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How the three Ds affect firm pricing, markups and productivity

The impact of climate transition policies on Belgian firms – what can we learn from a survey?

by Raïsa Basselier, Nabil Bouamara, Geert Langenus,
Gert Peersman and Peter Reusens

National Bank OF BELGIUM
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Editorial

On October 3-4, 2024 the National Bank of Belgium hosted a Conference on *"Deglobalisation, decarbonisation and digitalisation: How the three Ds affect firm pricing, markups and productivity".*

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The impact of climate transition policies on Belgian firms

What can we learn from a survey?

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Abstract

This paper examines the impact of current and future climate transition policies on Belgian firms as they approach the 2030 milestone set by the European Green Deal. Using data from an online survey conducted with members of key Belgian employers' federations, we assess the effects on firms' costs, pricing, demand, and investment decisions. The climate transition is largely perceived as a classical negative supply shock, resulting in higher prices, squeezed profit margins, and reduced activity. While the impact on Belgian investment remains ambiguous, part of production capacity – particularly in manufacturing – is expected to shift outside the EU. A scenario analysis and an information experiment embedded within the survey show that an increase in the carbon price beyond firms' current expectations could exacerbate these adverse effects. Survey participants also express widespread scepticism about the EU's ability to meet its 'Fit for 55' targets, citing high costs, reduced profitability, unclear policy guidance and administrative burdens as major impediments.

Keywords: Business surveys; Firms; Climate transition; Randomized information provision.

JEL codes: C83; C93; D22; D83; D84; Q58.

This paper was prepared for the 2024 Colloquium on "Deglobalisation, Decarbonisation and Digitalisation: How the three Ds affect firm pricing, markups and productivity" at the National Bank of Belgium.

1. Introduction

> "Europe must confront some fundamental choices about how to pursue its decarbonisation path while preserving the competitive position of its industry."
>
> (The future of European competitiveness, Mario Draghi, September 2024)

With a view to combating the adverse impact of climate change, the European Union has committed to becoming "climate-neutral" by 2050. Greenhouse gas emissions should be cut to a net-zero level (i.e., remaining emissions should be fully offset). As an intermediate step, the European Green Deal mandates that net greenhouse gas emissions should be reduced by at least 55% by 2030, compared to 1990 levels.[1] A key pillar of the EU's climate transition strategy is the Emissions Trading System (EU ETS), a market-based policy instrument that prices carbon emissions to incentivize pollution reduction and promote investments in clean technologies. The EU ETS currently covers primarily Europe's power sector and energy-intensive industries, but the coverage of climate regulations will expand in the future.

Reaching the aforementioned emission targets will require more stringent climate regulations and, in particular, an increasing carbon price. As such, the climate agenda is likely to have a significant effect on households (via for instance renovation obligations for dwellings) but also on firms The recent Draghi (2024) report has highlighted that the relatively more ambitious EU policies may further erode the cost competitiveness of European firms. This raises a significant challenge for a small open economy like Belgium. Hence, it is important to gauge how Belgian firms – from large industrial players to SMEs – perceive and plan for climate transition policies. This could help to design and finetune policy packages that support a smooth and equitable climate transition while safeguarding economic growth.

Against this backdrop, this article analyses the impact of current and planned climate transition policies on Belgian firms as they prepare for 2030 milestone set by the European Green Deal. A comprehensive online survey was conducted in May 2024 by the National Bank of Belgium in collaboration with key employer federations in order to collect data on how climate regulations are affecting and are expected to affect firms' practices. While there were a few more general questions, the survey specifically focused on the impact on input costs, the pass-through to sales prices, the evolution of demand, as well as the effects on companies' investment decisions. The survey also contained a scenario analysis (anchored to a more extreme level of the carbon price), as well as a randomised information experiment, which allows to explore the causal relationships.

Previous research on the impacts of climate policies typically relies on historical data – such as emission records, case studies, balance sheets, trade data, and patent applications – limiting the ability to predict the effects of future policies (see e.g., Martin, Muûls, and Wagner (2016) for a comprehensive ex-post evaluation of the EU Emissions Trading System's impact on firms). While retrospective studies provide valuable insights, they may overlook the unobservable factors that influence firms' strategic responses to evolving regulations. Surveys can typically add a forward-looking dimension to the analysis that cannot be addressed with administrative data, that, by definition, describe the past. Yet only a handful have been conducted to date, as seen in Table 1.

Nonetheless, it should be acknowledged at the outset that all impacts that this paper aims to measure are based on self-reported data. Hence, they should be interpreted carefully as firms may not have a perfect grasp of the actual impacts, in particular for the future. In addition, participation to the survey was on a voluntary basis and there is a risk that firms that care more about or are already affected more by climate transition policies, were more motivated to participate and, hence, are over-represented in the sample. The larger-than-proportional share of manufacturing firms in the sample is a clear indication in this respect. Finally, respondents may consciously exaggerate certain impacts, as they seek to affect future government policies in their favour. These caveats are quite typical for the economic survey literature and cannot be fully neutralised via checks and balances in the list of questions. Hence, in line with the best practices in the literature, the

[1] The European Green Deal - European Commission (europa.eu)

survey's findings are mostly reported based on an interpretation of general patterns, rather than specific quantitative results from individual questions.

Table 1 : Overview of previous business surveys on the impact of the climate change and the transition

Entity	*Which survey?*	*Focus of survey*	*Geography*	*Sample size*
ECB	Part of ECB Economic Bulletin (4/2022)	Impact of climate change and related measures and policies on activity and prices	Euro Area	90
San Francisco Fed	2021 ad-hoc business survey	Climate-related risks (revenues, costs, investments, risk mitigation)	Western US States	100
Dallas Fed	Part of the 2023 Monthly Texas Manufacturing outlook survey	Traditional business survey supplemented with topical questions on the impact of the summer 2023 heat wave	Southern US States	80
EIB	Part of 2021 Investment Survey	Physical and transition risk perceptions, energy costs, and investments	European Union	13 500
LSE/Grantham	2020 Climate Risk Business Survey	Current and future climate risk/opportunities, financial impact, adaptation, preparedness, reporting, and engagement	United Kingdom	225
Ernst & Young	2019 Climate Risk Disclosure Barometer	Disclosures on governance, strategy, risk, and measures	Belgium	56
KPMG	Survey of Sustainability Reporting	Reporting of Sustainable Development Goals, climate risk and decarbonisation (in reports and on websites)	52 countries	5 200 (100 in Belgium)
PWC	EU Green Deal Survey	Familiarly with and preparedness to EU Green Deal	13 countries in EU	300 (20 in Belgium)
Chapter Zero Brussels, Roland Berger, and Potloc	Climate Survey	Climate risk action in Boards	Belgium and Luxemburg	154

This study contributes to the growing literature on environmental regulations and their impact on firm operations. Previous research has explored various dimensions of regulations' influence on firms, including their impact on emission efficiency and/or overall economic performance (Colmer et al., 2024; De Jonghe et al., 2020; Dechezleprêtre, Nachtigall, and Venmans, 2023), technological innovation (Calel and Dechezleprêtre, 2016; Calel, 2020), outward Foreign Direct Investment (Borghesi et al., 2020), competitiveness (Dechezleprêtre and Sato, 2017), carbon leakage (Martin et al., 2014), managerial and financial barriers (De Haas et al., 2023), to name but a few examples. Our study adds to this body of literature by providing a snapshot of firms are preparing for the 2030 milestone, focusing on firms' practices, priorities, hurdles, and expectations regarding firm-level operational variables.

The remainder of the article is organised as follows. Section 2 describes the set-up of the business survey in greater detail, as well as the key characteristics of the respondents, and presents a first batch of results. Key findings regarding the reported impact of climate regulations on firm operations are then presented in Section 3. The following section aims to sharpen the causal relationships in the context of the aforementioned scenario analysis and the randomised information experiment. Section 5 restates the main conclusions of the paper.

2. Set-up of the survey, sample characteristics and first results

Our survey was specifically tailored to assess the impact of the 2030 milestone. In collaboration with Belgium's key employer federations (BECI, NSZ, UNIZO, VBO, and VOKA), we reached a wide range of firms across various industries and sizes. The online survey was distributed by email to individual members of these federations, which are mostly executive-level employees with a broad, strategic perspectives within their companies. The survey was designed to take approximately 15 minutes to complete and required no prior preparation.

The survey was divided into two parts. The first part collects firm characteristics and assessed the past and anticipated impact of the climate transition on their operations. The second part incorporated an information experiment and scenario analysis. The results will be described in more detail in the following sections.

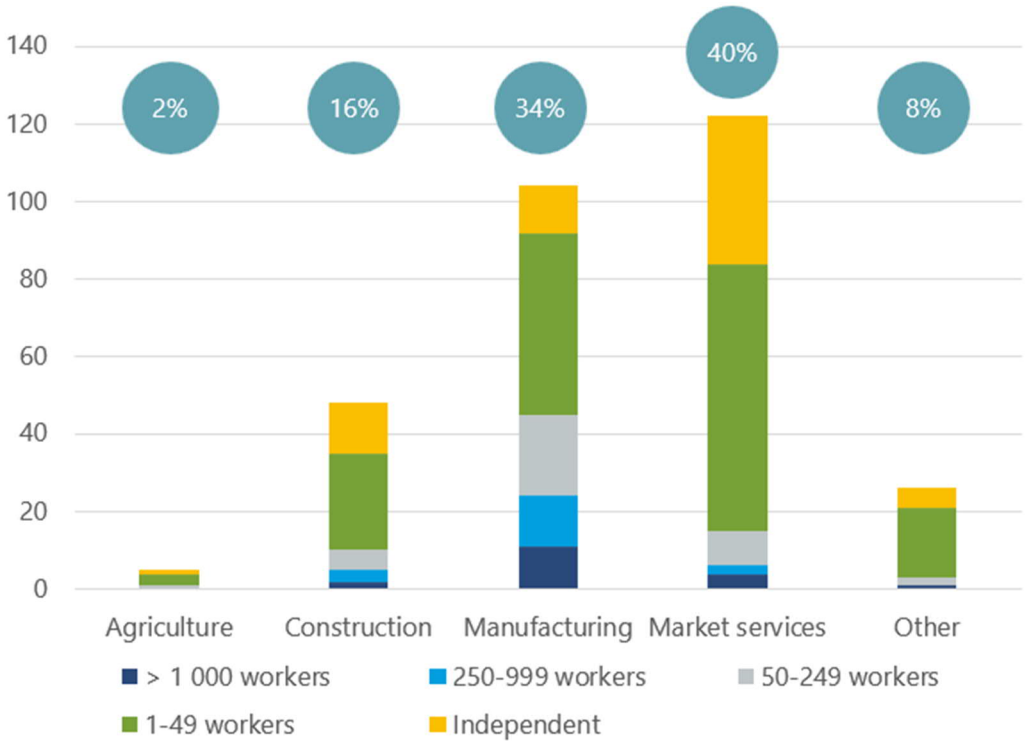
2.1. Sample size and firm characteristics

As the survey was distributed to all members of the participating organisations, most firms that received it are not yet directly impacted by climate transition obligations. This likely contributed to the relatively low engagement within the survey. Out of all firms contacted, around 800 started the survey, possibly indicating limited interest in climate-related issues or a lack of knowledge. Moreover, participation dropped further as the survey progressed, with only around 300 firms completing the entire survey. This drop-out in participation could suggest a waning interest or perhaps survey fatigue among respondents. Drop-out was slightly less significant among "ETS-firms": of the 46 firms that started the survey, 30 have completed the survey. Firms operating under the EU ETS, which are typically associated with higher emissions, are particularly vulnerable to increased costs arising from stricter climate regulations.

