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ORIGINAL ARTICLE

Wage Subsidies, Slack Resources and Behavioural Additionality: Evidence from Universities

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Abstract

We examine the behavioural additionality effects of a wage subsidy in the form of a tax cut on R&D personnel's wages in a population of universities. How does university management use this wage subsidy? The wage subsidy is welcomed by universities as additional slack resources which are free to be used by university management. Its use depends on its degree of absorption and on it generates specific behavioural additionality effects. Wage subsidy resources are initially unabsorbed slack but over time increasingly function as absorbed slack because of the continuity and predictability of these resources. Different types of behavioural additionalities are generated at different impact levels. We find that initiatives at the organisational level are funded with absorbed slack, while initiatives at the project level are likely to be carried out with unabsorbed slack. The paper contributes to discussing slack resources in a non-profit setting and adds to the conceptual elucidation of behavioural additionality.

Keywords Universities · Research and Development · Wage subsidies · Slack resources · Behavioural additionality · Belgium

Introduction

Research and development (R&D) is vital in raising productivity and stimulating economic growth through knowledge creation (Ivus et al. 2021). R&D is also crucial for societal progress as it drives innovation, fosters technological advancements and cultivates solutions to pressing challenges, ultimately enhancing the quality of life

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and ensuring long-term sustainability (Morawska-Jancelewicz 2022). Universities are crucial in producing and disseminating advanced knowledge (Barra and Zotti 2018). The highest share of R&D expenditure, 57.7% of the total expenditure of 27 EU countries, goes to the wages of researchers (Eurostat 2021). Hence, reducing the cost of R&D might induce organisations, such as universities, to step up their R&D activities (Dumont 2017; Rao 2016). One way to lower the cost of researchers is to offer a discount on their tax burden, henceforth labelled a wage subsidy. Through wage subsidies, policymakers address the high cost of R&D activities and acknowledge the pivotal role of human resources in R&D.

Despite an increasing body of empirical work, Zúñiga-Vicente et al. (2014) and Dimos et al. (2022) report that the effectiveness of R&D tax credits is still not fully understood. Most scholars focus on fiscal measures in the private sector (Bodas Freitas et al. 2017; Lokshin and Mohnen 2013), and most studies look at their effectiveness in terms of additional input and/or output (Czarnitzki and Hussinger 2018; David et al. 2000). However, fiscal measures could also change the behaviour of organisations in ways which are not reflected by input and output statistics (Falk 2007; Kubera 2021; Haddad and Bergek 2023).

Assessments of wage subsidies in public organisations such as universities are scarce. Exceptions are evaluations of the EU Framework Programme for research and development, where projects often involve both public and private sector parties (Idea Consult and Falk 2009; Polt and Streicher 2005). Idea Consult and Falk (2009) conclude that research projects involving universities not selected for funding via the Framework Programme are often cancelled or executed on a smaller scale. In other words, universities have fewer options for alternative funding.

This paper complements the existing literature by focussing on the impact of tax measures in the public sector, specifically in universities. Universities employ over 40% of all R&D personnel (Eurostat 2021) and are significant users of a wage subsidy enacted in Belgium in 2003. The subsidy can be applied to all R&D personnel's wages, and a university determines how to use the saved funds. This paper considers the amount of this wage subsidy as uncommitted slack resources because it results in the immediate availability of considerable sums of money without imposing an a priori commitment to specific objectives.

The prospect of receiving these slack resources, the amount of which can be determined in advance because it is based on the current employment of R&D personnel, might induce university governance to absorb (part of) these slack resources in anticipation of their receipt. Hence, from the perspective of the receiving university, the slack resources can cover the continuum of unabsorbed–absorbed slack. However, little is known about the considerations associated with allocating slack resources by university governance. This paper aims to open this black box.

The paper offers three contributions. First, it explores how universities allocate slack resources from the wage subsidy. Second, it contributes to the literature on slack resources by integrating it with a behavioural perspective. Third, the insights offered by impact assessments of fiscal measures are extended and adapted to universities. This impact assessment will focus on behavioural additionality, analyse its inherent conceptual confusion and address the practicability of its use for impact assessments.

The paper is organised as follows. "Key concepts: wage subsidies, slack resources, behavioural additionality" section reviews the key concepts. The data collected through a questionnaire follows in "Data collection" section. "Analysis and discussion" section shows the analyses and discusses the results. The paper concludes by exploring the theoretical and managerial implications and opens further research avenues.

Key Concepts: Wage Subsidies, SLACK Resources, Behavioural Additionality

Wage Subsidies in Universities

R&D tax measures have become increasingly popular in many OECD countries and come in many forms and shapes: incremental or volume-based, with a minimum, maximum or no support threshold (OECD 2023). In OECD nations, 20 countries implement preferential deduction regulations for research and development expenses, 18 offer an R&D tax credit and 19 have provisions for a patent box (Dai and Wang 2024).

Federal and regional authorities in Belgium support university research differently, based on their respective competencies. The higher education institutions fall under the authority of the regional authorities, where two linguistic communities—Dutch and French-speaking—have exclusive political authority over higher education. They fund directly through subsidies (e.g. general university funds, grants, annual allocations), while the primary funding mechanism of the federal authority for universities is indirect funding via fiscal measures.

