Assessing synergy of incentives and nudges in the energy policy mix

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Abstract

Should policy-makers combine price incentives with behavioural nudges to encourage sustainable energy behaviour? Available evidence from various behavioural sciences is scarce and inconclusive about synergy of the two instruments. This is partly due to methodological limitations. We offer a framework to overcome such limitations in future research and to guide policy-making. It includes four cases: no synergy, positive synergy, weak negative synergy, and strong negative synergy or backfire. The adoption of a policy mix is recommended in the first two cases, and may be pursued in the third case. To clarify the underlying mechanisms of the synergy, a distinction is made between crowding (in/out) of intrinsic motivations by incentives and crowding (in/out) of extrinsic motivations by nudges. This distinction turns out to be especially relevant in the case of weakly negative synergy, as here behavioural and temporal spillover effects require consideration from the policy-maker as well. We end with broader reflections regarding other policy criteria for the design of an adequate energy policy mix.

Keywords: energy use; monetary incentives; nudges; behavioural interventions; instrument mix; motivation crowding.

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1. Introduction

Price instruments, such as carbon taxes or adoption subsidies, have proven to be effective in creating incentives for the reduction of energy consumption, waste or emissions (Newsham and Bowker, 2010; Maki et al., 2016). Another type of policy instrument involves interventions in the choice environment to induce behavioural change without reducing freedom of choice or altering economic incentives. These so-called nudges, such as social norm provision or default options, have been found to guide environmental behaviour as well (Andor and Fels, 2018; Liebe et al., 2018; Wynes et al., 2018). Not surprisingly, over the last decade various researchers have proposed to combine incentives and nudges (Dietz et al., 2009; Sorrell, 2015; Lehner et al., 2016; Nisa et al., 2019), especially since implementation of the latter is relatively cheap (Benartzi et al., 2017). While one should expect synergy of the two instruments, the empirical evidence is inconclusive about its size and direction, which is partly the consequence of studies using incomplete experimental designs.

This article presents a framework for assessing synergy of instruments and its implication for policy design. It disentangles synergy by distinguishing crowding (in/out) of intrinsic and extrinsic motivation. We further highlight some contextual issues such as behavioural spillovers, as these are relevant to a more complete evaluation of an energy policy mix, especially in view of the transitional nature and political instability of certain sustainability policies. The insights obtained here can guide policy-makers and will contribute to the growing literature on energy policy mixes (Fankhauser et al., 2010; Rogge et al., 2017; Wiese et al., 2018). This has focused on the interaction between economic instruments or between these and direct regulation (targets or standards), while somewhat neglecting the role of softer instruments. Although the focus of this article is on interactions between price incentives and nudges, the framework and insights may also be relevant to better understand other types of instrument interactions.

2. Challenges in assessing synergetic effects of instruments

To our knowledge, there are only a limited number of experimental studies that have compared the effectiveness of a policy mix of incentives and nudges with the performance of such instruments in isolation. At first glance, policy-makers might get the impression that the evidence is mixed: some studies suggest positive synergy (Hilton et al., 2014; List et al., 2017), others no synergy (Mizobuchi and Takeuchi, 2013; Handgraaf et al., 2013; Tørnblad et al., 2014; Schall et al., 2016; Pellerano et al., 2017; Panzone et al., 2018), and again others negative synergy (Dolan and Metcalfe, 2015; Sudarshan, 2017).

