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Market and policy shocks in economic systems: interrelated dynamics towards future sustainability

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Abstract.

This note addresses the issue of market and policy shocks in the transition to sustainability. Market Shocks may be driven by price volatility; policy shocks are likely to occur either given contingent conditions of policy feasibility - a concept that shifts over time – or in reaction to extreme climatic events. The paper questions the role of 'events' as drivers of change, with a focus on innovation responses. In doing so, it broadens the perspective on environmental policy's role and effects. Environmental policy is connected to institutional and market dynamics. It is not limited to the Pigovian rationale – the mere minimization of current costs - but rather tied to a 'standard and cost approach' which attempts to incorporate efficiency concepts in a dynamic scenario, where learning and adaptation through technological and behavioral changes are crucial.

JEL: H12, H23, Q54, Q58

Keywords: environmental policy, technological change, Pigouvian tax, market dynamics

Introduction

Economic systems face many complex environmental challenges today: reducing waste and material production, and cutting down on CO_2 emissions and other local pollutants to name just a few. The 'environmental efficiency' of these economic systems should be further enhanced in order to increase the chances of their sustainability in the medium-long term, moving towards an absolute de-coupling between economic growth and environmental pressures (OECD, 2002). Absolute decoupling is conceptually linked to the Kuznets curves framework. In the environmental realm, it means that environmental pressure decreases while the economic driver increases. In other words, a negative elasticity characterizes the environment-income relationship. Such a negative relationship was achieved for most local pollutants and acidificants, given the higher incentives communities have to tackle harmful local effects and the possibility they are given to address pollution reductions through end-of-pipe technologies (Marin and Mazzanti, 2013). Regarding more challenging environmental pressures, waste generation and CO2 emissions among others, the evidence is more mixed. In the waste realm, most efforts have been targeted towards recycling and recovery. It is not surprising, then, that an absolute decoupling for waste generation has not been achieved in the EU (Mazzanti and Zoboli, 2009). The EU has now launched a future policy agenda wherein member states must set targets in terms of waste generation reduction per capita. Regarding carbon dioxide, the overall global picture is far from presenting absolute decoupling (Musolesi et al., 2010). Nevertheless, the EU as a whole has presented, for example, a total growth of GDP over 1990-2011 of 44%, while CO2 emissions decreased by 15% (EC, 2013). Though evidence is very mixed across countries (Mazzanti and

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Musolesi, 2014), and some of this reduction simply results from production being shifted to emerging countries (this opens the 'sustainable consumption vs production'), the aggregate trend is one of 'absolute decoupling'[2].

This is a necessary—even if not sufficient—precondition to achieving environmental sustainability, given that, as noted, the relevant effect is exposed to global dynamics for some pressures, and sustainability depends on other considerations. Along narrower economic perspectives, sustainability is assured only if the total stock or capital (or alternatively the stock of natural capital for strong measures) is not decreasing over time. Ecological considerations might indicate a specific threshold regarding the exploitation of nature. Thus, absolute decoupling remains attractive and necessary, but it is only one piece in the puzzle.

One issue this paper addresses, that arose even before the 2008-2009 'economic-financial crisis', and was further exacerbated by ongoing economic stagnation in some world areas (e.g. the EU), is whether a smooth process towards sustainability is possible, or if the transition towards a sustainable economy (Rotmans, 2013) requires some radical changes along the way.

This is not purely a debate between radicalism and incremental reforms such as that of the historical clash between Marxist schools and Karl Popper's idea of 'incremental' reforms of social systems. It has more to do with the relative efficiency (dynamic costs and benefits) and efficacy – both to be accounted for – of different policy actions. It is aimed at smoothly changing the environmental performance of economic systems (namely, decoupling indicators, in terms of absolute and economically 'relative' pressures on the environment) on the one hand, and, on the other, eventually bringing about radical changes (e.g. sharp changes in income-environmental pressure elasticity).

Shocks, crises and change

Even in the evolution-oriented Schumpeterian tradition, economic crises provide benefits in terms of the 'selection' of firms and the redefinition of competitive advantages through the adoption of radical innovation. This idea was already debated during the 2009 recession (Edenhofer and Stern, 2009) (e.g. during the April 2009 G20 summit), specifically through the discussion of whether the recession would be capable of acting as a turning point towards a greener economy based on a different type of growth (greener eco-innovative firms, a greater part of the public budget devoted to environmental expenditures, etc.). The current situation and the last Conferences of the Parties for Climate Change show that though recessions and cost driven stagflation are eventual 'positive' turning points for economic-ecologic systems, environmental policies are more feasible during times of growth. Feasibility is a changeable feature dependent upon time- Kyoto was feasible in 1997, it would not be now; the same applies to the EU climate change mitigation strategy that was set before 2009.