This paper discusses the application of a wage subsidy in universities, namely the partial dispensation from the withholding tax on researchers' salaries. Out of the 1499 million euros the measure cost in 2022, 16% or 238 million euros went to researchers in the higher education sector, including universities, university colleges and two research funding agencies (Belgian Ministry of Finance 2023).

Since its establishment in 2002, the scope of the wage subsidy has been significantly enlarged: the percentage of the withholding tax dispensed from payment has been raised incrementally from 50 to 80%, and the researchers qualifying for its application now include, next to masters and PhD holders, also bachelors. In the higher education sector, the wage subsidy is easy to apply: a university can directly deduct 80% of the withholding tax on all researchers' salaries without any administrative procedures or the involvement of government agencies and without impacting the researchers' received net salary.

Wage Subsidy and Slack Resources: (Un)Absorbed Windfall Revenue

Slack resources are resources an organisation acquires which are uncommitted to a specific operational expenditure (Dimick and Murray 1978; Latham and Braun 2009). Having slack resources, if identified as such (Sharfman et al. 1988),

influences organisational behaviour (George 2005). First, slack resources act as a buffer, allowing organisations to adjust to internal and external pressures (Bourgeois 1981; Lawson 2001). Second, slack resources play a strategic role in organisations because they facilitate strengthening existing operations or taking new initiatives (Nohria and Gulati 1996). Third, slack changes the organisations' attitude towards deploying innovative activities (Nohria and Gulati 1996) and risk-taking (Wiseman and Bromiley 1996).

Scholars discuss the effects of slack resources in organisations using the theoretical lens offered by the behavioural perspective, which emphasises slack resources could influence a university's activities (Tan and Peng 2003; Lee and Wu 2016). Nohria and Gulati (1996) empirically corroborated the existence of a curvilinear relation between slack and innovative activities. The behavioural perspective thus considers slack resources up to a certain point to exert a positive influence, enabling an organisation to behave flexibly and to step up innovative behaviour with an uncertain outcome. Excess slack, however, causes organisations to be less disciplined and more inclined to waste resources. Although this theoretical perspective was developed in the firm setting (Cyert and March 1963), it can also be applied to non-profit organisations (Meyer and Leitner 2018; Salge and Vega 2013).

Scholars distinguish two forms of slack resources with different degrees of freedom in their allocation and different functions (Sharfman et al. 1988). These forms exist on a continuum that ranges from unabsorbed to absorbed slack resources (Singh 1986). Unabsorbed slack resources are not a priori designated for a particular purpose (Tan and Peng 2003); their allocation is decided by administrators or governance boards (Bourgeois and Singh 1983), and they can be easily redeployed (Moulick and Taylor 2017). Hendrick (2006) posits that unabsorbed slack resources remain highly visible to the decision-maker. An example of unabsorbed slack resources is a liquid financial resource, such as cash (Singh 1986).

Absorbed slack resources, on the other hand, are allocated to specific purposes, such as human resources or overhead expenditure, in excess of the costs guaranteeing a regular operation of the organisation (Greve 2003; Tan and Peng 2003; Voss et al. 2008). Because of their predetermined allocation, it is difficult to distinguish them from other current expenditures. The insights on slack resources are also relevant for non-profit organisations (Busch and Gustafsson 2002; George 2005; Vanacker et al. 2017; Meyer and Leitner 2018), although their effects outside of the private sector remain underexplored (Ferlie et al. 2003).

Slack Resources in Universities: Degrees of Absorption

Universities are complex organisations operating in a highly competitive environment (Hicks 2012; Marginson 2011; Unger et al. 2020) and are becoming increasingly professionalised (Aghion et al. 2010; Rabovsky 2014). Universities compete to select the most promising students, attract top researchers and professors (Boyd et al. 2010) and obtain research funding (Unger et al. 2020). Moreover, policymakers encourage universities to move beyond education and

research to activities such as stimulating knowledge transfer for societal impact and (regional) economic development (Göransson et al. 2009; McKelvey and Zaring 2018; Unger et al. 2020). This external environment drives university governance to develop new initiatives to strengthen their competitive position, which require additional funding. The wage subsidy could function as such an additional source of funding (Hicks 2012).

In the private sector, studies concentrate on a company's resources' overall level of slack (Lee and Wu 2016). The wage subsidy, however, is only a small part of the overall slack resources of universities and is conceptualised as additional slack resources, a subcategory of overall slack.

The general university funds, or the annual institutional allocation covering a large share of the organisational functioning, can be seen as partly absorbed slack: although the university governance can theoretically spend it autonomously to enable the university to perform its tasks, many items of expenditure are determined in advance, such as the salaries of appointed teaching and research personnel. The wage subsidy, however, qualifies primarily as unabsorbed slack, although it can gradually become absorbed through its repetitive allocation for specific tasks (Voss et al. 2008).

As a first step, we content analysed annual reports from 2003 to 2019 for the Katholieke Universiteit Leuven (KU Leuven) and Ghent University (Ugent), which are the largest universities in Belgium, with the highest R&D expenditure and personnel levels (CFS-Stat 2018). Consequently, they benefit from the wage subsidy, together claiming 44% of the amount conferred to all 11 universities. They are the only two universities explicitly addressing the use of the wage subsidy as a separate funding source in their retrospective annual reports, which are, therefore, an appropriate source of explorative research. Analysing the 2003–2019 annual reports offers the necessary longitudinal data to observe strategic shifts in the wage subsidy's utilisation and evolving degrees of absorption. Moreover, the wage subsidy is shown to remain visible to university administrators, who take full advantage of its predictability, immediate availability and freedom of use to make decisions concerning its allocation to maximise strategic impact. The universities' research activities benefit from the wage subsidy resources, both directly (f.e. through additional research grants) and indirectly (f.e. through initiatives such as hiring consultants to increase success rates for external funding).

