Policy announcements and economic activity: modelling the energy transition on the micro-level*

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Abstract

The starting point of this paper is the question whether policy announcements related to the energy transition have an impact on economic activity. In a first step, we explore empirically if an impact of policy announcements on microeconomic decision-making of firms can be identi- fied. Methodologically, we apply an event-study approach to test whether credible government announcements in uence the number of firm entries. To do so, we use data from the Swiss commercial register to analyse the number of new firm registrations related to green energy services. Our study reveals a significant relationship between information on future policies and firm entries. In a second step, we develop a stylised model in order to gain more clarity about the economic mechanisms behind the empirical observation. The commitment to regulations and laws, for example subsidies, is core to the credibility of environmental policies as well as to protect environmental targets against discretionary actions by myopic governments. Our model comprises strong and weak governments. The latter are unable to commit to their environmental policy. We show that a weak government has no incentive to mimic the environmental policy of a strong government such that the public has clarity about the government's nature. A strong government on the other hand can make use of policy announcements to spur technological change and green economic activity.

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1 Introduction

The aim of this paper is to analyze the relevance of policy announcements for the energy transition. Existing literature focuses on the implementation of taxes and subsidies aimed at an acceleration of green innovations to speed up the decarbonization of the growth process at large. Conceptually these papers build on seminal contributions by Acemoglu (1998), Acemoglu and Zilibotti (2001) and Acemoglu, Aghion, et al. (2012) and emphasise the relevance of relative market sizes for the development of green versus polluting innovations. They are thus history-dependent and leave no scope for the role of expectations. Complementing this strand of the literature, more recent papers sought to stress the impact of taxes and subsidies for the relevance of expectations compared to history in the context of the energy transition (Bretschger and Schaefer, 2017, Schaefer and Stünzi, 2019). Announcement effects of policy-makers are not considered. This is surprising because announcement effects are subject to a long history of research in monetary macroeconomics (e.g. King et al., 2008, Barro and Gordon, 1983). The lack of research about the impact of announcement effects may be legitimate, if we were sure that these would not affect current investment behaviour. However, we are not aware of any study confirming such irrelevance of announcements nor can we support this reasoning by theoretical arguments.

In a first step, we thus analyse empirically whether announcement effects of policy makers in the context of the energy transition affect current economic activity. To do so we propose the analysis of data that has - to our best knowledge - so far not been used for any empirical analysis. We look at the impact of specific policy announcements fostering the energy transition on the number of firm entries in Switzerland. In general, we argue that data on market entries could yield interesting insights about expectations on the firm level, in particular for companies not listed at the stock markets. Conceptually, we proceed somewhat similarly to event study analysis. We identify key decisions in the Swiss parliament with respect to the support of green energy use and test whether the number of firm registration changes following such major decisions. Our study reveals a significant relationship between information on future policies and firm entries.

Based on these findings, the ignorance of potential announcement effects is not reasonable. In contrast, they seem to be core for the formation of entrepreneur's expectations about the evolution of the future policy path. But if this is the case, earlier contributions in monetary

economics dealing with the inflation bias argument reason convincingly that policymakers may be unable to commit credibly to their announcements. In other words they deviate from their previous announcements in order to increase their utility by surprising the public with an unexpected inflation rate (Barro and Gordon, 1983). The discussion about the relevance of announcements thus involves the dimensions of credibility and time-consistency.

One might object against our empirical findings that focusing on Switzerland reduces this risk of hold-up problems, since political decisions are usually not reversed as it was for example the case in the UK for electricity system (Geels, 2014). In Switzerland, the decision-making process is very transparent (i.e. parliamentary discussions can be tracked, the agenda-setting is communicated beforehand etc.), however, the final outcome of a parliamentary vote can still yield surprises. Potential business founders can thus not be sure about a future policy up to the day of the actual vote in the parliament or the communication by the federal government. But even if Switzerland may be considered as a special case in terms of its institutional setting it underlines the fact that credible announcements affect current economic activity such that the absence of this research can not be explained by the irrelevance of announcement effects. Moreover, we think that this argument rather emphasises the necessity to understand the connection between announcements and economic activity also theoretically.