Figure 1 provides an overview of the survey respondents categorised across industry and firm size. Compared to the broader economy's sectoral distribution of employment and value added, our survey attracted a higher proportion of firms from the construction and manufacturing sector, while service-oriented firms are underrepresented.[2] This aligns with our initial assumption that respondents would predominantly be firms already affected by climate transition policies, which are less prevalent in the service sector. It should therefore be kept in mind that our results may predominantly reflect the perspectives of firms more actively engaged in or affected by current decarbonisation efforts and should not be generalised to the entire Belgian business community.

[2] Please also note that our dropdown selection menu in the question on sector did not include any non-market services, such as hospitals or schools. Those respondents would have to select "Other".

Figure 1: Number of respondents by industry and firm size



Source: NBB ad-hoc survey on climate transition.

Over 10% of responding firms could be considered large enterprises, with at least 250 workers. Over two-thirds of respondents are small- or medium-sized businesses (employing between 1 and 250 workers). Some 20% of respondents in our sample are independent workers.

Less than half of respondents have production sites in Belgium only and 16% has several production sites across Belgium and other countries. A small minority only has production sites outside of Belgium and about one-third of respondents (mostly those within the services industry) does not have any. Respondents are mostly oriented towards Belgian consumers (or other firms in case of B2B-sales): 78% of them sees Belgium as their main sales market; 18% is mostly targeted towards other European countries, while for 3% of respondents the main sales market is even outside the EU. When it comes to international competitors, replies are a bit more dispersed: 60% of respondents sees its main competitors within Belgium; 16% of respondents mainly face competition from other EU-countries and 2% from outside the EU. For one-quarter of respondents, competition is a mix of opponents at home and abroad.

2.2. A relatively small sample of ETS-firms

As part of this survey, businesses were asked whether any of their activities are covered by the EU Emissions Trading System (EU ETS) and whether they report on climate goals. A total of 30 ETS-firms completed the survey, representing nearly 10% of our full sample.[3] As anticipated, most of these firms are within the manufacturing sector, with small representation in transport (4), construction (3), and agriculture (1). Notably, half of the ETS firms are large companies, each employing at least 250 people, and half also reported having production sites outside of Europe.

[3] These 30 firms could also be considered to represent a substantial share of the roughly 300 ETS-installations that were active in Belgium in 2019 according to klimaat.be.

Given that most respondents were not expected to be covered by the EU ETS – and some might not be familiar with the term – the survey also inquired whether firms considered themselves energy-intensive. In response, 27% of the sample identified their business as such, with half of manufacturing firms labelling themselves as energy-intensive.

When asked if climate transition is an item on firms' strategic agenda through 2030, slightly less than 10% of all respondents consider it to be the most important agenda item. Respectively 40% and 35% consider it to be important or slightly important, while almost one out of five respondents believe it has no place on the strategic agenda. Looking at the sectoral differences, it is mostly firms in agriculture, manufacturing and construction who rank climate transition high (i.e., most important or important) on the strategic agenda. Climate transition is also ranked higher on the agenda among larger firms, energy-intensive firms and ETS-firms.

Publicly reporting about climate targets, (the reduction of) emissions and progress towards these targets is not strongly established among Belgian firms. Only 14% of the overall sample already publicly reports on its climate targets, while 20% expects to be reporting about these matters by 2030. That leaves two-thirds of the sample that does not report on climate targets and has no plans to do so in the future. Similarly to the importance attached to climate transition as part of the strategic agenda, the percentage of firms reporting on the issue is larger among subsamples of larger firms, energy-intensive firms, and ETS-firms.

2.3. Generally uninformed about current carbon prices

To assess respondents' knowledge of the EU Emissions Trading System, we asked them to estimate the current price of emission allowances traded within the System, specifically the cost per ton of carbon dioxide produced. Respondents were given a range of options, from less than € 25 per ton to more than € 275 per ton, including an "I do not know" option.

We considered responses within the "€ 25-75 per ton CO_2" or "€ 75-125 per ton CO_2" to be sufficiently accurate, as the carbon price climbed to € 100 in 2023 and varied between € 60 and € 80 per ton CO_2 just prior to the sending of the survey. About one-third of respondents who completed the survey selected a correct price range, supporting our initial hypothesis that many firms lack awareness of the ETS or its specifics. In contrast, among the 30 ETS firms that completed the survey, 87% accurately identified the current CO_2 price.[4]

This question was critical for gauging firms' awareness and understanding of carbon prices. Since many firms may not actively monitor carbon price trends, evaluating their current knowledge is crucial for effective policy implementation. This insight helps identify where additional outreach or educational efforts may be necessary and useful.

2.4. Sceptical about 'Fit for 55'

The 'Fit for 55' package is a cornerstone of the EU's strategy to achieve climate neutrality, aiming to reduce net greenhouse gas emissions by at least 55% by 2030, relative to 1990 levels. To assess firms' perceptions of this ambitious target, we asked them:

How likely do you think it is that the EU will achieve the 'Fit for 55' target of reducing total greenhouse gas emissions by 55% compared to 1990 by 2030?

This question was placed at the end of the survey, allowing respondents to consider their overall views on the EU's climate strategy after reflecting on other topics. Respondents could choose from a range of options, from "Very unlikely" to "Very likely'". Despite widespread public support for these targets in Belgium, as highlighted in a recent survey by *Klimaat.be*[5] (The Belgian federal website for reliable information about climate change), firms remain highly sceptical about the

[4] In order not to bias further replies and to allow all participants to form their future expectations based on the correct current value, a graph was shown with the recent developments of the CO_2-price, along with some basic information on the ETS.

[5] https://klimaat.be/in-belgie/communicatie-en-educatie/klimaatenquete

feasibility of reaching these goals by 2030. Specifically, nearly three-quarters of the full sample, and 70% of ETS-firms, believe it is (very) unlikely that the 'Fit-for-55' target will be met. Strikingly, the belief in the ability to comply to the 'Fit for 55' targets by 2030 is much higher (at least 50%) among a small sub-sample of 23 respondents who were also quite optimistic about the relative energy price (i.e., those expecting the relative energy price in Belgium to be lower or comparable to the rest of the world by 2030).

3. A first take on the impact of climate transition on business operations of Belgian firms

Moving beyond the questions regarding firm characteristics, the online survey first provided respondents with the following information:

In this survey, we examine the impact of the transition to a climate-neutral European Union. This transition requires an overall reduction of greenhouse gas emissions, which is supported by various policy instruments, such as legal restrictions and pricing mechanisms. In addition, we are also interested in the extent to which changing consumer preferences, driven by a growing awareness of climate issues, affect your business.

3.1. Impact of the climate transition regulations on Belgian firms over the past three years

The survey first aimed to capture the recent impact of climate transition policies:

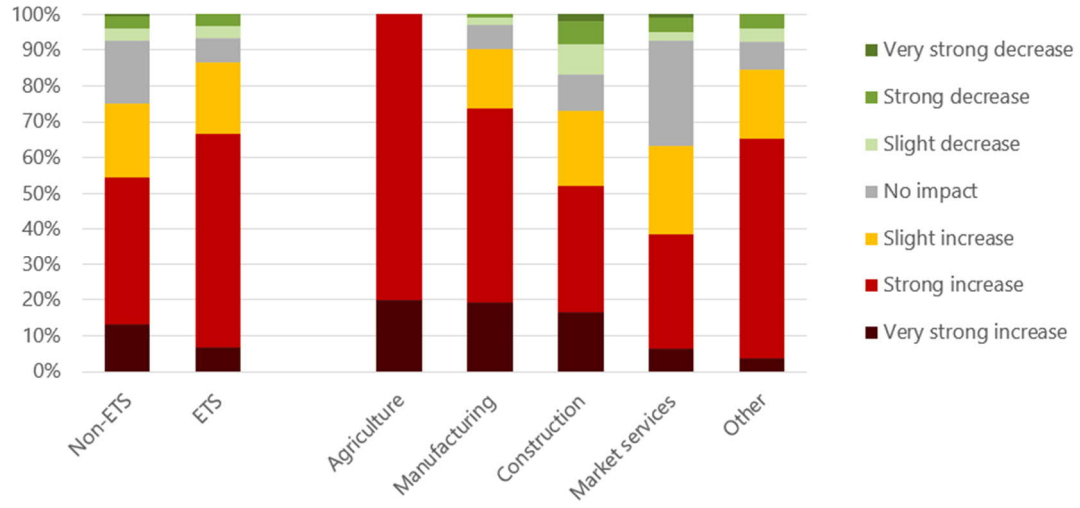
Please assess the impact of the climate transition on your business, with a specific focus on the past three years. We ask that you assess this impact independently of other recent economic events, such as the energy crisis.

Respondents were asked to assess the impact of climate transition over the past three years on different aspects of their operations, including input costs, sales prices, demand for products or services, and investments in Belgium, in Europe, and outside Europe. The responses were qualitative, with the possible impacts rated on a scale from a very strong decrease to a very strong increase. Recognising that the recent energy crisis likely influenced operations during this period, respondents were explicitly instructed to exclude its effects and focus solely on the impact of the climate transition. However, it is still possible that some responses partially reflect non-climate-related factors, such as the energy crisis fluctuations during the crisis.