Schumpeterian economists illustrate the role of innovation as a main driver of change (Borghesi et al., 2013). In the realm of sustainability, this is also a key issue that touches on the efficiency and efficacy of sustainable transitions: that is to say, whether market and policy shocks are the best way to generate the radical forms of change needed (such as curbing the amount of waste generated per capita through technological but also radical behavioral changes, (EEA, 2013a) and cutting CO_2 emissions by approximately 80-90% within 2050 as per the current EU and UK perspective).

A dynamic and evolutionary perspective is relevant to assuring long-term efficiency. Recent analyses have pointed out the possible inefficiency of strategies that pick up emission abatement options following the rule 'the cheaper beforehand, the more expensive later on' (Vogt-Schilb and Hallegatte, 2013). The reason for this is clear: postponing costly abatement measures might both create technological lock-ins and introduce

[2] Though it must be noted that structural change, production offshoring and low hanging fruit strategies explain a large part of this achievement. In the climate change realm future challenges are particularly tough. Even if innovation dynamics might promptly react to policies and new market conditions, diffusion is heterogeneous across regions and sectors, and often it is slow. Schumpeterian-like creativity waves do not always show up after shocks. (Silverberg and Verspagen, 2007) In addition, radical innovations cannot be managed top down: basic scientific development, market conditions, and policy drivers are all necessary ingredients.

certain technological options too late. Thus, a mix of cheap and expensive options is needed, even to achieve short-run targets, given the consequentiality of short-term and medium-long run scenarios.

More than proposing a simple tradeoff between short-term efficiency (supported by low abatement prices for example) and dynamic efficiency, this discourse calls into question the role of policies as providers of shocks and/or stable conditions for innovation adoption and invention. Stable conditions imply putting in place certain policy developments – stringency and uncertainty are both costs, the latter often harsher – to support markets with specific, robust state interventions (as in the 'entrepreneurial state' advocated by Mazzucato, 2012, who envisages the historical role of the state behind innovation development in markets, and beyond market failures). The impact of the public sector in this regard is enormous: the current funding stemming from development banks amounts to 40 billion USD compared to 12 billion from private funds. Robust state intervention could create massive leverages, as investors typically follow public expenditure.

Within this framework, environmental policy in a broader sense – pricing; fiscal reforms, possibly linked to specific revenue recycling; and short- and long-term target definitions - can provide shocks at relatively low costs, in order to address the challenging targets we face (again, waste reduction and global CO_2 mitigation, among others). Reaching the reductions in CO_2 which the last IPCC report has targeted, amounting to -70/-90% with respect to 1990 levels, will not be possible by way of a smooth process.

Trend-breaking events in the past: evidence from carbon dioxide

If these types of deep-seated changes have seldom occurred in the last decades (see figures 1 and 2 for energy intensity and EU CO_2 dynamics in overall terms, variegated but relatively break-free since the beginning of the century), even when relevant policies (e.g. the EU ETS experience started in 2003 with the EU DIrective) are introduced into the economic system (EEA, 2013b), the history of the evolution of economic-environmental systems has witnessed some breaking points.

It is worth noting that the EU's compliance with Kyoto targets largely depends on the reaction – in terms of CO_2 abatement – of some Northern countries (Mazzanti and Musolesi, 2009, 2013, see Figures 3-5). Some of these countries (especially Scandinavian countries and other northern EU countries) had already promptly reacted to the market oil shocks during the 70/80's, introducing green fiscal reforms in the early 90's. It is true that, even if due to data constraints, the evidence that supports significant policy effects for decoupling is rarer (see McKitrick, 2006; who shows the pollution reduction effect of the US Clean Air Act back in 1970) if compared to that showing policy effects on environmental innovations (Johnstone et al., 2010). It is also true that the oil price peaks might historically have had a lagged effect: world economies were not prepared for this at the beginning, the first shocks determined the development of energy saving technologies that were then adopted when new market- and policy-induced energy price increases occurred. In any case, the response of different areas to the oil shocks was different, depending on existent or developed institutional and technological capabilities. Shocks might well create the pre-condition for change, with market and policy driven prices for energy and externalities possibly being complementary throughout historical development. As an example, energy price increases in the 70/80s might have created the pre-conditions in some world areas for enhancing the efficiency of policies[3]. The opposite may be true as well: policies can influence the economy and enhance its adaptability to future market shocks in the energy realm.