We therefore consider in the second part of our paper a stylised model comprising entrepreneurs that invest before they produce in their technology given their expectations about the government's policy in terms of a pollution tax. The important feature is that the public is uncertain about the nature of the government. A strong government is able to commit to its previously announced policy while a weak government deviates from its announcement. The incentive to deviate stems from a tradeoff between increasing output above a sustainable long-run target and enforcing environmental targets which would reduce production as long as the technology is polluting. With this simple model we are able to isolate the most important arguments from a theoretical perspective. Irrespective of the institutional setting, the weak government has no incentive to mimic the strong government. This increases the credibility of announcements. In particular, if the technological alternative is non-polluting and subsidised, a weak government has no incentive to refrain from an announced pollution tax. This is the case because the tax income looses importance for the output target when the applied technology becomes less polluting (and thus not subject to the tax anymore). The incentive to deviate from an announced policy would be most pronounced if the environmental tax is high and there is

no technological alternative. Strong governments on the other hand can use policy information as credible signals to spur the transition to green technologies.

The reminder of the paper is structured as follows. In section 2 we describe the empirical data, the method and the results of the case study analysis. In section 3, we introduce the model and analyse the credibility of announcements by weak and strong governments. Finally, section 4 concludes.

2 Empirical Case Study

In the following section we analyse whether credible signalling and respective market entries can be identified empirically. Existing economic literature describes entry and exit decisions of companies mostly in light of the product lifecycle theory, innovation and technological advances (e.g. Geroski, 1995), market saturation (e.g. Agarwal and Gort, 1996, Campbell, 1997) and entry costs (e.g. Shapiro and Khemani, 1987). Furthermore there are empirical analyses, examining attributes that incentivise market entries in retail (e.g. Carree and Thurik, 1996), with respect to new business areas (e.g. Chang, 1996) or export markets (e.g. Bernard and Wagner, 2001).

With regards to policy information, there is broad literature about the impact of policies and announcements used in monetary policy (e.g. King et al., 2008) and asset markets (e.g. Ilic and Mollet, 2016; Ramiah et al., 2016) and the respective risk of stranded assets (e.g. Caldecott, 2017; Bretschger and Soretz, 2018) as well as with respect to research and development (R&D) (e.g. Schmidt, Schneider, et al., 2012). With respect to the combination of market entries and policy announcements we could not find any theoretical nor empirical literature. Political science literature has analysed the interplay between technological change and policy-making in light of the energy transition (e.g. Schmidt and Sewerin, 2017, Hoppmann et al., 2014). However, these papers usually analyse the total deployed capacity and not the economic activity on the firm-level. As Shen (2014) shows, firms are more likely to enter a market in prospect of demand taking off soon. Policy measures such as subsidies aim to increase demand and should therefore positively influence the expectations of entrepreneurs.

In general, data on firm entries could yield interesting insights about expectations on the micro-level, in particular for firms not listed at the stock markets. This paper make a first approach to analyse market entries of firms.

2.1 Data

We use data from the Swiss commercial registry (SHAB), publicly available on their website (SHAB, n.d.). We define three keywords "Solarenergie", "Erneuerbare Energie*" and "Solaranlage*".[1] At least one of these three keywords has to be present in the firm purpose of the newly listed company. As such, we make sure that the company's operation is related to green energy. For the timeframe January 2005 until August 2019 we manually determine the number of new firm entries per month from the archive. In total, there are 815 entries.

For determining the events, we manually draw a timeline of political decisions with respect to energy policy in Switzerland for announcements (date of decision) and implementation date. The analysed policies were planned to increase the share of renewable energy consumption by reducing the upfront investment cost ('EIV'), increasing the revenues for selling the electricity to the local energy providers ('KEV') and increasing the budget to supply KEV ('Ceiling increased'), creating the possibility to use the electricity as consumer ('ZEV') and thereby saving grid fees, reducing costs for planning ('No planning permission') and increasing overall transparency towards the customer about the energy mix ('New transparency guidelines'). We can differ between decisions made by the government, the parliament and a popular vote ('Revision'). In total we identified 6 important dates with new decisions and 6 implementation dates.