Three-quarters of the respondents indicated that climate transition has led to input cost increases over the past three years. Looking at the industry decomposition, climate-related input cost increases were more prevalent in agriculture (100%, but this is a small sample) and manufacturing (90%). 70% of manufacturing firms in our sample even saw strong input cost increases due to the impact of climate transition. Only a small minority of firms reported no or a downward impact on input costs (mostly in market services).

The difference between ETS and non-ETS firms is rather negligible: among responding ETS-firms, the impact of climate transition on input costs is only slightly more tilted towards '(very strong) increase' than for respondents outside the ETS.

Figure 2 – past impact of climate transition on input costs[6] (in % of respondents)



Source: NBB ad-hoc survey on climate transition.

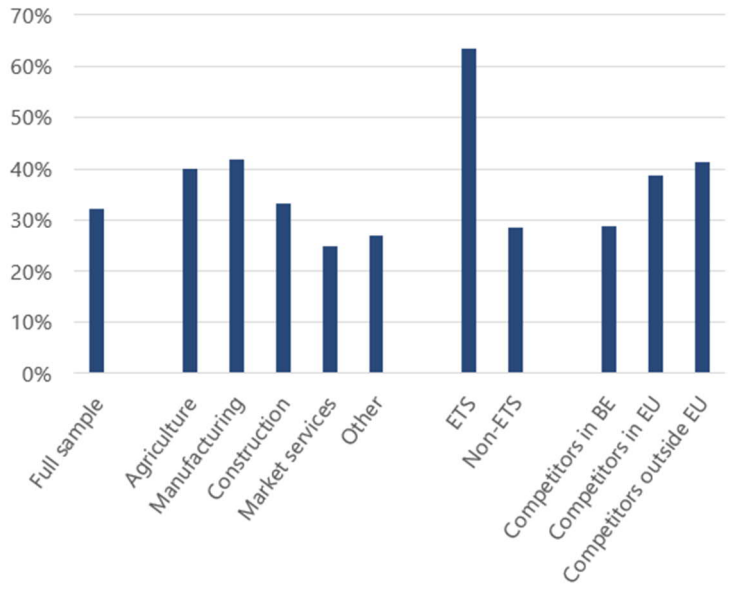
The impact on sales prices is broadly similar: a similar share of respondents (79% of the entire sample) indicates that the climate transition had an upward impact over the past three years. However, the replies were a bit less extreme than for input costs, with most respondents indicating a "slight" price increase. 42% of the firms in the sample had a (very) strong increase in their sales price, while 56% experienced a (very) strong hike in input costs. This may suggest that input cost pressures related to climate transition were mostly – yet incompletely – passed on to selling prices.

To evaluate this hypothesis, the qualitative replies were translated into scores: each of the potential qualitative responses for input costs and sales prices were scored, ranging from +3 for a very strong increase to -3 for a very strong decrease. We then calculate a simple 'pass-through proxy' by subtracting the score for the input costs from the one for the selling price for each of the respondents, with a zero-value pointing to a full pass-through, while a negative [positive] value may suggest that climate transition has eroded [boosted] mark-ups. Overall, the average pass-through proxy is slightly negative (yet close to zero). The median value is 0. For 32% of respondents, the proxy has a negative value, whereas for 19% of respondents, the proxy has a positive value (mostly +1).

The share of negative proxies varies across sectors (41% of manufacturing firms against 25% of services firms). The share of negative proxies tends to be higher among firms that (also) have competition outside Belgium. In the small sub-sample of ETS-firms, 60% of respondents have a negative pass-through proxy. If we only look at the subsample of respondents who indicated to have witnessed an input cost increase due to climate transition, over 40% has a negative proxy and only 10% has a positive proxy.

[6] Input costs were defined in the survey as costs of energy, intermediate products, raw materials, transport and packaging, excluding labour costs.

Figure 3 - Share of respondents with negative pass-through proxy (in % of respondents)



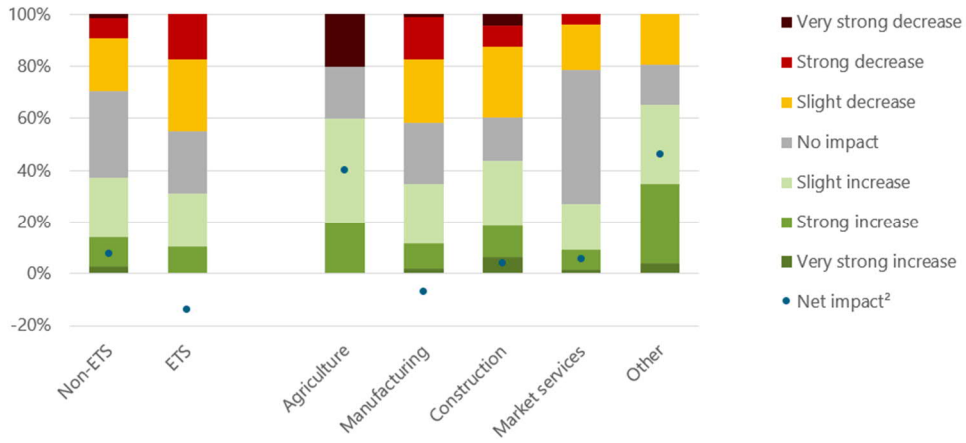
Source: NBB ad-hoc survey on climate transition and own calculations.

The effects on demand and investment in Belgium over the past three years are more mixed, but with a slightly larger share of all respondents stating a positive impact on demand and past investment in Belgium than those having perceived a decrease of demand or investment.[7] Mixed replies to the investment question may relate to the fact that some respondents have pursued investments in carbon efficiency or clean energy technologies, while other may have scaled back on expansion investment, possibly in response to weaker demand (prospects).

Among the small sample of ETS-firms, a small majority of firms experienced a net decrease in demand and investment in Belgium related to climate transition. Even with only a partial pass-through of costs to sales prices, the manufacturing industry also expresses to have seen a net decline in demand due to climate transition. Hence, the manufacturing industry appears to have suffered from a 'double whammy' related to climate transition: it was relatively more difficult for these firms to pass through higher costs to sales prices, resulting in a margin squeeze, and they witnessed a decline in demand. This weighs down their (financial) strength and is especially worrisome considering that additional (investment) efforts will be required from these industrial firms in the near future in order to meet stricter emission reduction targets (see also Bijnens et al., 2024).

[7] The same conclusion holds when we attribute more weight to more extreme responses, according to the Likert-scale (i.e. +3 for a very strong increase and -1 for a slight decrease).

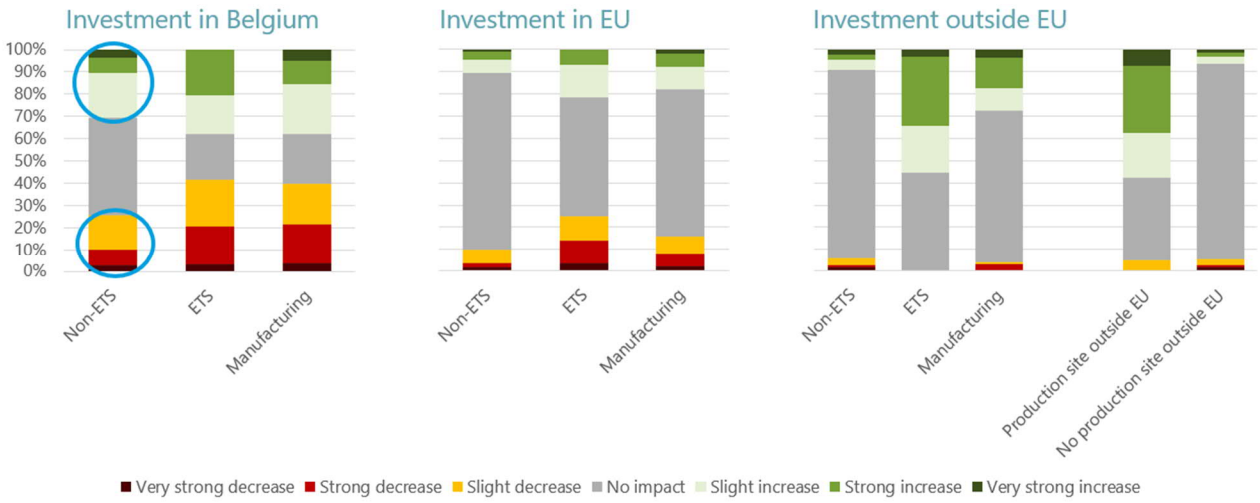
Figure 4 – Past impact of climate transition on demand (in % of respondents)



Source: NBB ad-hoc survey on climate transition.

Investment outside the EU has in net terms been largely positively affected by climate transition. Among the full sample, 14% of respondents has increased investment outside the EU in the past three years due to climate transition (whereas only 5% has decreased their investment there). Percentages of respondents having boosted investment outside the EU are higher among the subsamples of very large firms (63%), among ETS-firms (55%) and among firms that also have a production site outside the EU (58%).

Figure 5 – Past impact of climate transition on investments (in % of respondents)



Source: NBB ad-hoc survey on climate transition.

There are risks of relocation of investment, which mainly seems to occur in favour of investment outside the EU. Of the 82 firms that have reduced investment in Belgium in the past three years due to climate transition, in our sample, 7 % increased investment within the EU, while 26 % of them (or 21 firms) increased their investment outside the EU. Those firms were mostly large and energy-intensive manufacturing firms. Their average pricing power proxy equals -1.3, which is a lot more negative than that of the overall sample average (close to zero). While other factors may be at play as well, the inability to fully pass on climate-related cost increases to sales prices may have partly inspired their decision to move investment outside the EU.