However, most of these studies have not adopted an approach that allows assessing synergy well. For this, one needs to observe behaviour in four treatments, as shown in the left panel of Figure 1: a price incentive alone, a nudge alone, a combination of a price incentive and nudge, and a control-group treatment. As illustrated in the right panel of Figure 1, the effect of a combination of two instruments can either be higher (D_p) or lower (D_n and D_b) than the exact sum of their isolated effects ($D=B+C$). In two cases the decision for policy-makers is clear: in the case of positive synergy (D_p) go ahead with the policy mix as one or both instruments reinforce the environmentally desirable behavioural effect of the other; and in case of backfire (D_b), i.e. a strong negative synergy that results in a smaller behavioural effect than each instrument on its own, a single instrument should be implemented (the more effective price incentive in the case illustrated in the figure). In a third case of weak negative synergy (D_n), i.e. not resulting in backfire, the policy mix of two instruments is more effective than what each instrument achieves on its own. In contrast with the two previous cases, it is not clear then whether the policy-maker should implement the policy mix. Implementation is recommended if the policy-maker is primarily interested in immediate effects; when adopting a longer time perspective, however, it turns out that this subcategory of negative synergy requires further scrutiny. The reason for this relates to behavioural spillovers and will be discussed in Section 4.

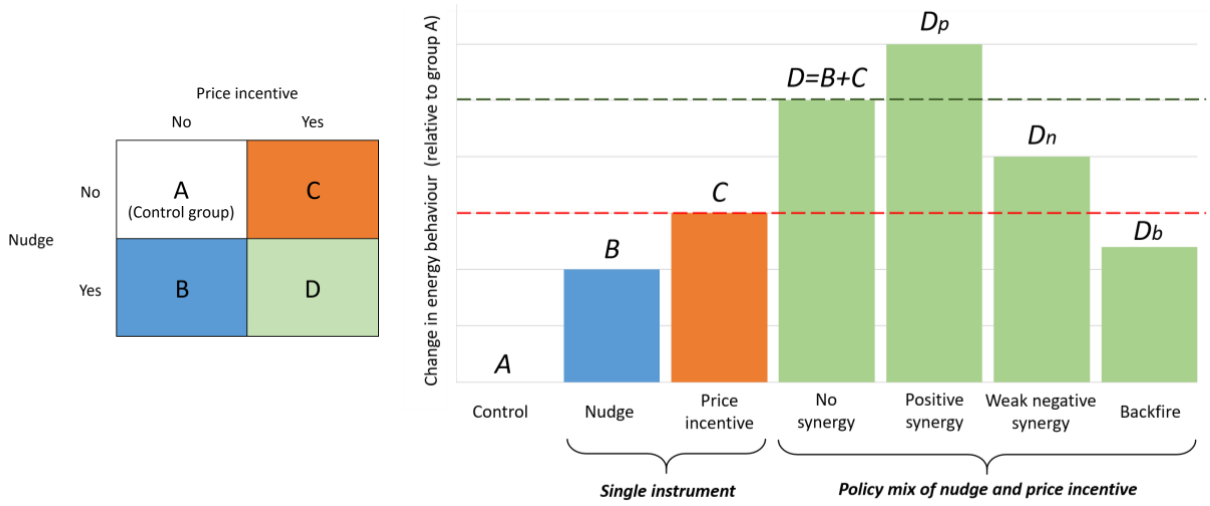

Figure 1. *Experimental design to test interaction effects between nudges and price incentives. Left panel shows the ideal experimental design of studies. Right panel classifies possible outcomes, including no synergy (D), positive synergy (D_p), weak negative synergy (D_n) and strong negative synergy resulting in backfire below C (D_b). The green broken line divides positive (above) and negative (below) synergy. Below the red broken line is backfire. For more explanation see the text.*

Note: References in the main text to treatments A-D in the left panel use no italics, while references to the associated effectiveness levels *A-D* in the right panel use italics.