Date	Announcement of Decision	Implementation
March 2007	KEV	
January 2009		KEV
December 2010	Ceiling increased	
January 2011		Ceiling increased
August 2011	New transparency guidelines	
October 2011		New transparency guidelines
June 2013	EIV + ZEV	
October 2013	No planning permission	
January 2014		Start ZEV
April 2014		Start EIV
May 2017	General Energy Law Revision	

Table 1: Announcements and implementation of new laws supporting green energy use in Switzerland.

Figure 2 shows the number of firms entries and the general trend. We can decompose the number of firm entries in trend, seasonal variation and random variation. There is some seasonal variability, but no linear trend. There was a substantial increase from 2005 until 2012, a decrease

[1] The * is used to for a more intelligent search, i.e. the word could also be longer, in plural etc.

between 2012 and 2015 and a stabilisation since 2015.

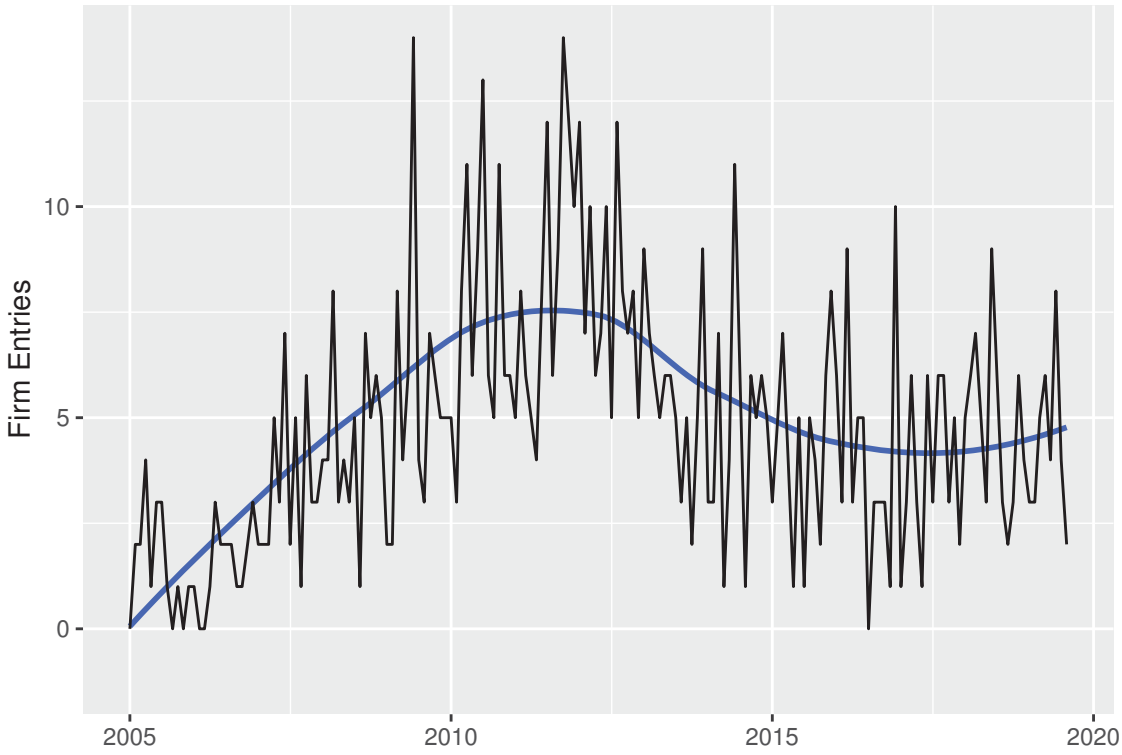

Figure 1: Number of firm entries related to green energy. Data: SHAB, n.d.

To control for seasonal variation we use monthly dummies. Furthermore, we create yearly dummies that allow us to reflect macroeconomic developments such as the steadily decreasing prices for solar modules (IRENA, n.d.) as well as the general economic trend for each year.

2.2 Method

For our analysis we proceed somewhat similarly to an event study analysis (Binder, 1998). Event studies are used to measure the impact of specific events or announcements on the market value of companies. In our case we look at the impact of a specific parliamentary decision on the number of firm entries. To do so we add new factors, representing new information available for potential firm founders. We then use OLS regression to test the effect of the periods where a decision was already taken on the number of new firm entries.