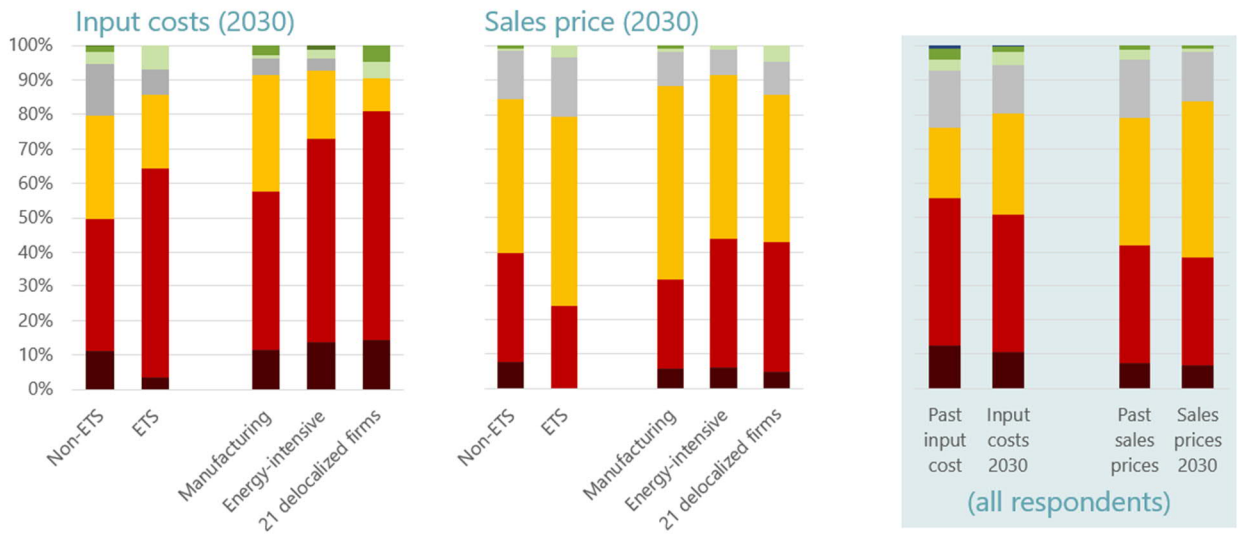
3.2. Expected impact of climate transition by 2030

Next, the survey looked at firms' expectations for the future. Respondents were first asked to provide an estimate for the CO_2-price within the ETS by 2030. The average expected carbon price amounted to about €130 with individual estimates ranging between more extreme values of €5 and €600. Respondents were also asked to provide an estimate for the expected percentage change in the price of natural gas and of electricity, compared to the current market price. Survey respondents by and large expected price increases: the average estimates were close to a 40% rise for electricity as well as for natural gas prices. Firms were also asked about how they expect energy prices in Belgium to relate to energy prices in the rest of the world (ranging from much lower to much higher than in the rest of the world). Almost all respondents (90% of the overall sample) replied that energy prices will be relatively higher in Belgium in 2030. The share is even larger among firms in agriculture (100% of a small sample) and manufacturing (95%).

Against this background, respondents were then asked to fill in the same table as before, listing the impact on input costs, sales prices, demand for products or services, investments in Belgium, investments within Europe and investments outside Europe. However, this time, they were asked to assess the expected impact of climate transition on each of these aspects by 2030.

As regards costs and prices, results are quite similar to the replies about the past impact, as shown in the right-hand side of Figure 6. About half of respondents provided the exact same response to the forward-looking question as to the question regarding the past impact.[8] All in all, 80% of the overall sample expects climate transition to lead to a further increase in input costs. That share is slightly higher for the sub-samples of ETS-firms (86%), manufacturing firms (91%) and, especially, energy-intensive firms (93%). 84% of the total sample also sees climate transition leading to an increase in sales prices. Results are quite comparable to the ECB-survey conducted in 2022 (Kuik et al., 2022) among 90 large multinational firms, where 90% of respondents agreed that climate change and their firm's adaptation to it would make inputs more expensive. Almost as many agreed that this would increase sales prices.

Figure 6 – expected impact of climate transition on input costs and sales prices by 2030 (in % of respondents)



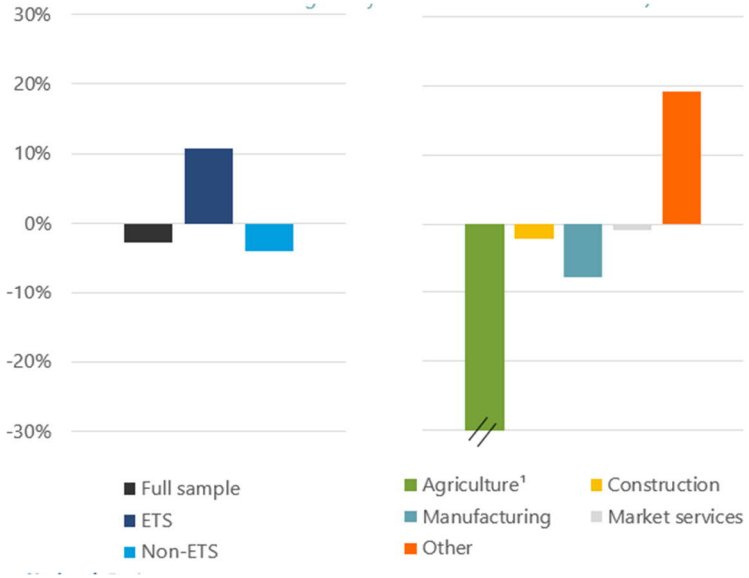
Source: NBB ad-hoc survey on climate transition.

8 The correlation between the past and forward-looking question on input costs equals 60%, while the correlation between the past and forward-looking question on sales prices equals 54%.

Turning to the expected impact on demand and investment in Belgium, replies are mixed again. Similarly, as for the question on the past impact on demand, the expected net impact (deducting the percentage of negative replies from the percentage of positive replies) on demand by 2030 is close to zero and slightly positive for the entire sample of respondents. Again, the expected net impact on demand is negative for the subsample of ETS-firms and manufacturing firms.

Within the full sample, the expected net impact on investment in Belgium is close to zero yet slightly negative. However, replies among sectors are mixed, with the agricultural sector (very small sample) and manufacturing industry being mostly intent on decreasing investment, while firms that fall within "other" industries are most positive in net terms. The fact that the net investment intent for the manufacturing industry is negative is noteworthy, because for this sector in particular, additional investments in improved carbon efficiency will be necessary. This may imply that industrial firms will be investing less in expansion, which could hamper potential growth, especially considering how the manufacturing industry is the most productive industry. For ETS-firms, the expected net impact is positive for investment in Belgium over the next three years, likely pointing at increased decarbonisation and energy efficiency investments.

Figure 7 – Net investment intent in Belgium by 2030
(difference between share of firms seeing an increase and share of firms seeing a decrease in investment in Belgium by 2030 due to climate transition, in percentage points)



Source: NBB ad-hoc survey on climate transition.
[1] The net investment intent in agriculture goes to -60% (of a very small sample of respondents).

Within the full sample of firms, there is a clear overall trend to increase investment *outside the EU* (25% of all firms), but it is stronger for ETS-firms (64% of them plan to increase while none of them plan to decrease investment outside the EU). Of 105 firms that are expecting to invest less in Belgium due to climate transition, there are 13 respondents thinking about increasing investment within the EU and 44 are intent on increasing investment outside the EU.

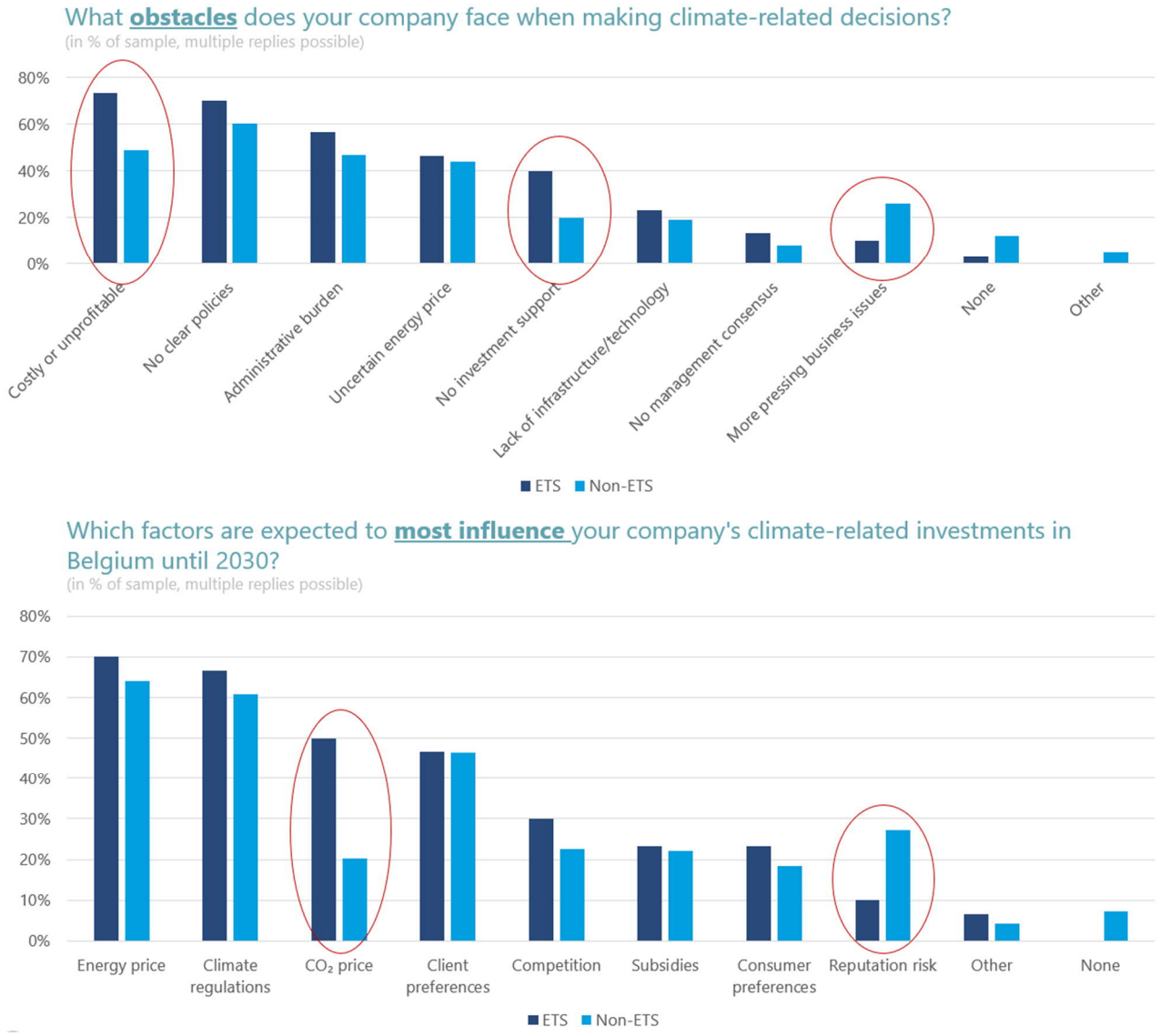
3.3. Reported obstacles to climate transition

The survey also inquired about the obstacles firms face in the climate transition. Respondents could specify which obstacles they encounter when making climate-related decisions. They were also asked about the factors most likely to affect climate-related firm investments by 2030. Obstacles when making climate-related decisions are found to be quite numerous (see top of Figure 8). Among the overall sample, lack of clear policies was selected most often to be an important hurdle (by 61% of respondents), followed by concerns about costs or profit (51%). The latter was a much more important obstacle for ETS-firms in particular, who also flagged a disadvantage in investment support compared to other countries

more often than the general sample. On the other hand, a larger share of non-ETS firms is currently dealing with other more pressing business issues than climate.