Environmental policy might influence economic systems, perhaps in radical ways reaching beyond the mere correction of externalities, if the design is appropriate and the scale of intervention is not negligible. The design of ecological tax reforms is diversified. Nevertheless, there may be one bit of 'shock'[4], given that

[3] I am grateful to one referee for drawing my attention to this point.

[4] I am grateful to one referee for this point. We acknowledge the fact that policy makers would find it difficult to set appropriate shocks. It remains true that unilateral policy shocks occasionally emerge: the 1970 US Clean Air Act, the 1989 Toepfer waste law in Germany which stimulated most EU policies then; the UK's 6% real value increase in the carbon tax escalator, the EU 2050 targets on CO_2 abatement (that certainly now need policies to be achieved). The EU ETS itself was in principle a largely unexpected policy shock (that has failed due to design features and the recession). The definition of a 'shock' is to a large extent ex post, depending on the effects a given market/policy change determines.

their aim is to fully rebalance the fiscal system of our economies away from labor and research-knowledge intensive activities to negative externalities and rent-based assets (e.g. properties). 3-4% of the GDP is a sensible amount in terms of fiscal rebalancing. Neutrality in taxation is a pre-condition to finding politically acceptable designs.

Scandinavia, Germany, and the UK as well, were most likely able to constructively react to shocks due to an accumulated relevant stock of 'institutional, social and technological capital' (Lehtonen, 2004): Stock that accumulates over time in societies and that supports sustainable social and ecological development (e.g. factors considered in the Human Development indexes which encompass intangible sources of wealth as pre-conditions to development). Shocks of a market or policy nature are not effective in all frameworks. The build up of intangible forms of capital is the pre-condition under which shocks can modify more flexible systems towards sustainable societies, through the emergence of technological and behavioral innovations. Adaptability depends on the amount of 'knowledge' a system embodies. This approach is in line with the EU redefinition of the Lisbon Agenda, which focuses on sustainability through the integration of environmental, technological and social objectives.

Environmental policy, fiscal reforms and carbon pricing

Fiscal reforms - in the form of carbon taxes (which periodically increase in real terms through a ladder system) and/or ETS systems with auctioned permits and decreasing caps - might complement market shocks (e.g. oil price peaks) and provide radical policy stimulus towards sustainability. Innovation is a key intermediate target in order for environmental policy to integrate sustainability and competitiveness (Costantini and Mazzanti, 2013). The static/Paretian efficiency of policies is not sufficient and, as explained above, (Vogt-Schilb and Hallegatte, 2013) it is in fact leading to low dynamic efficiency if the dynamic world is mapped as a mere consequential sum of 'static presents' that separately achieve abatement cost minimization.

The role of carbon pricing is harshly debated within the economic community and beyond. Carbon pricing is not the ultimate solution ensuring sustainability but it is an important part of this solution (Pearce, 2004). The correction of externalities and resetting of market prices are essential factors that need to be integrated within properly designed, mature socio-institutional systems (van den Bergh, 2010). Carbon pricing in its various forms, when properly adapted to different institutional systems (emissions trading, taxes, a mix of these two approaches which may also encompass the use of different economic tools, or command and control when deemed necessary for reasons of efficiency and efficacy), can deliver radical signals to economic institutions both public and private.

The current criticism of the EU ETS is reasonable, primarily regarding its low efficacy and low induction of innovation, but this largely depends on two factors: the design of the EU ETS (in its lack of adjustment to times of recession, the absence of auctions in the first two phases); and the diminishing forecasts of (stringent) future policies (Borghesi, 2011), which ongoing stagnation have further undermined to shift policies towards growth and employment creation. Growth and employment cannot be generated, however, without sustainability, and thus it is necessary to reconcile the two. Well-designed environmental policy may provide a good starting point of a radical nature if it is deemed necessary (Chichilinsky, 2013, Chichilinsky and Eisenberger, 2009). The EU ETS has created a price where none existed; its current low level could be increased by reshaping the cap, and its efficacy could be augmented by using auction revenues (80% of auctions in the future) to sustain innovation and new forms of economic growth (van den Bergh, 2011). Carbon taxes can complement this by covering non-EU ETS sectors. Placing innovation at the center of the arena increases the chances of reconciling economic and environmentally-sound production. Innovation can be radically stimulated by a far-reaching and credible design of policies in terms of their expectations of firms and households. For example, a clear reduction of allowances and/or an increase in the carbon tax level can be made up to plausible estimated costs of around 150-200$ per ton over a period of one or two decades (this is the Nordhaus level linked to the hypothesis of globally efficient markets for CO2. It jumps to 700$ per tonne in other estimates of more real world based scenarios to achieve the 2 degree target). Credibility enhances investments by extending their time of reference. In this sense, it might be more relevant than mere 'price stringency'. Policy stability and credibility are part and parcel of the design; technically speaking they increase the rate of return of long-term projects (lowering discounting, extending years of reference, etc.). With respect to this point, it is worth noting the difference between innovations induced by regulations and environmental pricing – whose related investments are subject to market discount rates – and innovation financed by, for example, R&D or innovation-oriented public funding[5], which is subject to lower-than-market or declining-over-time 'social discount rates'.