In 2003, the wage subsidy—about two million euros for each university—functioned as unabsorbed slack, primarily compensating for increased payroll costs and addressing staff shortages. From 2004 onwards, both universities also start using the funds for new initiatives within their strategic objective of research excellence. Additional postdoctoral research grants are created, showing increasing degrees of absorption: the grants at the Ugent evolved from 1-year funding to 3 years from 2005 onwards. At KU Leuven, 5-year grants under the Funding Excellence Program increased to 7-year grants under the subsequent Program Funding initiative and, in 2017, fully integrated into the general framework of internally funded research.

A second early use for the wage subsidy, similar in both universities, is delegating funds to the level of research groups (KU Leuven) or faculties (Ugent), enabling them to pursue their strategies and policies, to attract top researchers, enhance their

research infrastructure, set up new projects, etc. Because the delegated funding is allocated annually and is additional to an existing funding system, it retains characteristics of unabsorbed slack. However, the allocation continues without interruption, and the recipients counting on its continuing in their strategic planning indicate a degree of absorption.

A third initiative similar to both universities concerns additional funding for satellite campuses after the 2013 integration process of university colleges into universities, aiming to build research capacity on the new campuses. In this case, the wage subsidy funds, functioning as unabsorbed slack, are used to (co-)fund a new initiative, enlarging the previously available means. Both initiatives remain active over the whole period under review, consequently functioning as absorbed slack.

Fourth, both universities use wage subsidy resources to encourage research collaborations between domestic universities, with foreign universities; but also between different academic disciplines. Again, wage subsidy funds are increasingly directed towards longer-term projects or programmes, which move these funds towards absorbed slack.

Fifth, both universities take advantage of the unabsorbed character of (part of) the wage subsidy means for occasional equipment needs, from smaller items to more extensive infrastructural needs.

As the proceeds from the wage subsidy go up in line with the increases in R&D staff and the exempted tax percentage, both universities add various elements of expenditure, which for the most part directly benefit additional research projects or programmes, such as a stimulus funding aimed explicitly at humanities; funding innovative, high-risk projects; increasing the participation rate of researchers in humanities in external funding; support for the open access database for peer-reviewed publications; funding for doctoral schools, …

In conclusion, the wage subsidy resources, which initially functioned as unabsorbed slack, deployed on an ad hoc basis where the university suffers shortages, increasingly take on characteristics of absorbed slack: they are used to broaden the scope of existing initiatives and even to create new initiatives, which indicates multi-annual commitments and a progressive integration in other, already committed funds.

We will analyse through a survey if these observations hold for all universities and formulate our first hypothesis as follows:

> Hypothesis 1: While the wage subsidy is initially characterised as unabsorbed slack, it will increasingly function as absorbed slack over time.

Behavioural Additionality

Additionality offers a perspective for evaluating the impact of government funding for research and development by describing the net changes brought about by government intervention (Antonioli and Marzucchi 2012). Three types of additionality are described in the literature: input, output and behavioural additionality (Gök and Edler 2012; Steinmo et al. 2022). Most studies evaluating the effects of a particular policy measure follow the approach of input or output additionality, or both.

Input additionality refers to the extra resources an organisation invests in an R&D project because of, and in addition to, the public funding received (Luukkonen 2000). If an organisation uses public funding as a substitute for its investment, there is no input additionality (Aerts and Schmidt 2008; David et al. 2000). When measuring input additionality, most studies use econometric analysis of financial inputs, ignoring more systemic effects (e.g. Czarnitzki and Hussinger 2018).

Output additionality focuses on the results of a public intervention that benefits the organisation. Output additionality examines direct and tangible results regarding employment, patents, publications, new or improved products, increased exports, fixed assets, sales and productivity (Clarysse et al. 2009; Gök and Edler 2012). However, output additionality ignores the use of these results and other impacts they may have (Gök 2010).

The practical application of input or output additionality to evaluate the effects of a policy measure remains difficult because their focus ignores the broader impacts of public funding (Clarysse et al. 2009; Falk 2007). Research shows that the effectiveness of support measures is not always clear-cut, and results vary according to the data source, research method and indicators used (Zúñiga-Vicente et al. 2014). Steinmo et al. (2022) use case study research to highlight the interrelations between input, output and behavioural additionalities. Moreover, to evaluate a public policy's output additionality, the policy's outputs need to be identified and attributed to the policy. The more time elapses or the more comprehensive the range of possible impacts considered, the more complex an unambiguous attribution becomes (Luukkonen 2000).

For universities, input additionality can take the shape of additional R&D employment or investments, whereas scientific publications, patents or academic spin-offs can be considered output additionality. Because the wage subsidy represents a limited amount in the total public funding of universities and the application of the measure changed over time, isolating the effects of input or output additionality of the wage subsidy for universities in an econometric model is extremely difficult and highly dependent on data quality.