When it comes to factors expected to influence climate-related investment in Belgium, energy and carbon prices, climate regulations, and requirements from clients or investors are selected most. Unsurprisingly, CO_2-price matters more to ETS-firms, who foresee less reputation risk.

*Figure 8 – **Obstacles currently faced** when making climate-related decisions and **drivers expected to influence** climate-related investment in Belgium by 2030?*
(in % of respondents, multiple replies possible)



Source: NBB ad-hoc survey on climate transition.

4. Causal effects of carbon price increases on firm operations

Firms facing the complexities of the 2030 milestone must make many decisions under uncertainty. Surveys are a powerful tool for understanding how they form expectations and how factors like carbon pricing and the perceived stringency of climate policies shape these expectations. Although the previous descriptive analysis offers useful insights, it may not be sufficient to establish a causal link between stricter climate policies and changes in firm operations.

Establishing this causal link is inherently difficult due to the many factors that drive business decisions (see e.g., Martin et al., 2016). For example, firms may invest or adjust prices for reasons unrelated to climate policies, such as business cycles of industry-specific trends. This complexity remains even when the survey explicitly instructed them to focus solely on the impact of the climate transition.

To overcome this challenge, randomised information provision experiments and scenario analysis can simulate the potential impact of a substantial hypothetical carbon price increase. These approaches allow us to generate causal evidence and offer more concrete insights into how firms might react to such a policy shift.

4.1. Design and set-up

Carbon price shocks serve as our key policy stringency indicator, based the assumption that all policies aimed at meeting the EU's climate objectives are proportionally reflected in projected carbon prices. To test the causal effect of carbon price shocks on firm operations, we embedded a randomised information experiment within the survey to assess how respondents' expectations and planned actions change when they receive additional information about the expected path of carbon prices.

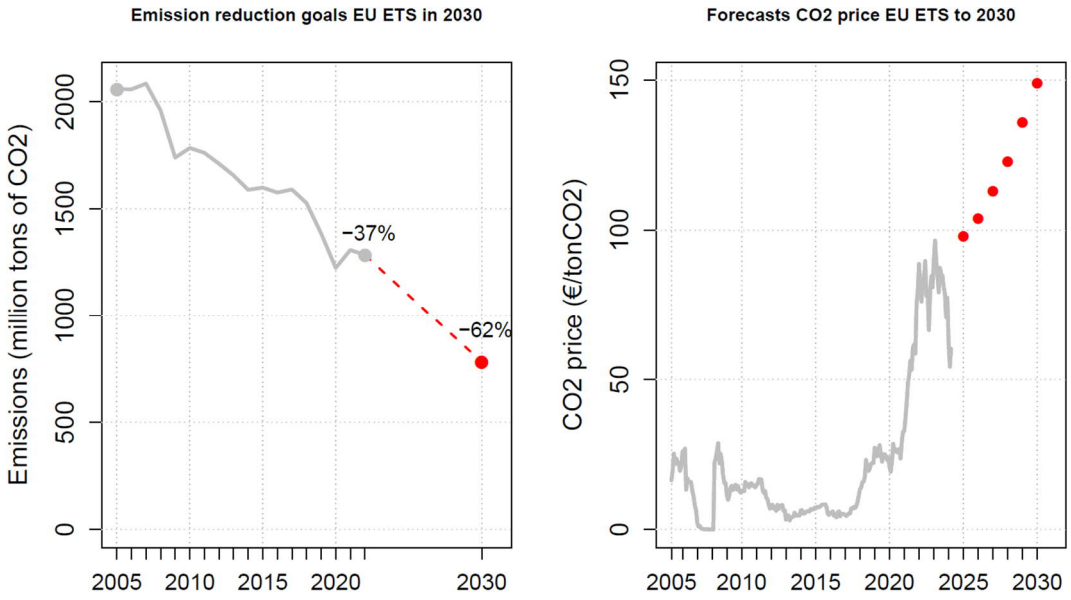
This methodological approach, which induces controlled exogeneous variation, ties in with the growing literature on conducting field experiments in surveys to understand expectation formation and its links to economic behaviour (e.g., Coibion, Gorodnichenko, and Weber, 2022; Fuster & Zafar, 2023; Haaland, Roth and Wohlfart, 2023; Stantcheva, 2023). Such experiments have been shown to effectively influence economic decisions, from household spending (van Rooij et al., 2024) to firm-level decisions (Coibion, Gorodnichenko, Ropele, 2020). Their advantage lies in their ability to experimentally alter beliefs, without needing to track individuals over time or collect longitudinal data. Our goal is to use these experiments to understand how firms might adjust their operations in response to stricter climate policies.

Our information experiment follows three main stages, commonly used in the literature:

1) *Prior expectations:* We first measure respondents' initial expectation regarding key variables of interest, such as future carbon prices, energy price changes, input costs, sales prices, demand, and investments. This step, of which the results were discussed in the previous sections of this article, establishes a baseline for understanding how firms anticipate economic conditions before receiving any additional information.

2) *Information provision:* After establishing the baseline, respondents are randomly assigned to receive either an informational signal or a placebo. About 90% were shown the following figure illustrating the projected path of emission reduction targets and carbon prices according through 2030, alongside historical data. Bloomberg forecasts carbon prices rising to €150 per ton of CO_2 by 2030. This information is simple, forward-looking, and based on publicly available data. The placebo group received a generic message that simply reiterated the European Union's goal of achieving climate neutrality by 2050, without specific details on emissions targets or carbon pricing (see the first sentence in the notes of Figure 9). This control group helps ensure that any observed effects can be attributed to the information treatment, rather than to other confounding factors, such as survey fatigue.

Figure 9 – Information content signalling increased stringency in climate policy.



Note: This informational signal was provided to about 90% of the sample, accompanied by the following text: "The European Union aims to achieve climate neutrality by 2050, an ambition that challenges our companies to develop sustainable, long-term strategies. The climate transition is expected to increase the costs of fossil fuels. The left graph illustrates the required reduction in emissions (expressed in million tons of CO_2 equivalent) in the ETS sector by 2030, a transitional milestone within the European Green Deal. The right graph, based on Bloomberg data, shows the projected rise in CO_2 prices in the EU ETS sector through 2030. This CO_2 price not only has direct implications for companies covered by EU ETS, but can also indirectly affect your business through, for example, rising energy costs."

Sources: Annual report National Bank of Belgium 2023, Bloomberg NEF.

3) *Posterior expectations:* After providing the information, we measure respondents' updated expectations to identify any shifts in their beliefs about carbon prices, energy prices, and firm-level operational variables. To prevent giving away the experimental nature of the survey and mitigate "experimenter demand effects" - where respondents might answer in ways they believe are preferred by researchers or society - we included questions on various topics related to the transition, as well as long-term outlooks up to 2050, alongside the core variables. We deliberately avoided asking whether respondents want to revise their earlier answers based on the information provided to prevent priming effects. Additionally, respondents were unable to revisit previous answers, reducing the risk of consistency bias. We also asked about carbon price predictions in different ways: In Step 1, we elicited point forecasts along with a qualitative assessment of the respondent's confidence in their predictions, while in Step 3, we only elicited point forecasts.

This three-stage approach allows us to systematically analyse how new information impacts firm-level expectations. The information treatment was designed to help firms update their expectations about future policies, particularly carbon prices in 2030. We assume that all policies aimed at meeting the EU's climate objectives are proportionally reflected in expected carbon prices, which serve as both our policy indicator and shock.

We also include a scenario analysis with more precise identification of the potential effects, similar in spirit to the approach of Peersman and Wauters (2024). Respondents were asked to consider how their company would be impacted if the EU ETS CO_2 price rose to €250/ton CO_2 by 2030. By exploring how firms would respond to such a substantial rise in carbon prices – assuming all other conditions remain constant – we can better understand the effects of a policy shift.

4.2. Magnitude of carbon shocks

Recall that despite the growing importance of the EU ETS, earlier sections revealed that most respondents were not very familiar with carbon pricing, and only few respondents dared to even give a crude estimate the current carbon price (see Section 2.3). After recalibrating their expectations using a graph showing the recent trajectory of EU ETS carbon prices - around €65/ton CO_2 at the time of the survey – the median (prior) expectation for the 2030 carbon price was equal to €120/ton CO_2. However, there is considerable uncertainty surrounding these expectations, with the median confidence level being equal to 4 on a scale of 1 to 10, and the most frequent response being 1. In contrast, respondents were more confident in their forecasts for future energy prices.

As shown in Table 2, messaging about climate policy stringency in the information experiment has a noticeable impact on future carbon and energy price posterior expectations. In the treatment group, there is a clear upward shift in anticipated carbon prices, while the control group expects negligible price changes. Although the median price expectations for gas and electricity remain unchanged, suggesting the central tendency did not change, there are notable increases in the means, suggesting that some respondents made substantial adjustments to their expectations.