Building farsighted policy or reacting to extreme events: dynamic interactions between market and policy events

Credibility is both a part of policy design and of the intangible 'capital' societies possess (in policy making). This 'credible' shock can be healthy for overall economic sustainability. It should certainly be accompanied by institutional and social capital creation (Putnam, 2001), and able to provide the necessary stimulus – from the pricing/market perspective – for radical changes in behavior (the sharing and leasing of goods, a reduced use of materials in addition to recycling, etc.) and technology (private transport not reliant on fossil fuels, carbon capture and storage, a further increase in the integrated firm's efficiency, rather than isolated parts of production activity).

Given the likelihood that policy making will be forced to introduce sudden changes to cope with extreme environmental events, as well as the high chance of market volatility and spikes in energy costs, we must define the necessary social, institutional and technological pre-conditions, in terms of adaptability, to favor the positive effect of radical changes within ecological-economic systems. Shocks affect the short-term dominant equilibrium. They might on the one hand create new conditions in the system for future flexibility and the diffusion of innovation. On the other hand, depending on flexibility and other specific conditions, shocks can move the system towards options that are cost effective only if we extend the short-term 'equilibrium 'perspective. Based on historical experiences, market and policy shocks are likely to be dynamically interrelated, occurring at different points in time (e.g. carbon pricing introduced in absence of oil peaks/high energy inflation) but generating complementary, mutually interactive effects in the way the system 'adapts' and reacts to changing (pricing) conditions over time. This view also broadens the perspective on environmental policy; the notion of optimality itself is affected. Environmental Policy is connected to market and institutional dynamics, it is not limited to the Pigovian rationale and to the minimization of current costs, but rather to a 'standard and cost approach' which attempts to incorporate efficiency concepts in a dynamic scenario where learning and adaptation – through technological and behavioral change - are crucial.

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[5] Ecological tax reforms might well use revenue generated to fund innovation adoption and R&D. Examples of such funds (e.g. Kyoto funds) exist in some EU countries.

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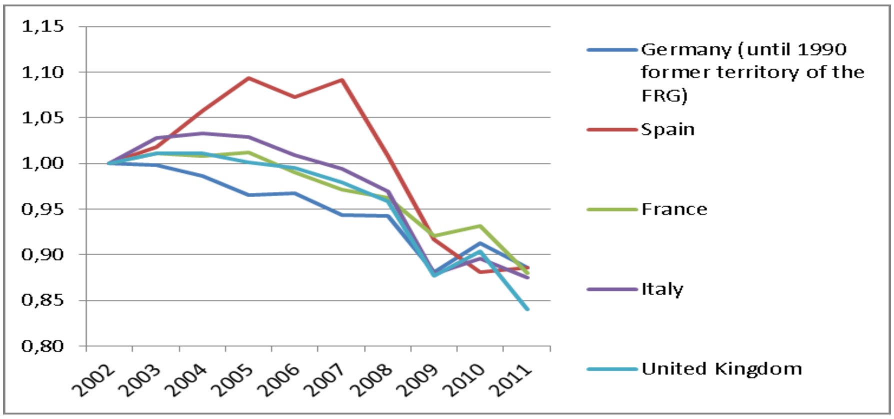

Figure 1 - GHG trends (2002=100), source: EUROSTAT (March 2014)

