How Fit are Feed-in Tariff Policies?

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September 2012

Outline

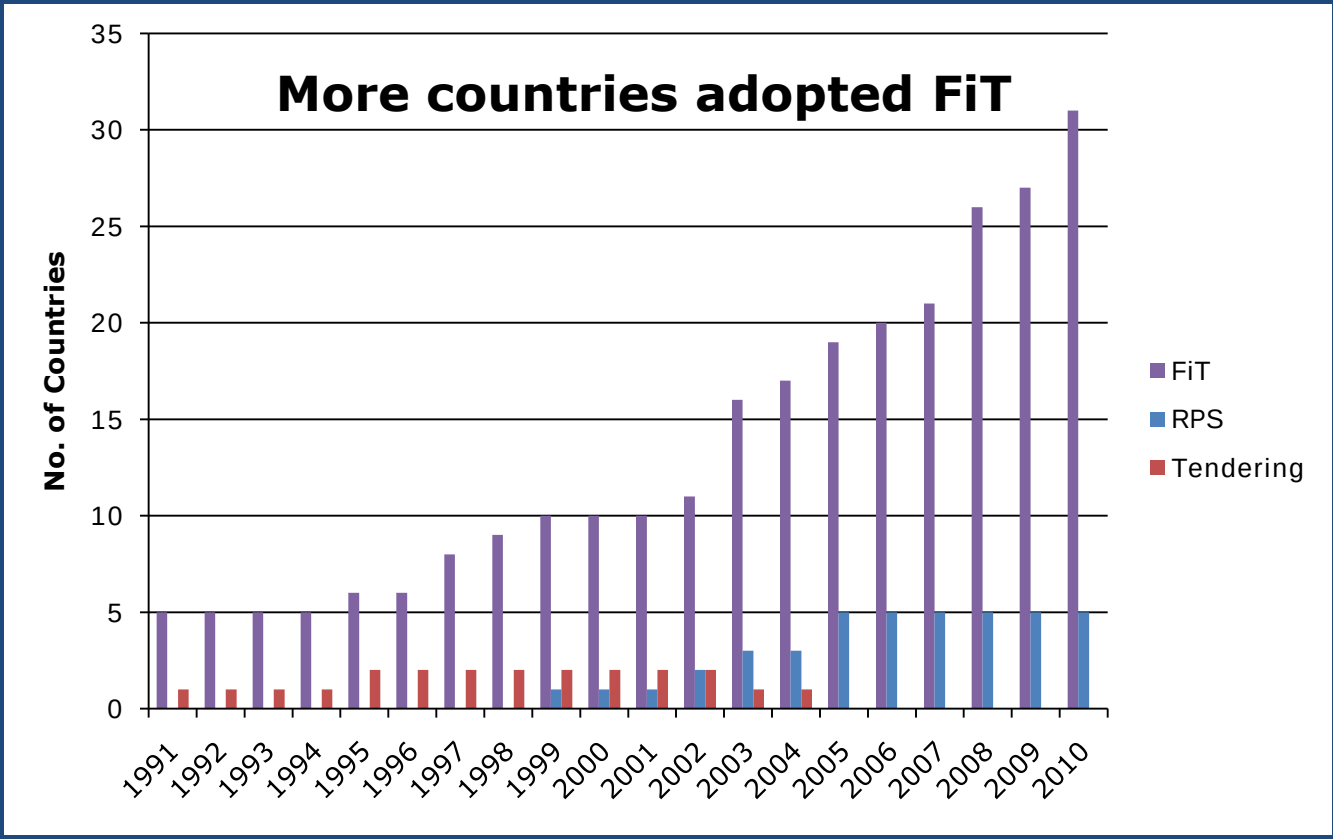
- Production-based renewable incentives
- Design of feed-in tariffs (FiT)
- How to set the right level of FiT support?
- Policy implications
- Q&A

Production-based Renewable Incentive Policies

- Price-based
  - Feed-in tariffs (FiT)
    - Guaranteed price premium above the electricity market price
    - Guaranteed purchase by utilities
- Quantity-based
  - Renewable portfolio standards (RPS)
  - Competitive bidding

FiT is the most popular RE incentive policy

- 46 European countries from 1991-2010



Design of Feed-in Tariffs (I)

- Price differentiation
  - Installation type
    - Residential vs. utility
    - PV - rooftop vs. ground-mounted
    - Biomass - type of feedstock
  - Location
    - Greece offers separate rates for mainland vs. island
  - Size
    - Restrict FiTs to installations below a certain size (e.g. <20MW)
    - Size-specific rates

German 2004 Biogas Tariffs	
Generator Size	**FiT (€/kWh)**
< 150 kW	0.117
> 150 kW, <500 kW	0.092
> 500 kW, < 5 MW	0.083
> 5 MW, < 20 MW	0.078

  - Resource intensity
    - German and French FiTs are differentiated by resource intensity

Design of Feed-in Tariffs (II)

- Time trends and cost containment
  - Digression rates
    - German wind FiT rates decrease by 2% annually
    - Germany PV FiT degression rates are determined by the amount of new installation
  - Indexing to inflation
    - Many FiT policies are not indexed to inflation
    - French FiTs raises rates annually by 60% of inflation on new contracts and 70% on existing contracts
  - Capacity/generation caps or triggers
    - Italy's solar program limits the total capacity at 1,200 MW.