Table 2 : Summary statistics of carbon prices (in €/tonCO_2) and energy price changes (in %) in 2030 (prior expectations vs. posterior expectations)

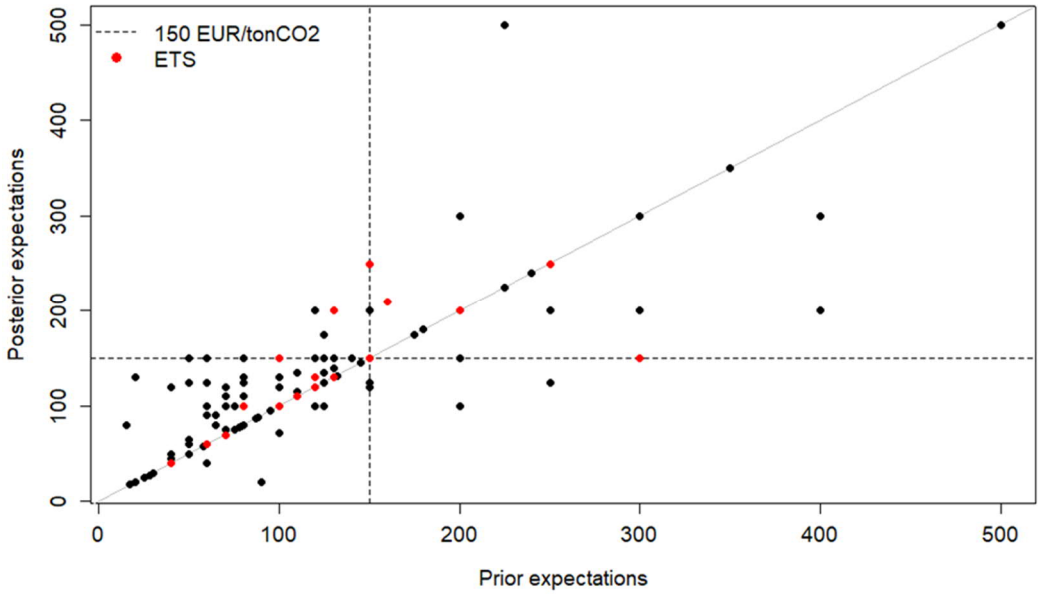
	Group	Sample size	Median		Mean	
			Prior	*Post.*	*Prior*	*Post.*
Carbon prices	Treatment	257	120.	130	130.9	139.4
	Control	23	100.	100	108.3	110.2
Gas prices	Treatment	245	25	25	39.2	45.7
	Control	22	30	30	53.3	55.5
Electricity prices	Treatment	251	25	25	39.9	44.9
	Control	22	30	30	60.0	55.5

Note: Carbon price expectations are expressed in €/tonCO_2, while energy prices changes are expressed as percentage increases compared to today's levels.

Figure 10 shows that the signal on climate policy stringency prompted many respondents to revise expectations upward, especially for those who initially anticipated lower carbon prices. The diverse responses to the information treatment highlight heterogeneous effects in belief updates: while some made large adjustments, others made little to no changes. Even within the group of ETS firms, who are presumably more acquainted within carbon pricing mechanisms reactions, the reactions were heterogenous.

There are several reasons why the information provision may not elicit a belief update. First, the provided information may lack credibility to respondents, or they may prefer to stand by their own initial estimate, reflecting overconfidence, well-studied in the behavioural economics literature. Second, as Haaland et al. (2023) suggests, people who already hold 'accurate' beliefs are less likely to change them. With prior expectations averaging €130.9 per ton CO_2 – close to Bloomberg forecast of €150 per ton – the information may not have been sufficiently surprising to trigger a belief update. Recall that around one-third of respondents had current expectations between €120 and €180, which could be considered "accurate" based on the signal provided.

Figure 10: Revision of carbon price expectation (in €/tonCO2) in 2030 (prior vs. posterior)

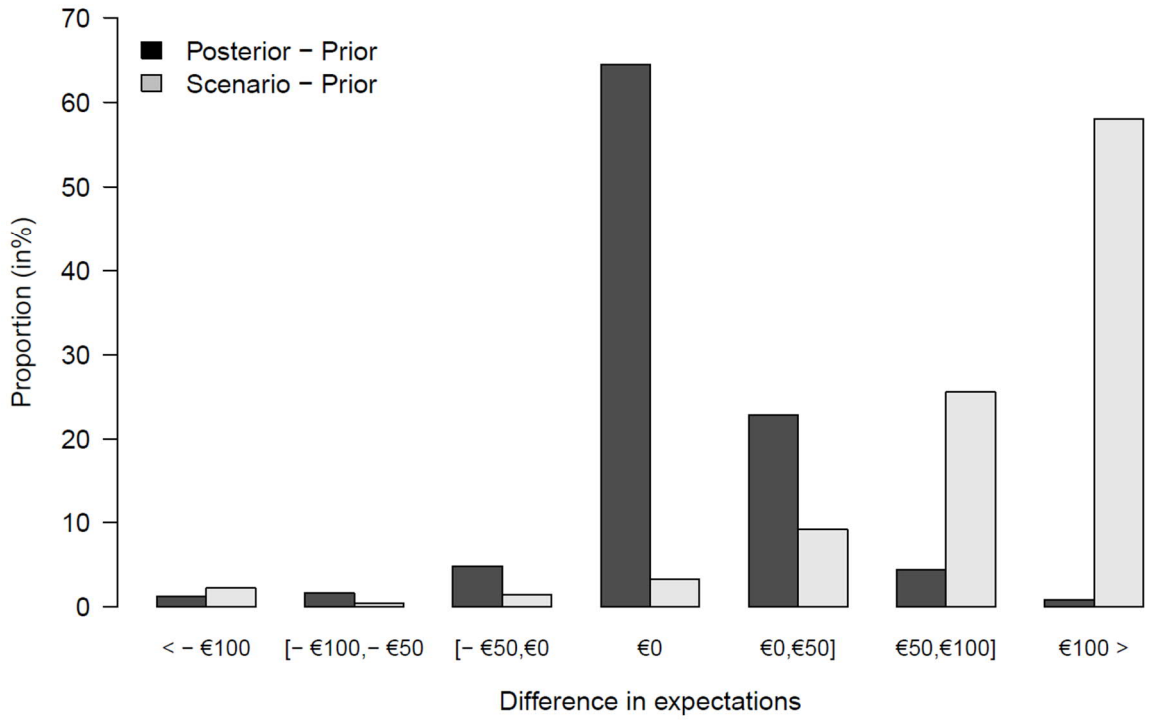


Note: This scatter plot illustrates the relationship between respondents' prior (x-axis) and their posterior (y-axis) expectations for carbon prices in the treated group. The dashed intersection lines represent the signal of €150/ton$C0_2$ by 2030. Points to the left of the vertical line represent respondents with prior expectations below €150, while those below the horizontal line maintained expectations below €150, even after receiving new information. The diagonal line represents cases where there is no change in expectations (posterior = prior). Red dots indicate respondents specifically associated with the EU ETS.

The figure below compares the size of the carbon price shocks from the information experiment (black, 'Posterior minus Prior') and the scenario analysis (grey, 'Scenario minus Prior'). The results from the information experiments suggests that messaging about climate policy stringency has a modest impact on respondents' carbon price expectations, as many disregard the information and stuck their initial beliefs. However, a noticeable portion, almost 30%, experienced an upward shift in expectations.

In contrast, the hypothetical scenario led to far fewer respondents showing no change in expectations. Most had substantial upward revisions, particularly in the €100+ range, reflecting a substantial implicit shock (or shift in expectations) due to the scenario's hypothetical conditions (i.e., a carbon price of €250/ton CO_2). This suggests that many firms' initial expectations were at least €100 below the scenario price, indicating that many firms do not consider such high carbon prices as a plausible outcome in their planning for 2030.

*Figure 11 –**Difference** in carbon price expectations (posterior minus prior expectations, scenario minus prior expectations) (in % of sample)*



Note: In the information experiment, the change in expectations is calculated as the difference between firms' posterior and prior expectations. In the scenario analysis, the change in expectations is calculated as the difference between the hypothetical scenario price (€250/ton CO2) and firms' prior expectations. The information experiment results reflect only the 'treated' group (N = 250), while the scenario analysis includes all participants (N = 274).

In what follows, we begin by discussing the results of the scenario, as the scenario analysis induces more substantial changes in firms' expectations compared to the information treatment. The experiment's findings will then be used to validate these results.

4.3. Results scenario analysis

The descriptive results in Section 3 have highlighted that, a priori, most respondents tend to associate the climate transition with higher prices and reduced economic activity by 2030. The hypothetical scenario featuring a more extreme carbon price of €250/ton CO_2 exacerbates these concerns, suggesting adverse effects on firm operations.

The summary statistics in Table 3 compare firms' prior expectations with their revised expectations under the scenario across several operational variables. The results include only firms with a non-zero carbon price shock. As noted in the previous section, only a small number of firms experienced no carbon price shock. In the treated group, just 7 respondents – who also provided expectations for operational variables – reported no change in carbon price expectations. A small group of firms experienced a negative carbon price shock - about 11 firms for input costs, sales prices, and demand, and 7 for investments. Across all variables, most firms show a belief update of zero, suggesting minimal impact to the interpretation of our results.

The columns report the median, the percentage of negative responses, and the percentage of positive responses. For example, firms expect input costs and sales prices to rise (more strongly), with the median response increasing from 1 (i.e., slight increase) to 2 (i.e., strong increase). For demand and investments in Belgium and the EU, there is a noticeable increase in negative expectations, and positive responses decrease. Overall, more firms exhibit a pessimistic outlook under

the hypothetical scenario. Firms foresee pronounced inflationary pressures in response to a sharp rise in carbon prices, which would likely also dampen economic activity, as firms predict lower demand and reduced investment within the EU.