An additional difficulty in capturing the effects of a wage subsidy is that its existence may tempt organisations to game the system, for example, by labelling certain expenses as research activities or certain personnel members as researchers (Antonelli and Crespi 2013). This 'optimisation' of wage subsidies hinders a correct evaluation by inflating research personnel and expenditure reporting.

The third conceptualisation of additionality moves beyond mere input and output and, by concentrating on the changing behaviour resulting from a policy measure, aims to describe the change process itself (Davenport and Davies 1998; Steinmo et al. 2022). Behavioural additionality (Buisseret et al. 1995) refers to organisational adjustments or changes in organisations' activities and competencies (Steinmo et al. 2022). Gök (2010) even considers input additionality without accompanying behavioural changes an 'achievement by chance' and consequently a 'hidden failure'. Research suggests that behavioural additionality occurs even without input and output additionality (Orlic et al. 2019). Behavioural additionality thus allows for a broader view of results and impacts—tangible as well as intangible, immediate as

well as long term and direct as well as indirect (Simachev et al. 2017; Kubera 2021; Steinmo et al. 2022). However, the concept of behavioural additionality remains diffuse (Gök and Edler 2012). Different authors have emphasised different dimensions of behavioural additionality, either considering them to have effects in their own right or grouping them.

A first interpretation of behavioural additionality only considers changes in R&D-related behaviour during the funded project or programme. In this interpretation, the most cited additionalities are at the project level, i.e. scale, scope, acceleration and project additionality. Scale additionality refers to an increased size of the project or programme, while scope additionality points to an enlargement of research objectives. Acceleration additionality is present when a project can start earlier or has a shorter timespan because of government funding than would otherwise be the case. Project additionality refers to the decision to take up a new R&D activity.

A second interpretation of behavioural additionality takes a longer time frame into account: behavioural changes can persist after the funded project is finished, changing R&D routines or even general organisational behaviour (Gök 2010). This broader view leads to another set of subcategories of behavioural additionality, focussing on aspects such as follow-up, challenge, competence, cognitive capacity, networking, management, attitudinal, operational and strategic additionality. Undertaking riskier projects (challenge additionality), creating more extensive or more varied networks (network additionality) and increasing knowledge and skills (competence additionality) can also be considered indicators of scope additionality (Falk 2006). Bach and Matt (2002) introduced the concept of cognitive capacity additionality, or a positive impact on competencies and expertise, initially as an impact of public intervention separate from behavioural additionality. Knockaert et al. (2014) group network additionality and cognitive capacity additionality together to reflect competence additionality, which then describes a blend of individual and organisational learning. For Chapman and Hewitt-Dundas (2015), networking additionality is an aspect of strategic additionality, and challenge additionality or the willingness to engage in risky behaviour is just attitudinal additionality. Similarly, follow-up additionality, or the extent to which further research builds on the funded research, could be considered an aspect of scale or scope additionality. Strategic additionality, or the decision to take up R&D as an internal activity; management additionality or the formalisation of R&D processes; and operational additionality or changes in the operational management of R&D projects seem to be related and sometimes overlaying concepts (Chapman and Hewitt-Dundas 2015; Davenport and Davies 1998; Georghiou and Clarysse 2006). In conclusion, the conceptual framework of behavioural additionality remains confused and contentious (Pérez 2016).

This paper introduces a distinction between tangible and intangible behavioural additionalities to increase the concept's operability for impact assessment. Tangible additionalities are revealed in demonstrable, measurable form. In contrast, the presence of intangible additionalities can only be inferred from the immediate context or the lived experience of the persons directly involved. Examples of tangible additionalities are project additionality (Kubera 2018; Simachev et al. 2017); acceleration additionality (Kubera 2018; Simachev et al. 2017); follow-up additionality (Falk 2006; Simachev et al. 2017); networking

additionality (Simachev et al. 2017); operational additionality (Davenport and Davies 1998; Kubera 2018); and strategic additionality (Davenport and Davies 1998; Pérez 2016). Intangible additionalities are scope additionality (Gök and Edler 2012; Simachev et al. 2017), challenge additionality (Falk 2006; Pérez 2016), competence and cognitive additionality (Chapman and Hewitt-Dundas 2015; Gök and Edler 2012; Simachev et al. 2017) and managerial additionality (Chapman and Hewitt-Dundas 2015; Simachev et al. 2017). This paper concentrates on tangible additionalities.

A second distinction we will use to enhance the usefulness of behavioural additionalities for impact assessments is the distinction between the level at which additionalities become visible: at project level, with short-term effects, or within the organisation, resulting in longer-term effects.

We apply the concept of behavioural additionality of wage subsidies in the context of universities. Two important characteristics of universities distinguish them from the private sector, where the concept of additionality originated, and will make two kinds of behavioural additionalities irrelevant to our analysis. First, performing research is already a fundamental task of universities, so we expect no strategic additionalities at the organisational level. Second, universities, especially in Europe, largely depend on public funding: grants and mandates span predetermined periods, and universities receive structural funding without an immediate connection to specific project outcomes, rendering acceleration additionalities are less important than in the private sector.