Croatian FiTs for Hydro > 1 MW, ≤ 10 MW	
Plant's Cum. Annual Gen.	**FiT (HRK/kWh)**
≤ 5 GWh	0.69
> 5 GWh, ≤ 15 GWh	0.55
> 15 GWh	0.42

  - Funding triggers
    - Swiss FiTs have a budget constraint

Types of Feed-in Tariffs

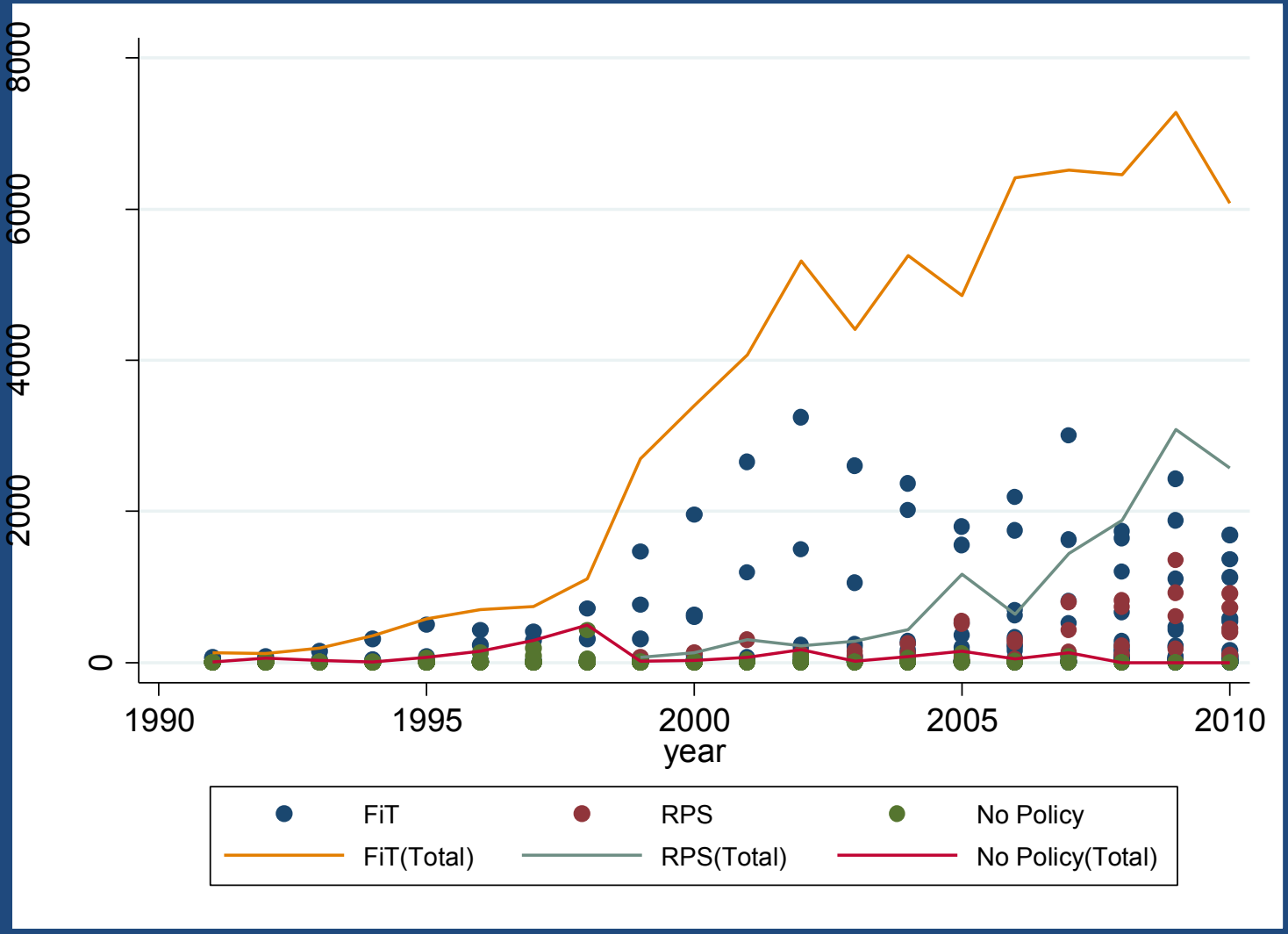
- Standard FiT
  - FiT rates are fixed over the contract
- Variable FiT
  - FiT rates vary annually according to electricity market changes
  - Example: Germany's pre-2000 FiT
- Premium FiT
  - A fixed premium on top of a variable electricity price

How to set the “right” level of FiT

- The Policy Questions
  - How responsive is investment to the level of FiT?