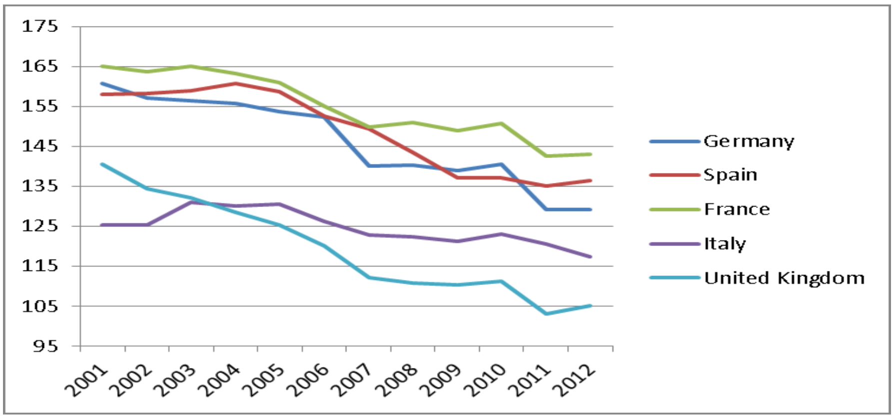

Figure 2 - Energy intensity of GDP, source: Eurostat (March 2014)

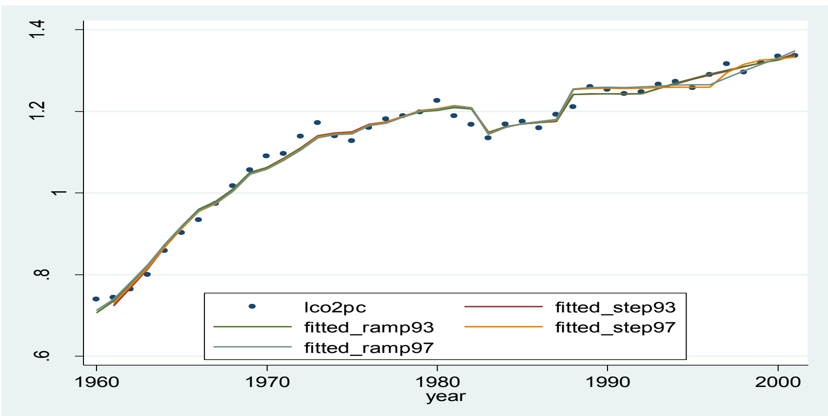

Fig. 3 – North America, Oceania, Japan - CO2 trends

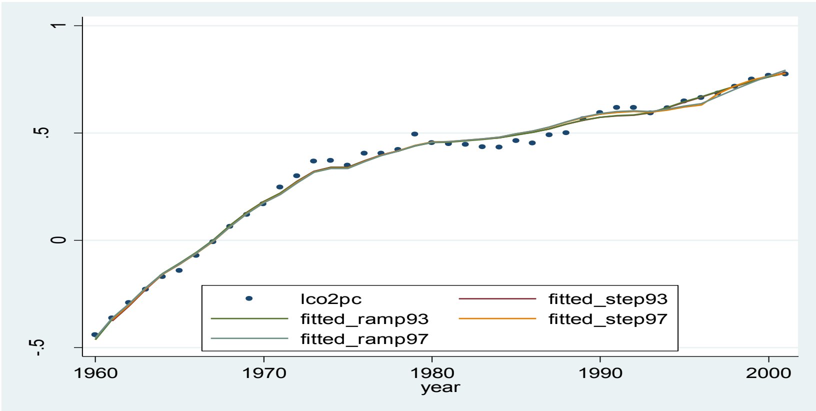

Fig. 4 – Southern EU - CO2 trends

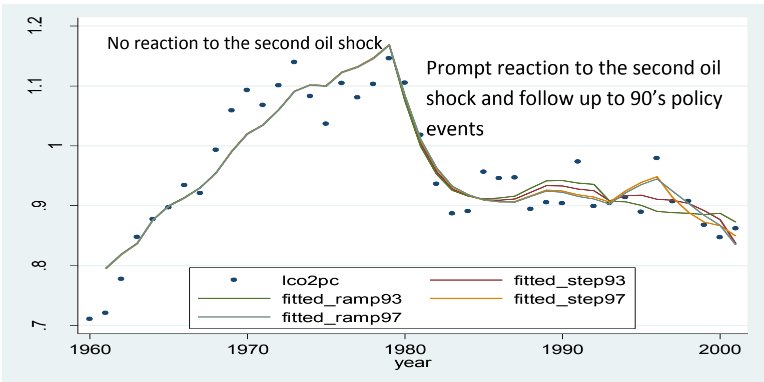

Fig. 5 – Northern EU - CO2 trends