Based on the two universities' annual reports and the literature analysis of the concept of behavioural additionalities, we expect the wage subsidy to impact universities in the following ways: scale additionality at project and organisational levels, with the wage subsidy allowing for increased employment and more encompassing initiatives, and project additionality, with new initiatives set up with wage subsidy resources. Further possible additionalities at the organisational level are operational additionality, describing a positive impact on how R&D activities are organised, and networking additionality, which fits with universities' explicit policy priority of encouraging international collaborations and researchers' mobility (Kubera 2021).

As proposed in hypothesis 1, we view the allocation of the wage subsidy on the continuum of unabsorbed to absorbed slack. The absorption level could generate behavioural additionalities at both project and organisational levels. At project level, we expect unabsorbed slack mainly to contribute to scale additionality, while the creation of new projects and programmes, implying a longer-term commitment, will move the invested slack on the continuum in the direction of absorbed slack. At the organisational level, unabsorbed slack can be mobilised to increase the scale of initiatives benefitting the entire organisation, while absorbed slack allows for longer-term commitments in how a university operationally manages its R&D.

Based on the preceding arguments, the second hypothesis is as follows:

Hypothesis 2a: At project level, the wage subsidy is associated with project, scale, and follow-up additionalities.

Hypothesis 2b: At organisational level, the wage subsidy is associated with scale, networking and operational additionalities.

Data Collection

During the period under review, the public cost of the wage subsidy for all universities went up from 80.5 million euros in 2012 to 95.8 million in 2018 due to the steady growth in both research personnel and the percentage of the payroll tax to be deducted (CFS-Stat 2018). The wage subsidy accounts for on average 5% of the universities' total R&D expenditure but the impact of this additional unabsorbed slack could nevertheless be significant (CFS-Stat 2018).

The universities' use of the wage subsidy is identified using a dedicated questionnaire (see Appendix 1), sent to all eleven universities in Belgium, with the following structure. First, each university's annual wage subsidy from the federal government through a non-payment of part of the payroll tax is prefilled for 2012 to 2018. This information is sourced from the annual R&D survey coordinated by the Belgian Science Policy Office (CFS-Stat 2018). Then, a series of multiple-choice questions ask for the use made of the wage subsidy resources, the decision processes involved and the wage subsidy's perceived importance (questions 1, 5 and 7); possible impacts representing different behavioural additionalities (questions 2 and 6); and the level of absorption of the slack resources (questions 3 and 4). Two open questions address the evolution of the wage subsidy's use and its perceived advantages and disadvantages (questions 8 and 9).

The questionnaire, in Dutch and French, was emailed to all universities on 27 July 2020, with a reminder on 22 September 2020. The recipients are either the financial director of the university (in six cases) or the research director/coordinator (in five cases). The survey has a 100% response rate, with all responses arriving in August and September 2020.

Analysis and Discussion

Table 1 shows the evolution of the wage subsidy in all universities and compares it to their overall R&D expenditure.

From 2012 to 2018, the universities saved 4.54% of their total R&D expenditure because of the wage subsidy, creating an annual average of 8.37 M€ (median of 5.79 M€) additional slack resources in each university. This overall share in each university ranges from 3.20% up to 8.61%, with an average of 5.13% or a median of 4.57% of the total R&D expenditure.

Nearly all (98.8%) resources generated by the wage subsidy are reinvested in R&D activities (question 1), reflecting the critical role of the research council in the decision process (question 5): nine out of eleven universities see some form of exchange and deliberation between the research council and the board of directors. In one university, there is no involvement from other university management

Table 1 Descriptive statistics on the evolution of the wage subsidy and the R&D expenditure of universities. *Source*: CFS-Stat 2018

	Wage subsidy (in M€)	R&D expenditure (in M€)	Share of R&D expenditure financed by the wage subsidy (in %)
2012	80.3	1745.4	4.60
2013	86.9	1855.1	4.68
2014	94.8	1866.8	5.08
2015	95.7	2019.3	4.74
2016	93.5	2185.5	4.28
2017	97.4	2232.9	4.36
2018	95.8	2301.6	4.16
Period 2012–2018	644.3	14206.6	4.54
Average annual growth rate 2012–2018 (%)	3.07	4.76	− 1.48
Compound annual growth rate 2012–2018 (%)	2.97	4.72	− 1.67
Average per university (2012–2018)	8.37	184.5	5.13
Median per university (2012–2018)	5.79	164.5	4.57

departments in the research council's decision-making process. In contrast, the research council does not have any input in one university.

Each university provides the five most important expenditure items for the wage subsidy and the amount involved. The total amount of these five items per university taken together covers 75.4% of the total wage subsidy in 2018 and is, therefore, representative for the use of the wage subsidy. Two universities

Table 2 Types of behavioural additionalities resulting from the 58 most important allocations of the wage subsidy. *Source*: Our classification

Behavioural additionality type	Attribution clusters (+ number of instances)
Project additionality	New programme of postdoc grants (1); project-based funding for research (2); newly created fund to support researchers (1); investment in new research infrastructure (1)
Scale additionality	Increased size of existing funding programmes and/or the number of available grants (13); increased funding for existing research or research supporting centres, institutes, foundations or initiatives (10); increasing the volume of basic research equipment or IT equipment or both (5); additional funding for libraries and archives (2)
Follow-up additionality	Umbrella grants (2); part-time appointments (1)
Networking additionality	Organisation and facilitating of international collaborations (4); increasing mobility of researchers (2)
Operational additionality	Investment in research infrastructure and equipment benefitting multiple departments, research groups, centres, ... (4); organisational initiatives benefitting the operational management of research activities (6); administrative support for research (4)

provided information on only four initiatives, while five initiatives across all universities involved two additionality types, which amounts to 58 attributions of additionalities over 53 initiatives. In Table 2, the 58 attributions are classified by type of additionality.