2.3 Results

In (1) we only look at the publicly communicated decisions and implementation dates, in (2) we control for seasonal variation and in (3) for yearly variation.

Table 2: Results

	Dependent variable:		
	Firms		
	(1)	(2)	(3)
announcementParl: KEV	4.286***	4.046***	3.715**
	(0.499)	(0.749)	(1.824)
announcementBR: Transparency Guidelines	6.071***	6.160***	6.505***
	(1.884)	(1.918)	(1.999)
announcementBR: No planning permission	5.171**	5.032**	7.371***
	(2.535)	(2.545)	(2.761)
announcementParl: EiV + ZEV	1.921	2.413	4.486*
	(2.263)	(2.323)	(2.549)
announcementVote: Energy Law 2050	5.347**	5.039*	8.885***
	(2.688)	(2.696)	(3.160)
implementationStart KEV	5.012***	5.011***	3.757
	(0.636)	(0.603)	(2.337)
implementationCeiling increased	5.429***	5.390***	5.557
	(0.967)	(0.927)	(3.481)
implementationTransparency guidelines	1.829	1.422	4.702
	(1.953)	(1.915)	(4.129)
implementationNo planning permission	−2.171	−2.032	−7.052
	(3.415)	(3.339)	(4.832)
implementationStart ZEV	−1.505	−1.608	−6.660
	(2.859)	(2.821)	(4.363)
implementationStart EiV	−0.847	−0.929	−4.533
	(2.563)	(2.503)	(4.000)
month02		−0.608	−0.586
		(0.814)	(0.859)
month03		1.592*	1.614*
		(0.814)	(0.859)
month04		−0.257	−0.205
		(0.816)	(0.868)
month05		−0.835	−0.880
		(0.811)	(0.866)
month06		2.364***	2.220**
		(0.809)	(0.873)
month07		0.281	0.021
		(0.814)	(0.882)
month08		−0.519	−0.779
		(0.814)	(0.882)
month09		−0.229	−0.539
		(0.833)	(0.906)
month10		0.128	−0.182
		(0.833)	(0.906)
month11		0.367	−0.184
		(0.828)	(0.910)
month12		0.724	0.173
		(0.828)	(0.910)
year2006			−0.000
			(0.872)
year2007			0.214
			(1.416)
year2008			0.813
			(1.725)
year2009			0.556
			(2.313)
year2010			2.159
			(2.495)
year2011			−0.201
			(3.420)
year2012			−3.180
			(3.837)
year2013			−5.067
			(3.926)
year2014			2.681
			(2.984)
year2015			1.356
			(2.915)
year2016			1.356
			(2.915)
year2017			−0.027
			(2.628)
year2018			0.649
			(1.005)
year2019			
Observations	176	176	176
R^2	0.850	0.875	0.888
Adjusted R^2	0.838	0.855	0.858
Residual Std. Error	2.287 (df = 163)	2.163 (df = 152)	2.137 (df = 139)
F Statistic	70.933*** (df = 13; 163)	44.255*** (df = 24; 152)	29.849*** (df= 37; 139)
Note:			*p<0.1; **p<0.05; ***p<0.01

As shown in table 2 all announcements significantly alter the number of firm entires, while the actual implementation date is not significant anymore as soon as we control for monthly and yearly fixed effects. The adjusted R^2 increases to up to 85%. A certain seasonal variation is visible, in March and June significantly more companies are registered.

This effect is also visible if we split the different time periods before and after a policy decision and the corresponding implementation.