Table 3 : Summary statistics of firm-level expectations in 2030 (prior expectations vs. hypothetical expectations)

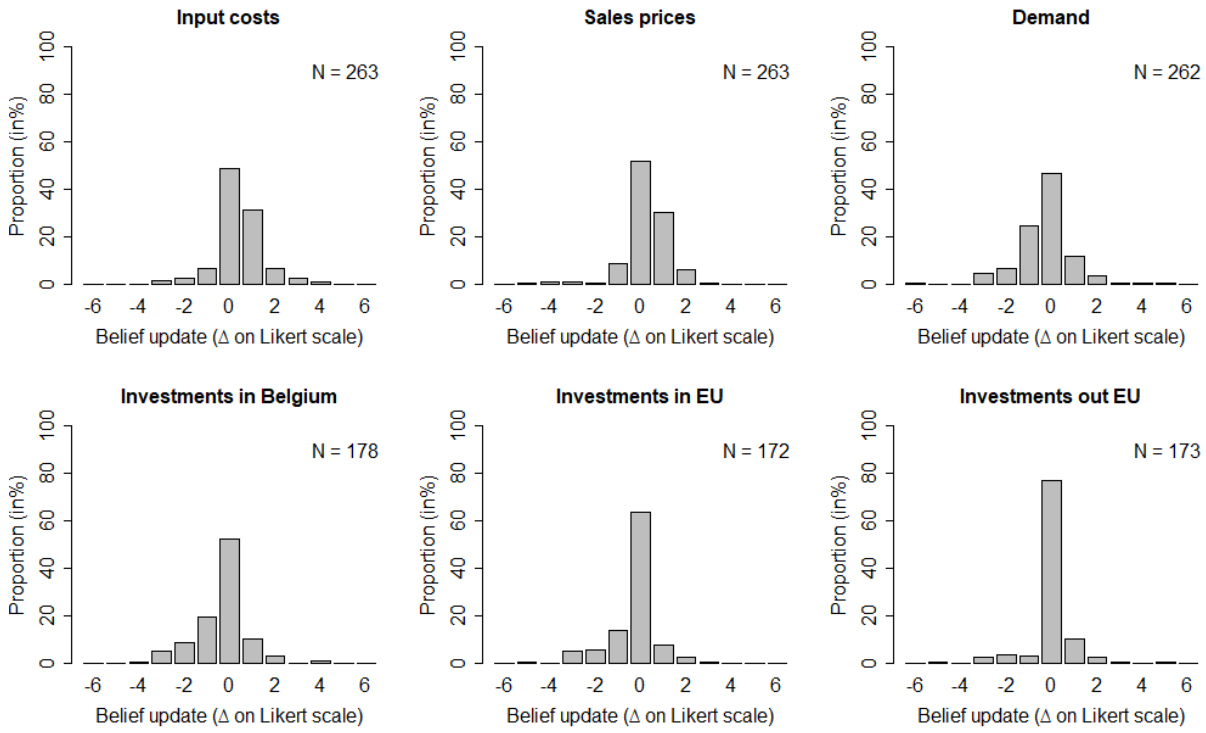
Phase	Sample size	Median		% Negative		% Positive	
		Prior	*Hypoth.*	*Prior*	*Hypoth.*	*Prior*	*Hypoth.*
Input costs	263	1.0	2.0	5.3	2.3	80.2	85.2
Sales prices	263	1.0	2.0	0.8	2.3	84.8	82.9
Demand	262	0.0	0.0	31.7	44.7	38.5	30.5
Investments in BE	178	0.0	0.0	33.1	43.3	39.9	29.8
Investments in EU	172	0.0	0.0	20.9	32.0	22.7	16.9
Investments out EU	173	0.0	0.0	8.7	12.1	28.3	30.6

Note: The original responses were collected using a Likert scale ranging from "Very large decrease" (-3) to "Very large increase" (+3). The sample includes only respondents with a non-zero carbon price shock. For investment-related variables, the sample is restricted to firms with production facilities.

Figure 13 below shows the distribution of hypothetical belief updates in firm-level operational variables, ranging from -6 to +6, under a hypothetical scenario of a sharp rise in carbon prices to €250/ton CO_2. These updates are calculated as the difference between firms' expectations under the hypothetical scenario and their prior expectations, as discussed in Section 3. For example, a belief update of '-6', though very unlikely, would indicate that a firm's expectation shifted from '+3' (i.e. very large increase) to '-3' (i.e. very large decrease) under the scenario. As with the previous table, the results include only firms with a non-zero carbon price shock.

About half of firms make minimal adjustments to their expectations for operational variables, with belief updates clustering around zero. For input costs and sales prices, there is a noticeable positive shift, consistent with the findings in Table 3. In contrast, belief updates for demand and investments in Belgium show a more spread-out distribution, with a slight tendency towards negative updates. A similar, though less pronounced pattern is observed for investments in the EU. Investments outside the EU show more zeros, likely reflecting less impact. It's important to note that the sample includes smaller firms that may be less inclined to invest outside Belgium in any case.

*Figure 12 – Histogram of hypothetical **belief updates** (updates in expectations) in firm-level variables (scenario minus prior)*
(in % of sample)



Note: The original responses were collected using a Likert scale ranging from "Very large decrease" (-3) to "Very large increase" (+3). The sample includes respondents with a positive carbon price shock. For investment-related variables, the sample is restricted to firms with production facilities.

To formally test the effect of the carbon price shock on belief updates for firm-level variables, we conduct a regression analysis where the dependent variable is the hypothetical belief update (depicted in Figure 13 and the right-hand side variables include a set of dummies representing the direction of the difference between the hypothetical carbon price (€250/ton CO_2) and firms' prior expectations of the carbon price (depicted in black in Figure 11).

The regression equation is specified as follows:

$$\Delta y_i = \beta_1 D_i^+ + \beta_2 D_i^0 + \beta_3 D_i^- + \beta_4 (D_i^+ : \Delta \ln x) + \beta_5 (D_i^+ : y_{\text{prior}}) + \epsilon_i$$

In which $\Delta y_i = y_{i,\text{scenario}} - y_{i,\text{prior}}$ represents the belief update in firm-level variables (e.g., input costs); that is, the expected response of the firm to the price (scenario) shock. D_i^+, D_i^0, and D_i^- are dummies for the direction of the price shock: D_i^+ is a dummy variable for respondents with a positive price shock (i.e., prior expectations are below the hypothetical price), D_i^0 is a dummy for respondents whose expectations are at the hypothetical price level, and D_i^- is a dummy for respondents with prior expectations above the hypothetical price.

The subsample of respondents with a positive price shock, which represents the primary group of interest, has sufficient observations to examine the responses in more detail. Specifically, in our baseline estimations, we include two interaction variables with the dummy for the positive shock: $(D_i^+ : \Delta \ln x)$ is the interaction of the positive dummy with the size of the price shock (in log-differences), i.e., $\Delta \ln x_i \coloneqq \ln(250) - \ln(x_{i,\text{prior}})$. This term tests whether the magnitude of the revision affects firm operations, with larger gaps potentially triggering larger updates in their expectations of operational variables. We also include the interaction of the positive dummy with the prior expectation, i.e., $(D_i^+ : y_{\text{i,prior}})$. This term controls for the possibility that respondents with more extreme prior expectations for firm-level variables have less room to adjust their expectations in response to the scenario. Both interaction terms are de-meaned to isolate the incremental effects.

Consequently, the parameters β_1, β_2 and β_3 capture the responses of firms experiencing positive, zero and negative price shocks, respectively. Meanwhile, β_4 and β_5 assess the extent to which these responses are amplified or diminished, depending on the magnitude of the price shocks and the expected response in absence of the shock.

The regression results in Table 4 indicate that a hypothetical increase in the carbon price to €250/ton CO_2 would amplify the adverse supply shock already evident in the prior expectations discussed in the descriptive results. Firms with a positive carbon price shock – those whose prior expectations were lower than the hypothetical price - expect higher input costs and sales prices, compared to their initial expectations, suggesting potential inflationary pressures. The coefficients for the firms whose initial expectations align with the hypothetical price, or for those with a negative shock, are not statistically significant, likely due to small sample sizes in these groups. Notably, the (opposite) signs of the point estimates of the group experiencing a negative shock all align with those of the positive shocks. The negative coefficients for demand and investments indicate a pessimistic outlook for future economic activity in Belgium and the EU under the scenario of a sharp carbon price increase. The interaction with the size of the perception gap is consistent with the base responses, but not significantly different from zero across all firm-variables. A plausible explanation for the insignificant role of the magnitude of the price shocks is the limited number of categories on the Likert scale, which allows for little variation in the dependent variables. On the other hand, the interaction with the prior expectation is typically negative, confirming that firms with high prior expectations have less room to revise their beliefs upward (and more room to revise their beliefs downwards) in response to the scenario.

Table 4 : Regression coefficients results for the effect of the shock in carbon prices on belief updates of firm-level operational variables (hypothetical minus prior expectations)

Firm-level variable:	*Input costs*	*Sales prices*	*Demand*	*Investments in BE*	*Investments in EU*	*Investments out EU*
D_i^+	0.43 ***	0.28 ***	-0.33 **	-0.32 ***	-0.28 ***	0.03
D_i^0	-0.57	-0.43	-0.57	0.29	0.43	0.14
D_i^-	-0.45	-0.18	0.00	0.55	0.20	-0.30
$D_i^+ : \Delta \ln x_i$	0.02	0.14	0.04	-0.08	-0.11	0.04
$D_i^+ : \mathrm{y}_{\mathrm{i,prior}}$	-0.46 ***	-0.31 ***	-0.11 *	-0.05	-0.12 *	-0.13 **
R^2	0.33	0.14	0.08	0.08	0.08	0.03

Note: The results of the regression equation, $\Delta y_i = \beta_1 D_i^+ + \beta_2 D_i^0 + \beta_3 D_i^- + \beta_4 (D_i^+ : \Delta \ln x_i) + \beta_5 (D_i^+ : \mathrm{y}_{\mathrm{i,prior}}) + \epsilon_i$, estimated via ordinary least squares. The significance codes are as follows: '***' $p < 0.01$, '**' $p < 0.05$, '*' $p < 0.1$. Significant coefficients are shaded in grey.

Other factors beyond the price shock and prior expectations may also influence belief updates. For example, the firms' specific economic context is important to understand how they are likely to respond to increases in carbon pricing. In Table 5, we extend the basic regression model by adding additional interaction terms one-by-one, i.e., $\beta_6 (D_i^+ : \mathrm{z_i})$, where z represents a specific firm characteristic of interest. Examples are the impact of the climate transition over the past three years, the level of certainty in respondents' prior expectations, firm size, etc. As before, the interactions are de-meaned to capture incremental effects.

A notable finding is the response of the manufacturing sector, which shows a shift in investment strategy: these firms anticipate reducing investments in the EU and increase investments outside the EU if faced with higher-than-expected carbon prices. Other insights include firms that have experienced increases in sales prices, demand, and investment in recent years, tend to carry over these expectations into the hypothetical scenario. Large firms are more likely to increase investments outside of the EU. Sectoral differences are also evident: construction firms expect higher input costs, while manufacturing firms foresee higher sales prices. Service firms, on the other hand, anticipate more subdued increases in input costs and sales prices. Energy-intensive firms are particularly sensitive to carbon price shocks and expect higher input costs and sales prices. Firms that place greater trust in the achievement of 'Fit for 55' targets show smaller reductions in investments within the EU, suggesting that confidence in policy effectiveness can mitigate some adverse effects of stringent climate measures. Firms that view the transition is a strategic priority expect an increase in demand, but, at the same time, plan to boost investments outside of the EU. Firms with European focus for their activities expect an additional

increase in input costs, and those with European production facilities are likely to decrease their investments outside the EU.