Question 2 asks if the wage subsidy funded a new initiative; if it funded an existing initiative where the wage subsidy allowed for an enlargement of the scale of the initiative; or if the initiative existed but would have been cancelled, were it not for the additional funding the wage subsidy provided. In addition to these three possibilities, we have applied three ancillary classifications: we assigned the initiatives an impact level (project level or organisational level); a cost type (personnel costs, working costs or investment); and an identification of either absorbed or unabsorbed slack resources. All options are mutually exclusive. Table 3 summarises and shows the association between the type of slack and each of the three variables in turn: use, impact and cost type. Cramér's V measures the association between two categorical variables in a contingency table and determines its strength of association. It ranges from 0 to 1, where 0 indicates no association and 1 indicates a perfect association. Fisher's exact test is particularly useful for assessing the significance of associations between categorical variables, especially when traditional chi-square tests may not be appropriate.

First, the wage subsidy is predominantly used as additional funding for existing initiatives, some of which risk being cancelled should the wage subsidy cease. To a lesser degree, the wage subsidy leads to the creation of new initiatives. The measure of association points to statistical independence between the use of the wage subsidy and the type of slack: for all initiatives, the share of (un)absorbed slack is similar for all uses of the wage subsidy. The right-hand column demonstrates that using the wage subsidy to fund new initiatives is more important for larger universities, with R&D personnel in headcounts used as criterium for university size. Smaller universities are more focussed on increasing the funding for existing initiatives.

Second, Table 3 shows that over half of the initiatives are geared towards the organisational level (31 out of 53). The initiatives funded with unabsorbed slack are predominantly relevant at the project level, while being used at an organisational level tends to turn the resources into absorbed slack. The association measure shows a statistical association between the level impacted by the slack resources and the type of slack, leading to accepting hypothesis 1.

Third, the initiatives funded by the wage subsidy are classified by cost type. In just over half, or 27 out of 53 initiatives, the wage subsidy provides additional personnel in either a research or support capacity. The wage subsidy is used in just over one-third of the initiatives to cover working costs, ranging from purchasing small scientific material to creating research and expertise centres. When the wage subsidy is used as an investment in 15% of the initiatives, (co-)funding large-scale research infrastructures occur most frequently. Personnel costs are often covered by unabsorbed slack but larger scale initiatives, such as infrastructure investments, due to the commitment this represents, with absorbed slack resources. Nevertheless, there is no statistical association between the cost type and the type of slack.

Table 3 The five most important initiatives financed by the wage subsidy and its type of slack ($N = 53$)

	Answers by universities			
	(Unweighted)			(Weighted[a])
	Initiatives	Unabsorbed slack (row %)	Absorbed slack (row %)	Initiatives
Use of wage subsidy				
New initiative, non-existent without the wage subsidy	19	42.1	57.9	26
Additional funding of an existing initiative, scaled up by the wage subsidy	23	56.5	43.5	20
Additional funding of an existing initiative, but the wage subsidy prevents it from being cancelled	11	54.5	45.5	7
Cramér's $V = 0.13$; Fisher exact = 0.68				
Impact level				
Project level	22	77.3	22.7	23
Organisation level	31	32.3	67.7	30
Cramér's $V = 0.44$; Fisher exact = 0.00**				
Type of cost				
Personnel cost	27	59.3	40.7	31
Working cost	18	50.0	50.0	14
Investment	8	25.0	75.0	8
Cramér's $V = 0.23$; Fisher exact = 0.24				
Unweight answers type of slack		27	26	
Weighted answers type of slack [a]		23	30	

**$p < 0.01$

[a]Because the wage subsidy is allocated to R&D personnel, the weights of the universities are calculated based on their average number of R&D personnel (in headcounts) over 7 years (2012–2018).

Weighted and unweighted responses are similar in terms of both the wage subsidy's level of impact (project or organisational) and the cost type (personnel, working cost and investment). The degree of absorption of the wage subsidy's slack resources is higher in larger universities, which dispose of a larger sum in absolute terms and can launch larger initiatives.

Most of the wage subsidy is used as absorbed slack by universities, as seven out of the ten universities who answered question 4 indicate that 100% of the wage subsidy resources are already committed before the annual budget is drawn up. For the remaining three, this is the case for 90% (twice) and 80%, respectively. Moreover, the answers on what the universities consider to be the most critical developments in their use of the wage subsidy (question 8) demonstrate this: all universities indicate that the wage subsidy allows for increased research activities (in personnel capacity, duration of projects, more ambitious research ideas), and four out of those explicitly use the word 'structurally' to describe this process, thus indicating a high degree of continued allocation and, consequently, absorption.

Table 4 focuses on the types of additionality resulting from the wage subsidy, again combined with its use, impact level, cost type and type of slack. Responses to question 2 allow us to categorise the additionality types for each of the 53 initiatives identified as most important by the universities. Because five initiatives cover two types of additionality, the total number of allocations to an additionality is higher ($N=58$).