Figure 1 clarifies that if a study lacks the full set of four experimental treatments it cannot draw clear conclusions about the synergetic effects of combining the two instruments. This is because one cannot compare the effect of the policy mix with the exact sum of the effects of each instrument in isolation ($D=B+C$). If, for example, a study does not observe the behaviour of treatment B (nudge alone), it can only determine whether the change in environmental behaviour of the treatment with the policy mix is higher, lower or equal than that of treatment C (price incentive alone). If the policy mix has an effect higher than *C* (right panel), it is unclear whether one is dealing with positive (D_p) or weak negative synergy (D_n) as $D=B+C$ (i.e. the green broken line dividing positive and negative synergy) is unknown. If it is lower (backfire case D_b), below the red broken line, then the policy-maker should evidently not combine the two instruments. An incomplete experimental set-up can create further confusion: if it covers treatments A, B and D but not treatment C, then one finds that the policy mix effect D_b exceeds the effect of a nudge (*B*), and one would be inclined to go for the policy mix, even though it suffers from backfire, i.e. its effectiveness is below that of the price incentive on its own (*C*).

Table 1 provides an overview of the above-mentioned studies. The majority of them are field experiments, which most often address behaviours related to household electricity use, but also fuel-efficient driving, choosing between transport modes with different energy intensity, or food choices. For example, consider a field experiment from the US, involving almost 200,000 participants with the aim of encouraging them to reduce household electricity use (List et al., 2017). In one treatment group, people received information triggering social comparisons, which reduced energy use by 1%. In another group, the nudge was combined with a financial incentive, namely rewarding households when their energy use was below the average use of similar households. Results show that the instrument mix achieved a significantly larger reduction in energy use compared to nudge-only group. The study hence suggests that combining nudges and incentives can be useful. However, it lacks an incentive-alone treatment that would allow drawing such a conclusion. This treatment would be rewarding households in case their energy use was below the average energy use of all households, without, though, framing this threshold as such. To measure the net effect of the price incentive, free from the additional effect of the nudge, the threshold would need to be framed neutrally without any reference to others' energy consumption.

A similar study was conducted by Sudarshan (2017) for Indian households. People were exposed to either weekly energy reports showing own electricity use and those of neighbours (nudge treatment), or the same reports combined with monetary incentives (policy mix treatment). In particular, participants were endowed with an initial reward budget, which they could lose due to an above-average electricity use or further increase due to a lower-than-average electricity use. In the nudge-only treatment, the study finds a significant reduction of electricity use, whereas no reduction was found for the instrument mix. These results hence suggest a negative synergy. Once again, such a conclusion cannot unambiguously be made since the incentive-only treatment was missing.

Only three of the existing experimental studies mentioned before have a research design that includes all four treatment groups (Hilton et al., 2014; Schall et al., 2016; Panzone et al., 2018). They arrive at distinct conclusions with respect to synergy. The first study by Hilton et al. considered hypothetical transport choices in France and finds a positive synergetic effect of combining a tax and norm. The second study by Schall et al. undertook a field experiment among employees of a German logistics company to examine how information and incentives and their combination affect fuel use in driving. Neither providing a monetary reward or tips for "eco-driving", nor their combination, was found to reduce fuel consumption in the long run. The third study by Panzone et al. for the UK analyzed how a carbon tax interacts with a moral nudge in influencing food choices in an online supermarket. While both instruments in isolation reduced the carbon footprint of consumers' food basket, the study found no evidence for any synergy between them.

The rest of the earlier mentioned studies include at least one treatment combining incentives and nudges, and one treatment with either an incentive or a nudge, but not both (Mizobuchi and Takeuchi, 2013; Handgraaf et al., 2013; Tørnblad et al., 2014; Dolan and Metcalfe, 2015; List et al., 2017; Sudarshan, 2017; Pellerano et al., 2017). To be fair, some may be limited for practical reasons, especially field experiments where the design is sometimes imposed by real-life constraints. Moreover, not all of them have identification of instrument synergy as their main research objective, but they still draw conclusions about interaction effects. Often the reasoning is that when the effect of a combination of instruments is larger than that of a stand-alone instrument, the instruments can be judged as complementary (i.e. positive synergy). However, without knowing the size or the direction of one intervention, it is impossible to draw conclusions about synergetic effects.

