock (positive vs. negative). Standard errors, reported in parentheses, are clustered at firm level. ***, **, * indicate significance levels at 1%, 5% and 10%.

Table 3: **Impact of shocks to firms' raw material costs on their value added and the value-added allocation**

	Raw Material Costs	Value Added		Sales	Value Added Components						Labor Share	Productivity	Ext. Staff, Outs.	Default Prob.
					Wage Bill			Profit						
Dependent	$\Delta(RM/SA)$	$\Delta(VA/SA)$	gr(VA)	gr(SA)	$\Delta(W/SA)$	gr(ω)	gr(N)	$\Delta(P/SA)$	$\Delta(CF/SA)$	$\Delta(D/SA)$	$\Delta(W/VA)$	$\Delta(VA/N)$	$\Delta(OW/SA)$	$\Delta(PD)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Weighted oil increase×Lagged-Size[p0-p25)	0.017**	0.005	-0.013	-0.007	0.024***	0.047**	-0.035*	-0.019***	-0.018**	-0.001	0.012	-0.216	-0.018***	0.463
	(0.007)	(0.007)	(0.028)	(0.021)	(0.006)	(0.020)	(0.021)	(0.007)	(0.007)	(0.003)	(0.024)	(1.447)	(0.005)	(0.984)
Weighted oil increase×Lagged-Size[p25-p50)	0.011*	-0.003	-0.022	0.018	0.014***	0.015	0.001	-0.017***	-0.015**	-0.002	0.029	-1.524	-0.010**	2.540***
	(0.006)	(0.006)	(0.025)	(0.019)	(0.005)	(0.016)	(0.017)	(0.006)	(0.006)	(0.003)	(0.021)	(1.379)	(0.004)	(0.859)
Weighted oil increase×Lagged-Size[p50-p75)	0.025***	-0.021***	-0.061***	0.053***	0.008*	0.001	0.018	-0.029***	-0.025***	-0.004	0.063***	-3.937***	-0.007*	3.967***
	(0.005)	(0.005)	(0.023)	(0.017)	(0.004)	(0.014)	(0.015)	(0.006)	(0.006)	(0.003)	(0.020)	(1.287)	(0.004)	(0.808)
Weighted oil increase×Lagged-Size[p75-p100]	0.044***	-0.031***	-0.087***	0.086***	0.001	-0.005	0.002	-0.032***	-0.025***	-0.007***	0.063***	-4.541***	-0.003	5.129***
	(0.005)	(0.005)	(0.022)	(0.016)	(0.004)	(0.012)	(0.013)	(0.005)	(0.005)	(0.003)	(0.020)	(1.215)	(0.003)	(0.787)
Observations	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609	245,609
R-squared	0.120	0.107	0.186	0.262	0.160	0.084	0.191	0.130	0.111	0.070	0.131	0.125	0.095	0.201
No firms	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643	28643
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table is similar to Table (2) but the analysis is broken down by firm size. Firm size is defined through a yearly segmentation of the sales distribution in the spirit of Covas and Den Haan (2011) and Lé and Vinas (2024), based on quartiles. The size breakdown is as follows: [p0-p25),[p25-p50), [p50-p75), [p75-p90), [p90-p100]. The size used is the size before the shock in year t. Standard errors, reported in parentheses, are clustered at firm level. ***, **, * indicate significance levels at 1%, 5% and 10%.

Table 4: **Impact of changes in firms' raw material costs on key financial ratios**

	Profit Margin	Labor Share	Productivity	Default Prob.
Dependent	$\Delta(P/SA)$	$\Delta(W/VA)$	$\Delta(VA/N)$	$\Delta(PD)$
	(1)	(2)	(3)	(4)
Changes in Raw Material Costs	-0.750***	1.182***	-67.460***	57.352***
	(0.082)	(0.266)	(16.480)	(9.672)
Observations	245,609	245,609	245,609	245,609
No firms	28643	28643	28643	28643
Industry-year & Firm FE	Yes	Yes	Yes	Yes
Firm-level cluster	Yes	Yes	Yes	Yes
First-stage IV coef.	0.0389	0.0389	0.0389	0.0389
First-stage IV p-value	0.000	0.000	0.000	0.000
K-P Wald F-stat	228.2	228.2	228.2	228.2

This table is similar to Table (2) but 2SLS estimation are carried out using the Bartik instrument as an IV to instrument the dynamics of firms' raw material costs per euro of sales. Standard errors, reported in parentheses, are clustered at firm level. ***, **, * indicate significance levels at 1%, 5% and 10%.

Table 5: **Impact of shocks to firms' raw material costs on their value added and the value-added allocation**

	Profit Margin	Labor Share	Productivity	Default Prob.	Profit Margin	Labor Share	Productivity	Default Prob.	Profit Margin	Labor Share	Productivity	Default Prob.
Dependent	$\Delta(P/SA)$	$\Delta(W/VA)$	$\Delta(VA/N)$	$\Delta(PD)$	$\Delta(P/SA)$	$\Delta(W/VA)$	$\Delta(VA/N)$	$\Delta(PD)$	$\Delta(P/SA)$	$\Delta(W/VA)$	$\Delta(VA/N)$	$\Delta(PD)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Restriction on firms	Firms present in 2000				Firms entering the database after 2000				All firms			
Weighted oil price changes	-0.034***	0.050***	-2.935***	2.842***	-0.021***	0.038**	-2.203**	1.390**				
	(0.004)	(0.013)	(0.792)	(0.463)	(0.005)	(0.017)	(1.072)	(0.546)				
Weighted oil price changes × Top-3 energy-intens. sect.									-0.038***	0.097**	-4.917*	5.933***
									(0.010)	(0.038)	(2.527)	(1.251)
Weighted oil price changes × Not (Top-3 energy-intens. sect.)									-0.028***	0.041***	-2.398***	1.865***
									(0.003)	(0.011)	(0.655)	(0.367)
Observations	143,614	143,614	143,614	143,614	101,995	101,995	101,995	101,995	245,609	245,609	245,609	245,609
R-squared	0.117	0.116	0.109	0.184	0.150	0.151	0.144	0.227	0.128	0.129	0.123	0.199
No firms	13884	13884	13884	13884	14759	14759	14759	14759	28643	28643	28643	28643
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table is similar to Table (2) but the sample is (i) restricted to firms that were already present in 2000 (columns (1) to (4)), (ii) restricted to those that entered the database after 2000 (columns (4) to (8)). (iii) The analysis is broken down between energy-intensive and non-energy-intensive sectors. Standard errors, reported in parentheses, are clustered at firm level. ***, **, * indicate significance levels at 1%, 5% and 10%.