First, when the wage subsidy (co-)funds new initiatives, scale effects occur in almost half of them. However, these initiatives can also lead to operational additionality, as (larger parts of) the university benefit from them, and in some cases, to both scale and operational additionality, e.g. with a commitment to extending the research capacity of satellite campuses. Full project additionality occurs five times for specific research projects that did not receive alternative funding (19%). When universities use wage subsidy funds to allocate additional funding to an existing initiative, apart from the expected scale additionality, there is a component of operational additionality in one in four cases, and networking additionality in 15%. This suggests a strategic use of the additional slack resources, impacting the size, the organisation and the focus of R&D activities. When universities consider the wage subsidy as vital for continuing an existing initiative, the most common additionalities are scale, operational and follow-up additionalities. We find a slight statistical dependence (at 10% significance level) between the type of additionality and the use made by the wage subsidy.

Second, the type of additionality differs significantly according to the impact level of the initiatives (at 1%). As predicted by hypothesis 2a, scale additionalities are most common at the project level, followed by networking additionality, project additionality and follow-up additionality. However, networking additionality also appears at the organisational level, and scale additionality and operational additionality occur, thus corroborating hypothesis 2b, except for networking additionality. As Kubera (2021) notes, networking additionality is considered a special type of behavioural additionality when viewed as a one-off effect to carry out a project.

Third, each cost type is associated with different types of additionality. Additional expenditure on personnel mainly results in scale additionalities and, to a lesser

Table 4 The 53 most important initiatives funded by the wage subsidy and types of additionality ($N=58$)

	Answers by universities					
	Initiatives	Type of additionality (row %)[a]				
		Project	Scale	Follow-up	Networking	Operational
Use of wage subsidy						
New initiative, non-existent without the wage subsidy	21	19.0	47.6	0.0	9.5	23.8
Additional funding of an existing initiative, scaled up by the wage subsidy	26	3.9	53.8	0.0	15.4	26.9
Additional funding of an existing initiative, but the wage subsidy prevents it from being cancelled	11	0.0	45.4	27.3	0.0	27.3
Cramér's $V=0.41$; Fisher exact $=0.08$*						
Impact level						
Project level	23	13.0	52.2	13.0	17.4	4.4
Organisation level	35	5.7	48.6	0.0	5.7	40.0
Cramér's $V=0.49$; Fisher exact $=0.00$**						
Type of cost						
Personnel cost	28	3.6	53.5	10.7	14.3	17.8
Working cost	22	13.6	45.5	0.0	9.1	31.8
Investment	8	12.5	50.0	0.0	31.8	37.5
Cramér's $V=0.28$; Fisher exact $=0.52$						
Type of slack						
Unabsorbed slack	29	6.9	48.3	10.3	17.2	17.2
Absorbed slack	29	10.3	51.7	0.0	3.5	34.5
Cramér's $V=0.36$; Fisher exact $=0.12$						
Type of additionality						
Unweight answers		5	29	3	6	15
Weighted answers[b]		9	31	2	5	11

*$p < 0.10$ and **$p < 0.01$.

[a]The 53 recorded initiatives financed through the wage subsidy can involve multiple additionality types. Five initiatives cover two additionalities, and two universities provided information on four instead of five initiatives, which amounts to 58 attributions for 53 listed initiatives.

[b]Because the wage subsidy is allocated to R&D personnel, the weights of the universities are calculated based on their average number of R&D personnel (in headcounts) over 7 years (2012–2018).

extent, operational and networking additionalities. Wage subsidy resources going towards working costs lead to scale and operational additionalities. Wage subsidy resources for investment lead predominantly to scale, operational and networking additionalities. This, again, points to a strategic use of the wage subsidy resources, impacting more than only the available amount for the specific initiatives concerned.

Fourth, the measures of association point to statistical independence between the additionality type and the type of slack: for all additionality effects, the share of (un)

absorbed slack is largely similar because the most common type of additionality, scale additionality, results from both absorbed and unabsorbed slack.

There are slight differences when universities are weighted by their R&D personnel. Project additionality occurs more in larger universities, while smaller universities experience more operational additionality effects. This corresponds with the answers to question 9, where universities are asked to name the most important advantages and disadvantages of the wage subsidy. Of the six universities indicating operational effects as most impactful, four are smaller-sized, while three of the five more prominent universities indicate scale additionality as most important. Four universities also perceived disadvantages, with two universities stating that they still find the amount too variable, depending on how many researchers are employed and their fiscal situations. Two other universities are inhibited by the lack of certainty concerning the wage subsidy's continuing existence.

Based on the data and using the calculations presented in Tables 3 and 4, we plot these results in Fig. 1.

Hypotheses 1, stating that the wage subsidy is initially unabsorbed slack and increasingly functions as absorbed slack over time due to the continuity and predictability of the measure and a university's organisation of continuing research activities, can be accepted based on the survey responses to questions 4 and 8.

We accept Hypotheses 2a, stating that the wage subsidy is associated with project, scale and follow-up additionality at the project level. However, networking additionality predominantly appears at project level. The organisational level shows primarily operational additionality. Scale additionality is present but to a slightly larger extent than at project level. Therefore, Hypothesis 2b, stating that the wage subsidy is associated with scale, operational and networking additionality at the organisational level, is accepted for the scale and operational additionality but must be rejected for networking additionality.