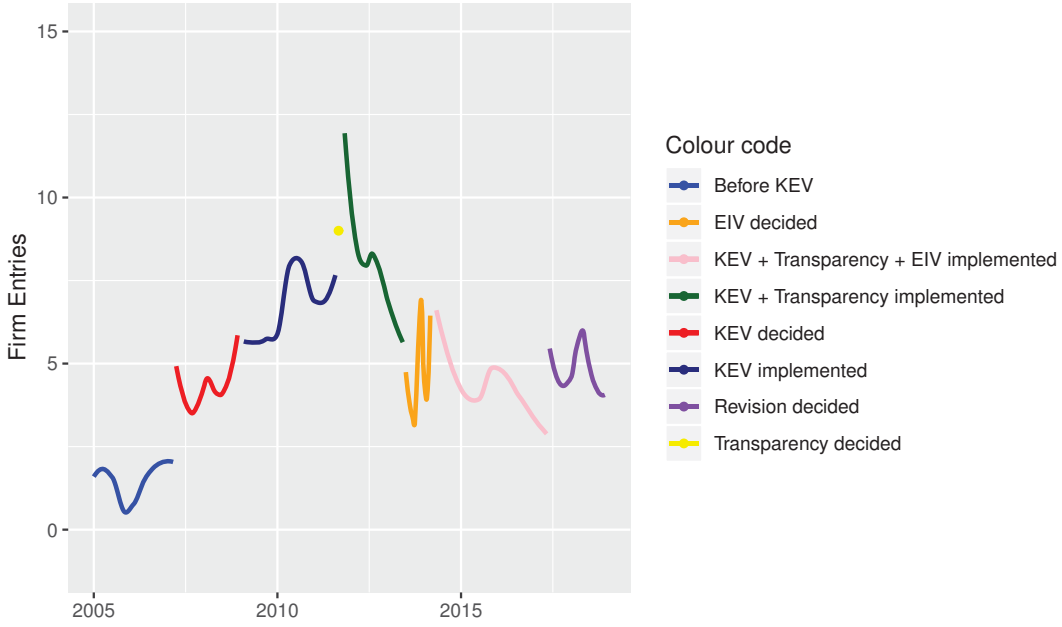

Figure 2: Number of firm entries related to green energy, divided in different time periods. Data: SHAB, n.d.

2.4 Discussion

The empirical analysis shows that the number of firm entries significantly increased after the decision (and public announcement) of specific policies aiming to increase the share of renewable energy consumption. For the actual implementation of the respective policies such effect is not visible. From these results one can derive two interesting implications: first, it is likely that the government was indeed able to signal a commitment towards entrepreneurs in the area of renewable energies. As such, it was able to spur the development of a market simply by providing information. The government was therefore credible - an important prerequisite for the use of announcements for policy-making as shown in literature on monetary policy (e.g. King et al., 2008). Second, political science literature has shown that policy-making relies on

feedback mechanism (e.g. Schmidt and Sewerin, 2017). With increasing numbers of companies relying on a certain policy, a government may be more committed to actually implement the policy after its announcement. In the following sections we discuss these factors theoretically.

Note that there are several limitations. First, we do not observe whether the company stays in the market or not (*exit*). The aim of the analysis is however, to analyse the expectations about the economic development. Although optimistic expectations about future revenues may not be sufficient to determine whether someone enters the market, it is definitely a necessary condition. Second, we only include national policies and respective information and neglect any potential support on a communal level. The additional analysis of exit decisions and such local legislatives may be an interesting project for future research.

Despite these open questions, it seems save to say that the ignorance of announcement effects is not reasonable when analysing the interplay between economic activity and policy-making. In contrast, policy information seems to be core for the formation of entrepreneur's expectations about the evolution of the future policy framework and therefore the respective business case.

3 The Theory

The empirical case study suggests that announcements are critical and anticipate the foundation of new firms before the actual implementation date of a policy itself. Conceptually this relates to the question of the credibility of policy announcements and the possibility to commit to these announcements. In this section, we seek to shed light onto the economic reasoning behind the observations revealed in the previous section.

3.1 A simple model

We consider the interplay between firms and different types of governments, weak (W) and strong (S). These differ with respect to their ability to commit in the sense that a weak government may deviate from previously announced environmental targets while a strong government is able to commit credibly to its announced policy target. Firms are homogeneous and unable to observe the type of the government until their type is revealed by the actions they have taken. This implies that firms take their actions based on beliefs, i.e. some prior probability about the government's nature. We derive the central arguments in a two period model. Conceptually we

build on seminal contributions by Barro and Gordon (1983) and Cukierman and Liviatan (1991).

Weak and strong governments

Realistically, the objectives of governments are myopic and at the same time related to long-term goals. In particular during the electoral cycle, one important aim of governments is to stabilize the level of output (y) around a certain trend level ($\bar{y}$). At the same time, the acceleration of climate change forces governments to aim at environmental targets which are at least in the short-run in conflict with their output target. We capture this trade-off by the following objective function

$$u_{j,t} = \lambda(y_{j,t} - \bar{y}) - \frac{\pi_j}{2}(P_{j,t} - \bar{P})^2, \tag{1}$$

with $\lambda, \pi_j > 0$ and $j = S, W$.