Table 1. Overview of experimental studies examining price-nudge synergy

Study	Domain	N	Instrument mix	Missing treatment	Synergy

Dolan and Metcalfe (2015, experiment 2)	Household electricity use	2,142	Descriptive norm + financial reward	Nudge	Negative (suggestive)
Handgraaf et al. (2013)	Energy saving behavior in workplace	83	Social comparison + financial reward	Nudge	Zero (suggestive)
Hilton et al. (2014, experiment 1)	Transport mode	887	Injunctive social norm + tax	-	Positive
List et al. (2017)	Household electricity use	195, 826	Descriptive norm + financial reward	Incentive	Positive (suggestive)
Mizobuchi and Takeuchi (2013)	Household electricity use	236	Comparative feedback + financial reward	Nudge	Zero (suggestive)
Panzone et al. (2018)	Food choices	260	Environmental recall + carbon tax	-	Zero
Pellerano et al. (2017)	Household electricity use	27,634	Descriptive norm + hypothetical financial reward	Incentive	Zero (suggestive)
Schall et al. (2016)	Fuel-efficient driving	91	Information + financial reward	-	Zero
Sudarshan (2017)	Electricity use	484	Descriptive norm + financial reward	Incentive	Negative (suggestive)
Tornblad et al. (2014)	Transport mode	1,792	Information + free public transit pass	Incentive	Zero (suggestive)

Note: Given the lack of all four treatments in many studies, the term "suggestive" in the last column on "Synergy" expresses what the authors suggest or what seems most plausible.

3. Synergy through motivational crowding

Many of the previously discussed studies (Hilton et al., 2014; Dolan and Metcalfe, 2015; Schall et al., 2016; Pellerano et al., 2017; Sudarshan, 2017) explain their findings through the lens of motivation crowding theory (Ryan and Deci, 2000). This builds on the idea that people act upon a combination of extrinsic and intrinsic motivations. The former refers to doing something because of monetary incentives (Bowles and Polania-Reyes, 2012). The latter refers to doing something because it is inherently pleasant itself, or for moral or other non-economic motives, such as values, pride, shame, warm glow, etc. Motivation crowding-out (in) then refers to the idea that a monetary incentive weakens (strengthens) any intrinsic motivation an individual has for undertaking an action, as depicted in the left panel of Figure 2. Various mechanisms may underlie motivation crowding (Rode et al. 2015), such as control aversion, reduction of image motivation, or release from moral responsibility in the case of crowding-out; and enhanced self-

esteem through social recognition or observing the restriction of others in the case of crowding-in. Motivational crowding is a psychological explanation of an observed synergetic effect, which most of the here discussed papers adopt in a post-hoc manner.

It could also be the case, though, that instead of motivation crowding, a mechanism that we call 'incentive crowding (in or out)', caused by the nudge, is active. The right panel of Figure 2 graphically illustrates it. An example of crowding-in of an incentive effect by a nudge is combining an adoption subsidy for electric vehicles with a nudge stressing their social status; since consumers generally are willing to pay much for status goods, this could strengthen the incentive effect. Alternatively, motivational crowding-in may be in place. In this case, the introduction of the incentive attaches additional status to the electric vehicle, which subsequently increases the effect of status concerns. Hence, in reality both motivation and incentive crowding mechanisms may be simultaneously at work.

Even if the four treatments are included and weak negative synergy is unambiguously identified, this still does not suffice to decide which type of crowding underlies it. For this purpose, one needs to collect specific data capturing respondents' motivation. This can be achieved through self-reported data, such as in a related study by Steinhorst and Klöckner (2018) on household electricity use. This study has not been included in the review as it does not examine an instrument combination but rather two single instruments in isolation. There are three experimental groups: one that receives environmental reasons as a motivation to reduce electricity use, another group with financial reasons, and a control group without information. In addition to actual and intended behaviour, the study also measures intrinsic motivation. It shows that financial reasons do not reduce intrinsic motivation (vs. a control group), but environmental reasons increased motivation. Moreover, both interventions increased short-term behaviour change intentions, but none increased electricity savings in the long-term. If the study had examined the instrument combination, it could have derived insights regarding the underlying mechanisms of the potential synergy, i.e. about how the instrument

combination affects intrinsic motivation, by comparing the intrinsic motivations across treatments.