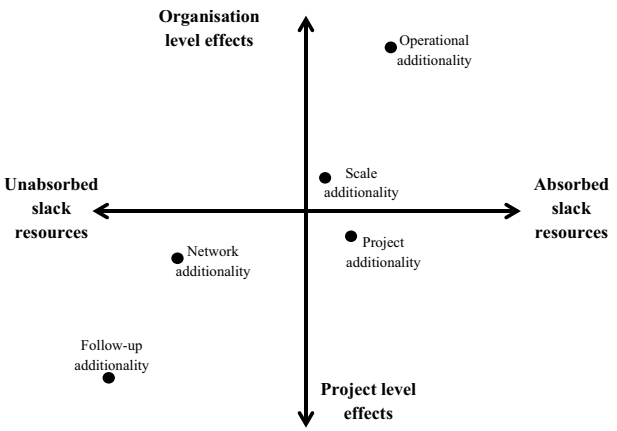

Fig. 1 Behavioural additionality effects from additional slack resources resulting from the wage subsidy in universities

Conclusions and Implications

In conclusion, our analysis of the impact of a wage subsidy in universities shows how additional slack resources move from unabsorbed to absorbed slack and result in clearly identifiable tangible behavioural additionalities. Universities' use of additional unabsorbed slack shows a more varied impact than increased means and scale effects alone. Although the wage subsidy represents, on average, 5% of a university's R&D expenditure, additionalities of scale, project, follow-up, networking and operational management have been identified.

Behavioural additionality refers to the policy impact on the actions of receiving universities (Kubera 2021), and stresses the learning processes in universities due to the public support (Georghiou and Clarysse 2006). Behavioural additionality evaluation in government policy measures assesses whether changes in behaviour occur due to the intervention. Governments are interested in this aspect of additionality to understand whether their interventions justify resource allocation, improve policy effectiveness, enhance accountability and inform future decision-making. Policy evaluation needs the concept of behavioural additionality to ascertain how policy generates outcomes and assess input and output additionality correctly (Haddad and Bergek 2023).

Two factors contribute to this effect and should be taken into account by research performing organisations and policymakers. First, if strategic priorities are firmly established, the wage subsidy can be used to greater effect. Second, a fiscal measure should be continuous and its actual amount predictable. These factors combined facilitate the transition of an important part of the resources to absorbed slack, and enable universities to plan ahead and invest structurally in their research priorities, over longer periods.

Although the bulk of the wage subsidy is used as absorbed slack, allowing for more structural support of new or upscaled initiatives, the unabsorbed part also plays a role, mainly at the project level. The degree of absorption in itself does not seem to directly impact the kind of additionalities created. But the level of intervention—project or organisation—acts as an intermediate factor with a statistically significant link to both the behavioural additionalities created and the degree of absorption.

Moreover, the freedom of use of the wage subsidy needs to be preserved because a large part of a university's existing R&D funding is already earmarked. Public support allows for experimentation and organisational innovation (Kubera 2021). The flexibility enables universities to emphasise their organisational priorities and develop initiatives aligned with their unique strengths, impacting both project and organisational level.

Future research could focus on elucidating the concept of behavioural additionality in other types of public sector organisations, more specifically on intangible additionalities such as cognitive, scope and challenge additionalities. Analysing how they can be measured reliably and objectively can contribute significantly to evaluation practices.

Appendix A: Survey on the Use by Universities of the Partial Exemption on the Payroll Tax for Researchers

No.	Information	Measure	Remarks and options
0.	Amount of wage subsidy (2012 to 2018)	euros	Prefilled based on R&D survey (Belspo, 2020)
Evolution of the use made of the wage subsidy, and decision processes involved			
1.	Share of reinvestment in R&D	%	
5.	Decision on the use of the wage subsidy funds	text	Initiative Final decision Distribution keys
8.	Major evolution in the use of the wage subsidy	text	Open question
Possible impacts representing different behavioural additionalities			
2.	The five most important expenditure items, and the amount, for 2018 to be classified in three mutually exclusive groups	text and euro	New initiative (would not exist without the wage subsidy) Additional funding for an existing initiative (would not exist on this scale without the wage subsidy) Existing initiative with insufficient funding (would be cancelled without the wage subsidy)
6.	Impact of the wage subsidy in the university (12 items)	ordinal scale (1= unimportant to 5 = very important)	Starting up new projects or programmes Extending the scale of existing projects or programmes Enlargement of the objectives of projects or programmes Increased opportunities for uncertain/risky projects Accelerated implementation of projects or programmes Development of new knowledge, skills and competences Extension of national collaborations, interactions or exchanges with other organisations Extension of international collaborations, interactions or exchanges with other organisations Altering the organisation of departments' or research groups' governance Altering the organisation of the university's governance Altering strategies of departments' or research groups' governance Altering strategies of the university's governance Other
Level of absorption of the slack resources			

No.	Information	Measure	Remarks and options
3.	Share of wage subsidy spent in the same year	%	
4.	Earmarked share of wage subsidy	%	
The wage subsidy's perceived importance, advantages and disadvantages			
7.	Importance of the continuation of the wage subsidy	ordinal scale (1= not important to 3 = very important)	
9.	Advantages and disadvantages of the wage subsidy	text	Open question

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest in this research.

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