The environmental target is reflected by an emission target of pollutants ($\bar{P}$), where pollutants are generated by production subject to the following relationship

$$P_t = \phi y_t, \qquad \phi > 0, \tag{2}$$

such that an emission target implies an upper bound of production ($\bar{y} = \frac{\bar{P}}{\phi}$) with a given technology. The first term in (1) reflects the government's desire to increase actual output above the sustainable long-run value of output weighted by λ. The second term captures a quadratic cost term arising from violations of the emission target owed to a level of production above $\bar{y}$. The government optimises the trade-off between output and the emission target by implementing a pollution tax (τ). Based on the announcement of this tax, firms invest in their productivity or conduct a switch to a green and non-polluting production technology. Following that, production takes place and the pollution tax is implemented. The difference between a weak and a strong government is that a strong government is able to pre-commit to its announced pollution tax while a weak government deviates from environmental targets, for instance if the economic outlook becomes more pessimistic after the tax has been announced. Simplifying matters we assume that a weak government ignores under these circumstances the emission target completely, i.e. $\pi_W = 0$, such that it prioritises the maximisation of output.[2]

[2]We could also introduce a productivity shock on production which materialises after the announcement of the pollution tax and investments have taken place. To save on notational clutter, we assume that the weak government prioritizes output over the pollution target with the rather harsh assumption that $\pi_W = 0$ at least

Firms

Consider a $[0,1]$-continuum of identical firms producing output with energy only

$$y_t = a_t^{1-\beta} e_t^{\beta}, \qquad \beta \in (0,1). \tag{3}$$

Each of which invests in its productivity (a_t) before production takes place and after the government has announced a pollution tax ($\tau_{a,t}$).

The timing of events within one period is a follows:

1. The government announces a pollution tax $\tau_{a,t}$.
2. Firms form expectations about the pollution tax based on their beliefs that the government may be strong or week.
3. Based on their expected tax rate ($\tau_{e,t}$) firms invest in their productivity level a or switch to a non-polluting technology[3].
4. Firms produce output and the pollution tax is implemented.

Denote the price per unit of energy by z, profits of a typical firm read as

$$\Pi_t = y_t - (z + \tau_t) e_t - m \cdot a_t^2, \qquad m > 0. \tag{4}$$

Investments in a capture the notion of upfront investments in the technology before production takes place. Since the pollution tax has not been materialized at this stage, investments in the technology take place based on expectations ($\tau_{e,t}$) and we obtain a_t from the first-order condition of the profit function as

$$a_t = a(\tau_{e,t}) = \frac{1-\beta}{2m} \Big(\frac{\beta}{z + \tau_{e,t}} \Big)^{\frac{\beta}{1-\beta}}. \tag{5}$$

Obviously, higher energy prices and higher expected taxes reduce investments.

Profit maximizing energy demand builds on investments in technology

$$e_t = a(\tau_{e,t}) \Big(\frac{\beta}{z + \tau_t} \Big)^{\frac{1}{1-\beta}} \tag{6}$$

with some positive probability.

[3]Note that conceptually there is no difference between technology switch and new market entries as analysed in the empirical case study

3.2 Equilibrium solutions - the strong government only

It is instructive to look at the implications of our model if there was no weak government. Under these circumstances there is no scope for time inconsistencies and the announced policy is credible in the sense that

$$\tau_t = \tau_{e,t} = \tau_{a,t}. \tag{7}$$

Hence, investments, energy demand and the level of output are obtained as

$$a_t = \frac{1-\beta}{2m}\Big(\frac{\beta}{z+\tau}\Big)^{\frac{\beta}{1-\beta}} \tag{8}$$

$$e_t = \frac{1-\beta}{2m}\Big(\frac{\beta}{z+\tau}\Big)^{\frac{1+\beta}{1-\beta}} \tag{9}$$

and

$$y_t = \frac{1-\beta}{2m}\Big(\frac{\beta}{z+\tau}\Big)^{\frac{2\beta}{1-\beta}}. \tag{10}$$