Given the problems with self-reported data, such as social desirability bias, one might also investigate mechanisms in a more sophisticated way through neural research (Sawe, 2019). In any case, it is not our purpose here to discuss the variety of potential mechanisms or how to investigate them, but rather to stress that most current studies only speculate about mechanisms. Further research needs to go one step further and actually examine potential mechanisms. This is also important from a policy perspective, as we will point out in the next section.

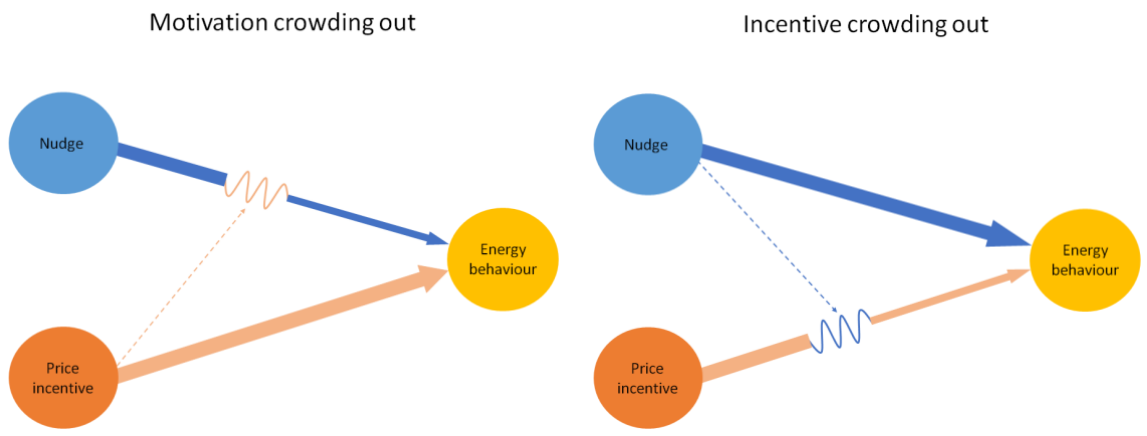

***Figure 2**. Two types of crowding-out illustrated for negative synergy. Similar diagrams can be drawn for crowding-in.*

4. Policy mix design accounting for spillovers of behaviour

If the policy mix is more effective than any single instrument alone, why is it important to know whether the synergy is positive or weakly negative? Is it not in both cases the policy-makers' best option to combine the instruments? And, in case of weakly negative, why is it important to differentiate between motivational and incentive crowding out?

To understand why, the concept of spillover is relevant here. It refers to situations where engaging in one behaviour affects the probability of engaging in another, similar behaviour (behavioural spillover), or in the same behaviour but in another context (contextual spillover) or point in time (temporal spillover). For instance, starting recycling at home may lead people

to buy organic food products (first type spillover), or to recycle at work (second type), or even to recycle repeatedly over a long period of time, i.e. to turn it into a habit (third type) (Truelove et al., 2014). If an intervention crowds out/in intrinsic motivation for the behaviour, it is then possible that the effect will spill over to other situations as well (Maki et al., 2019). Therefore, in case of weakly negative synergy with negative spillovers due to motivational crowding out, the policy mix should be re-evaluated.

Consider the case of temporal spillover. This is particularly relevant for sustainability policy as it has two features that create temporal variation: transitional nature and political instability. For example, policies such as subsidies for adopting electric vehicles or rooftop solar energy are generally intended to be implemented temporarily, that is, until a transition to a widely diffused technology or behaviour has been initiated. Other important sustainability policies such as carbon taxes are very sensitive to political winds – witness the variability of this instrument at regional and national levels in a country like Canada, France or Australia (Klenert et al., 2018; Macneil, 2020).