Table 5 : Regression coefficients results for separate interactions of firm characteristics (hypothetical minus prior expectations)

Firm-level variable:	*Input costs*	*Sales prices*	*Demand*	*Investments in BE*	*Investments in EU*	*Investments out EU*
+ $D_i^+ : \mathrm{y}_{\mathrm{i,past}}$	0.05	0.21 ***	0.19 **	-0.03	0.10	0.30 ***
+ $D_i^+ : \mathrm{y}_{\mathrm{i,certitude}}$	0.01	0.01	0.08 **	-0.01	-0.05 *	0.03
+ $D_i^+ : \mathrm{size_i}$	0.05	0.09	0.06	0.01	-0.02	0.17 **
+ $D_i^+ : \mathrm{D_i^{construct}}$	0.42 ***	-0.05	0.01	-0.01	-0.02	-0.13
+ $D_i^+ : \mathrm{D_i^{manufacturing}}$	0.09	0.23 *	0.07	-0.13	-0.28 *	0.22 *
+ $D_i^+ : \mathrm{D_i^{services}}$	-0.35 ***	-0.26 **	-0.07	0.01	0.19	0.00
+ $D_i^+ : \mathrm{D_i^{Energy\ Intensity}}$	0.28 **	0.33 **	0.06	0.08	-0.11	0.15
+ $D_i^+ : \mathrm{D_i^{Trust\ in\ Fit\ for\ 55}}$	0.07	-0.03	0.02	0.01	0.13 **	-0.04
+ $D_i^+ : \mathrm{D_i^{Strategic\ .Priority}}$	0.10	0.03	0.32 **	0.17	0.16	0.18 *
+ $D_i^+ : \mathrm{D_i^{European\ Activity}}$	0.64 *	0.13	0.05	0.18	-0.02	-0.34
+ $D_i^+ : \mathrm{D_i^{European\ Production}}$	0.14	-0.08	-0.09	-0.11	-0.07	-0.22 *

Note: The results of the regression equation, $\Delta y_i = \beta_1 D_i^+ + \beta_2 D_i^0 + \beta_3 D_i^- + \beta_4 (D_i^+ : \Delta \ln x_i) + \beta_5 (D_i^+ : \mathrm{y_{i,prior}}) + \beta_6 (D_i^+ : \mathrm{y_{i,prior}}) + \epsilon_i$, estimated via ordinary least squares. The significance codes are as follows: '***' $p < 0.01$, '**' $p < 0.05$, '*' $p < 0.1$. Significant coefficients are shaded in grey. The base effects are not reported but remain consistent across the different specifications.

4.4. Results randomised information provision experiment

In the regression analysis for the randomised information provision experiment we use the same specification as in Section 4.3 but redefine the carbon price shock variable as the difference between posterior and prior expectations. We also include an additional dummy for the control group. The regression equation is specified as follows:

$$\Delta y_i = \beta_1 D_i^+ + \beta_2 D_i^0 + \beta_3 D_i^- + \beta_4 D_i^C + \beta_5 (D_i^+ : \Delta \ln x_i) + \beta_6 (D_i^+ : \mathrm{y_{prior}}) + \epsilon_i \ ,$$

in which $\Delta y_i = y_{i,\mathrm{posterior}} - y_{i,\mathrm{prior}}$ represents the belief update in firm-level variables (e.g., input costs) and $\Delta \ln x_i \coloneqq \ln (x_{i,\mathrm{posterior}}) - \ln (x_{i,prior})$ captures the belief update in carbon prices (log-difference), and D_i^C is a dummy for the control group.

The regression results in Table 6 indicate that the information provided on the carbon price has a substantial impact on firms' belief updates regarding firm-level operational variables, though not everything is significant, partially supporting the findings from Section 4.3. Firms experiencing a positive carbon shock – those respondents who revise their expectations upward after receiving the information – expect higher input costs and investments outside the EU, and, to some extent, negative changes in demand. Surprisingly, even respondents whose initial expectations align with their posterior expectation showed a significant revision in input costs and sales prices, indicating that some firms are still adjusting their expectations despite not revising their carbon price outlook. One possible explanation is that we only collected expected carbon prices for 2030, while the information that we provided may have also influenced the path leading up to 2030, or for price expectations beyond 2030. Additionally, we cannot rule out a response to the information on emission reduction targets, beyond just carbon prices.

The interaction with the size of the belief update in carbon prices is significant for demand, meaning that firms anticipating a substantial increase in carbon prices anticipate a sharp drop in demand. Again, the interaction with the prior expectation is negative, for sales prices, demand, and investments, confirming that firms with high prior expectations have less room

to revise their beliefs upward in response to the information provided on the carbon price. Overall, the responses align with the scenario analysis, although these results are statistically less strong.

Table 6: Regression coefficients results for the effect of the belief update in carbon prices on belief updates of firm-level variables (posterior minus prior expectations)

Firm-level variable:	*Input costs*	*Sales prices*	*Demand*	*Investments in BE*	*Investments in EU*	*Investments out EU*
D_i^+	0.18 **	0.01	0.14	-0.08	0.00	0.18 **
D_i^0	0.16 ***	-0.09 *	0.02	0.01	0.02	-0.02
D_i^-	-0.05	0.05	-0.05	0.00	0.00	0.00
D_i^C	0.05	0.05	0.13	-0.07	-0.07	-0.01
$D_i^+ : \Delta \ln x_i$	-0.02	-0.08	-1.38 ***	0.12	-0.04	-0.22
$D_i^+ : \mathrm{y}_{\mathrm{i,prior}}$	-0.12	-0.19 *	-0.37 ***	-0.24 ***	-0.02	0.01
R^2	0.07	0.03	0.19	0.01	0.00	0.03

Note: The results of the regression equation, $\Delta y_i = \beta_1 D_i^+ + \beta_2 D_i^0 + \beta_3 D_i^- + \beta_4 D_i^C + \beta_5 (D_i^+ : \Delta \ln x_i) + \beta_6 (D_i^+ : \mathrm{y}_{\mathrm{prior}}) + \epsilon_i$, estimated via ordinary least squares. The significance codes are as follows: '***' $p < 0.01$, '**' $p < 0.05$, '*' $p < 0.1$. Significant coefficients are shaded in grey.

5. Concluding remarks

The EU's policy to become a climate-neutral economy by 2050 will gradually imply stronger incentives to decarbonise through increasing carbon prices and stricter regulations. This is likely to significantly affect various dimensions of the operations of firms (costs, pricing, sales, investment, hiring, etc.). As the EU's decarbonisation targets are more ambitious than the policies in the other world regions, the climate transition may also have negative impact on the cost competitiveness of European firms. While mitigating measures such as the Carbon Border Adjustment Mechanism will be taken to protect domestic firms against imports that have benefited from lower carbon prices, challenges remain, in particular on export markets.

Apart from macro model simulations, little is known about the way firms will adapt to higher carbon prices and competitiveness challenges. An emerging literature is based on specific business surveys on climate transition. While such surveys may suffer from reporting biases, they can provide a wealth of information on how firms plan to adapt to climate transition policies. In this paper, we contribute to this literature and specifically focus on Belgian firms. Firms were asked, inter alia, to report how climate transition policies are affecting and will continue to affect their input costs, sales prices, sales as well as their investments.

The first observation is that, while most respondents by and large recognise the importance of the climate transition efforts, they seem to be, on average, less knowledgeable about the concrete implications. This is witnessed, for instance, by the lack of awareness about the current carbon price or the ETS system. Firms are also sceptical about the feasibility of climate transition targets and point to cost implications, lack of clear policy guidance and the high administrative burden as key impediments.

Turning to the impacts on firm operations, respondents mostly interpret the climate transition policies as a classical negative supply shock. On average, they expect energy prices and input costs to go up, which will erode margins as the pass-through to selling prices is thought to be incomplete. Remarkably, the impact on demand remains relatively subdued (perhaps reflecting an expectation that incomes will be adjusted to higher prices, in line with the idiosyncratic Belgian mechanism of automatic indexation to prices). At the same time, the reported impact on investment in Belgium is somewhat ambiguous with certain firms reporting higher investment, while others indicate that investment plans will be curtailed. In general, effects tend to be clearly stronger for manufacturing and ETS firms in the sample. This may be because their daily operations are already affected more by climate transition policies. Those companies do see a limited negative impact on demand, which may be due to the issues regarding relative cost competitiveness compared to foreign firms. They also flag a stronger willingness to expand capacity outside Europe, rather than in Belgium or the EU. As manufacturing firms typically have a higher productivity, this could weigh on future domestic productivity and, hence, the growth potential of the Belgian – and European – economy.

A more in-depth analysis of the survey responses, including the randomised information experiment and scenario analysis that were incorporated, sheds greater light on the causal relationships at play and confirms the expected impact on firm costs, prices, and real activity. When faced with a hypothetical carbon price of 250 euro per ton CO_2, firms that initially had lower carbon price expectations, clearly adjust their expectations: costs and prices are revised upwards, while the real activity variables, both demand and domestic investment, are revised down. We also find interesting interaction effects with certain firm characteristics: again manufacturing (and larger) firms appear to be more likely to increase investment outside the EU when faced with higher carbon prices.

Turning to the randomised information experiment, messaging about future climate policy stringency has a noticeable impact on future carbon and energy price expectations; as regards the latter, respondents do not distinguish much between gas and electricity as, for both, the average expectation is revised up. Belief updates again affect expectations about firm variables and partially lend support to the findings in the scenario analysis even though some relationships are not statistically significant. Remarkably, firms that revise carbon price expectations up, indicate greater investments outside the EU. In addition, the extent of the belief update is clearly negatively correlated with demand expectations: firms with higher revisions expect stronger negative impacts on demand.

All in all, our findings indicate that firms generally expect that the climate transition is likely to lead to higher prices and lower activity growth. Highly productive manufacturing firms in particular flag that carbon price increases could imply more investments outside the European Union, which may reduce potential growth relative to that in the EU's main trading partners. Against this background, the crucial challenge for policymakers is to strike an appropriate balance between the environmental objectives and the financial resilience of firms and the growth potential of the economy. The firms' capacity to invest in necessary climate measures may be strained at a time when additional investments are needed to achieve climate neutrality. A better understanding of the potential economic consequences of climate transition policies could help to define or fine-tune effective accompanying measures.

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