The strong government maximizes its objective function (1) subject to (10) with respect to τ_t, such that

$$\tau_t = \beta\Big(2m\Big)^{\frac{\beta-1}{2\beta}}\Big(\frac{(1-\beta)\pi\phi^2}{\lambda+\phi\bar{P}}\Big)^{\frac{1-\beta}{2\beta}} - z \tag{11}$$

Intuitively, the pollution tax is declining in the weight of the output target (λ), the investment costs steered by m and energy prices (z) which reduce energy demand. On the other hand, the pollution tax is increasing in the weight of environmental targets (π), the pollution target (low $\bar{P}$) and the pollution intensity of production (ϕ).

Profits of a typical firm are the obtained as

$$\Pi_{d,t} = \frac{1-\beta}{2}\frac{\lambda+\phi\bar{P}}{\pi\phi^2}, \tag{12}$$

where the subscript d indicates that the polluting technology is applied.

Firms may switch to a green and non-polluting technology which is not taxed if they incur switching costs ψ. This technology may be subsidized with s per unit of energy produced, such

that (net) profits read

$$\Pi_{g,t} = \frac{(1-\beta)^2}{4m}\Big(\frac{\beta}{z_g - s}\Big)^{\frac{2\beta}{1-\beta}}. \tag{13}$$

Firms are willing to switch if $\Pi_{g,t} \geq \Pi_{d,t}$ which implies a minimum subsidy obtained from

$$z_g - s < \frac{\beta}{\frac{2m}{1-\beta}\frac{\lambda+\phi\bar{P}}{\pi\phi^2} + \frac{4m\psi}{(1-\beta)^2}}. \tag{14}$$

Clearly, arguments inducing an increase in the pollution tax like a low $\bar{P}$ make a market entry into green technologies more likely, potentially also at low subsidies. The point here is that the regime switch hinges on a credible emission tax related to clearly communicated emission targets.

3.3 Equilibrium solutions - the weak government only

If there is no uncertainty about the existence of a weak government in place, the public will anticipate that the government will prioritize the output target. Hence, the government will maximise (1) subject to (10) and $\pi_W = 0$ which implies that $\tau_t = 0$. Profits of a typical firm are thus obtained as

$$\Pi_{d,t} = \frac{(1-\beta)^2}{4m}\Big(\frac{\beta}{z}\Big)^{\frac{2\beta}{1-\beta}}. \tag{15}$$

Since the emission target and the pollution target cannot be credibly enforced, any subsidy on green technologies is also not credible. Under these circumstances a regime switch to the green technology would only occur if the green technology is sufficiently productive in the sense that profits compensate for the regime switch. A scenario which is rather unlikely.

3.4 Equilibrium solutions - uncertainty about the government's type

If the public is uncertain about the nature of the government in place it has to form believes, i.e. assign prior probabilities to the emergence of the type of a government being either strong or weak. Denote the probability of the government in place being strong by p, the expected tax

rate reads as

$$\tau_{e,t} = p\tau_{S,t} + (1-p)\underbrace{\tau_{W,t}}_{=0} \tag{16}$$

$$= p\tau_{S,t} \tag{17}$$

We consider two periods and both types of governments maximize

$$V_j = u_{j,1} + \beta u_{j,2}, \qquad j = S, W, \tag{18}$$

where $u_{j,t}$ is given by (1) and $0 < \beta < 1$ denotes a discount factor.

Separating equilibrium

The first period of a separating equilibrium reveals the type of the government such that the public is certain about its identity in the second period. Thus, the announcement of the strong government is credible and

$$\tau_{S,2} = \tau_{S,a,2} = \tau_{S,e,2} = \beta\Big(2m\Big)^{\frac{\beta-1}{2\beta}}\Big(\frac{(1-\beta)\pi\phi^2}{\lambda+\phi\bar{P}}\Big)^{\frac{1-\beta}{2\beta}} - z \tag{19}$$

where the equilibrium solutions are obtained from section 3.2.

Similarly, the identity of a weak government will also be known which has then no incentive to announce a tax rate different from zero, such that

$$\tau_{W,2} = \tau_{W,a,2} = \tau_{W,e,2} = 0 \tag{20}$$

and the equilibrium solutions are obtained from section 3.3.