The problem with such temporal variation in policies is that motivational crowding-out may occur because of a price incentive in the policy mix, which can weaken pro-environmental motives. If then this price incentive is removed, pro-environmental motives might not recover but remain at their low level. Energy behaviour is then worse than in the pre-policy stage. Unequivocal evidence for such temporal effects is difficult. It requires ambitious experimental designs that observe behaviour at three points in time: before the introduction of an incentive scheme, when the incentive is in place, and after removing it. If the behaviour in the third phase falls back to levels below that before the introduction of the incentive, then this may be seen as evidence for temporal effects. They have been observed for social problems such as the famous "kindergarten fine" (Gneezy and Rustichini, 2000) and they may equally apply to energy challenges.

The same considerations apply in the case of contextual spillovers, whereby the positive effects in the targeted domain might be partly offset by a negative effect in other domains. An expression of these contextual and behavioural spillovers are well-known direct and indirect rebound effects (Sorrell et al., 2020). In deciding about a policy mix, such long-term and contextual effects should be considered next to the direct synergetic effects of Figure 1.

Lastly, a disclaimer is in order. The area between the two dashed lines in the right panel of Figure 1, i.e. the weak negative synergy, is where most policy mixes are likely to be placed. This is not necessarily the outcome of an important drop in intrinsic motivation that policy-makers should be alarmed about. Instead, it can be a partial consequence of peoples' energy behaviour being only affected to a certain degree, after which further change is difficult or impossible – i.e. a form of diminishing marginal returns to policy pressure.

5. **Conclusion and policy implications**

In this article we have focused on the effectiveness of a policy mix in terms of changing behaviour and in turn environmental pressure. Hundreds of studies have examined how price incentives and behavioural nudges in isolation affect energy behaviour, with most of the evidence showing some degree of effectiveness. Policy-makers might jump to the conclusion that it is worthwhile to join these instruments. Here we have given reasons to be cautious. First, not only is there a small body of evidence but within it very few studies suggest positive synergy. Second, our understanding of their combined effects is limited, as studies rarely use an approach that allows properly assessing synergy or the causes and mechanisms of it. Many studies of instrument combinations have neglected to measure the effects of an incentive or a nudge as a stand-alone instrument. Third, studies often interpret any synergetic outcomes as due to motivation crowding. However, all reviewed studies that claim to find motivation crowding are unable to exclude what we have called 'incentive crowding'.

Building on best practices of experimental research, our main contribution is to provide policy-makers with a framework that allows assessment of research evidence to decide on policy design. Policy-makers best employ an instrument combination if – according to our framework in Figure 1 – the evidence points to no or positive synergy. In the case of a weak negative synergy, the policy-maker is most likely still interested in pursuing the combination, as both instruments achieve more than one single instrument. If the policy-maker is concerned about long-term effects, she has to know what underlies the weak negative synergy. Such long-term effects may, however, not play a major role in real-world policy-making, which arguably has fairly short time horizons. On the other hand, when dealing with energy policies in the context of climate change, it is important to adopt a long-term perspective. Finally, in the case of backfire, the policy-maker is clearly advised against adopting the instrument mix.

Our analysis focused on the effectiveness of a policy mix in terms of reduced energy use or emissions. To arrive at a balanced advice for policy mix design one needs to invoke other criteria, such as cost-effectiveness and feasibility. With regard to the first, in the right panel of Figure 1 one could assess whether additional effectiveness of a second instrument is worth the additional policy cost. Regarding the second, recent evidence suggests that making people aware of nudges can reduce public acceptability of a more effective carbon tax (Hagmann et al., 2019). This shows that one may have to trade-off distinct criteria to some extent. Our framework provides a starting point for further exploration of these issues.

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