In the first period, the public is uncertain about the identity of the government. Hence expectations are determined by (16). Since, it is clear that the weak government will reveal itself in a separating equilibrium as being weak by setting a tax rate of zero, the weak government is unable to influence the public's expectations by an announcement of any type. This contrasts the strong type. The strong type is able to influence the public's expectations because it is credible. The optimal announcement is obtained from maximising (1) subject to (10) and (16),

such that

$$\tau_{S,a,1} = \frac{1}{p}\left[\beta\Big(2m\Big)^{\frac{\beta-1}{2\beta}}\Big(\frac{(1-\beta)\pi\phi^2}{\lambda+\phi\bar{P}}\Big)^{\frac{1-\beta}{2\beta}} - z\right]. \tag{21}$$

This announcement implies that the public has correct expectations given their initial belief that the government is strong, in the sense that $\tau_{e,1} = p\tau_{S,a,1} = \tau_{S,1}$. However, the presence of a week government forces the strong government to increase its announced tax rate the lower the belief is that the government in place is actually strong.

The week government will set

$$\tau_{W,a,1} = 0. \tag{22}$$

This however is different to section 3.3, because the public was uncertain about the government's identity and undertook its investments based on their expectations, i.e.

$$a_1 = a(\tau_{e,1} > 0). \tag{23}$$

After the realization of investments the tax on pollutants will be set to zero but the expected tax rate is positive. Therefore, the time inconsistency in the implemented policy increases only the level of production given investments based on a positive expected tax rate. This implies also that enterprises may have switched already to the green technology. From the perspective of a weak government it also doesn't make sense to mimic the strong government in the first period in order to hide its identity. This would require the weak government to implement the strong government's preferred tax rate which would reduce then the weak government's utility even further.

Pooling equilibrium

A pooling equilibrium requires that the weak type mimics not only the strong type's announcement but also that it implements the same tax rate in the first period, otherwise the weak government would reveal its identity. In this case the public continues to face uncertainty about the government's nature in period 2. As the public will expect that each type will reveal its identity now, the solutions to the second period coincide to the solutions of the separating equilibrium for period 1.

3.5 Implications of the model

The weak government has a lower first period utility if it would follow a pooling strategy compared to the separating strategy. In the second period the utility is the same as in the first period of the separating equilibrium, but discounted by β. Thus, the weak government would always opt for a separating strategy and not try to mimic a strong type. This implies that the weak government has only an impact on output as long as the energy tax is sizeable. If it is sizeable it is however likely that firms switch to alternative energies which are not subject to an energy tax. This implies that the public has comparatively early knowledge about the identity of the government. Strong governments on the other hand can use policy information as credible signals to spur the transition to green technologies.

4 Summary and Conclusions

The starting point of this paper was the observation that policy announcements related to the energy transition and its impact on economic activity are under-researched. This would be legitimate if we could be sure that policy announcements had no impact on economic activity. Our first step, therefore, was to explore empirically whether or not we can identify an impact of policy announcements on economic activity. In this context, we tested whether credible government announcements actually influence the number of firm entries. To do so, we use data from the Swiss commercial register to analyse the number of firm entries (thus new firm registrations) related to green energy services. Our study reveals a significant relationship between information on future policies and firm entries. Hence, there is no reason to ignore announcement effects and they seem to be core for the formation of entrepreneurs' expectations about the evolution of the future policy path. In a second step, we developed a stylised model in order to gain more clarity about the economic mechanisms behind the empirical observation. Our model comprises firms investing in their technology given their expectations about a pollution tax. At this stage entrepreneurs are unable to observe the type of the government, which is strong or weak. A weak government is unable to commit to its pollution tax and sets it to zero after investments have taken place. With the model, we can show that a weak government has no incentive to mimic the environmental policy of a strong government such that the public has in general clarity about the government's nature. Environmental policies linked to subsidies of green technologies can then serve as a credible signal for strong governments. Furthermore,

the incentive and the leverage of weak governments to increase production by just reducing the pollution tax is reduced as soon as firms switch to green production technologies. This implies that the credible commitment to subsidies, for example by a law, is core to the credibility of environmental policies as well as to protect environmental targets against discretionary actions by myopic governments.

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