Europe’s Largest Solar Power Plant in Ukraine

Higher wind installation under FiT



A glance at the data (I)

1. Renewable policies are effective in stimulating clean energy deployment

Variable	FiT	[illegible]	No Policy
Annual wind installation (MW)	301	298	3.33
Annual wind generation (TWh)	2.73	1.93	0.024
FiT rate / TGC price (euro cents/kWh)	6.67	6.03	-
Avg. end-use electricity price (euro cents/kWh)	7.88	9.04	5.74
Avg. industrial natural gas price (euro/GJ)	5.32	5.74	4.5
Total electricity output (TWh)	119.65	217.15	48.9
Wind power potential (TWh)	1433	3021	1156.4
Competitive wholesale market (0/1)	0.51	0.73	0.06
Obs.	301	41	545

* Differences between "No Policy" and "FiT" and "TGC" in all variables are statistically significant at 1%

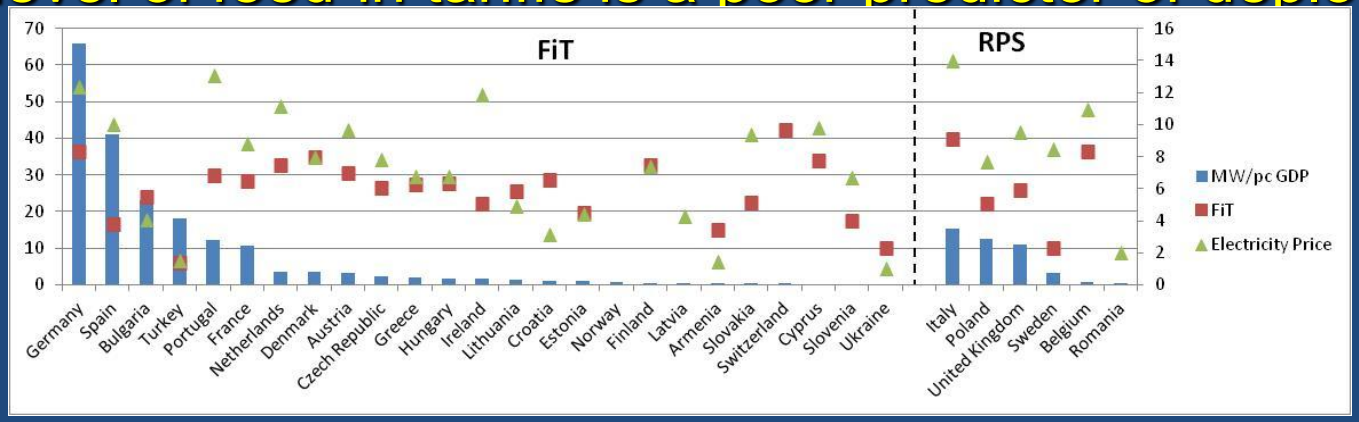
2. Many factors affect the political appeal of a renewable policy: renewable endowment, electricity demand and prices

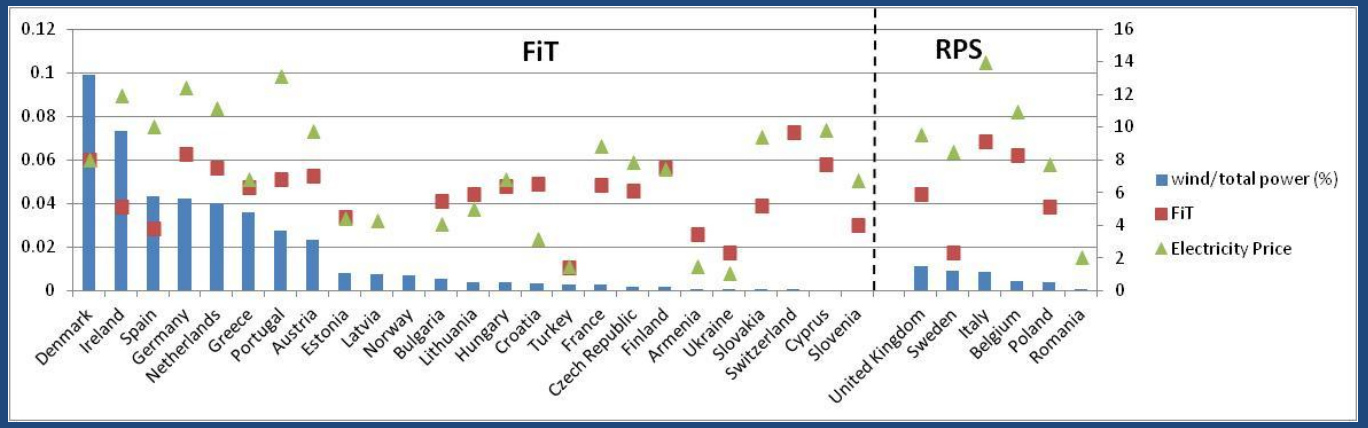
A glance at the data (II)

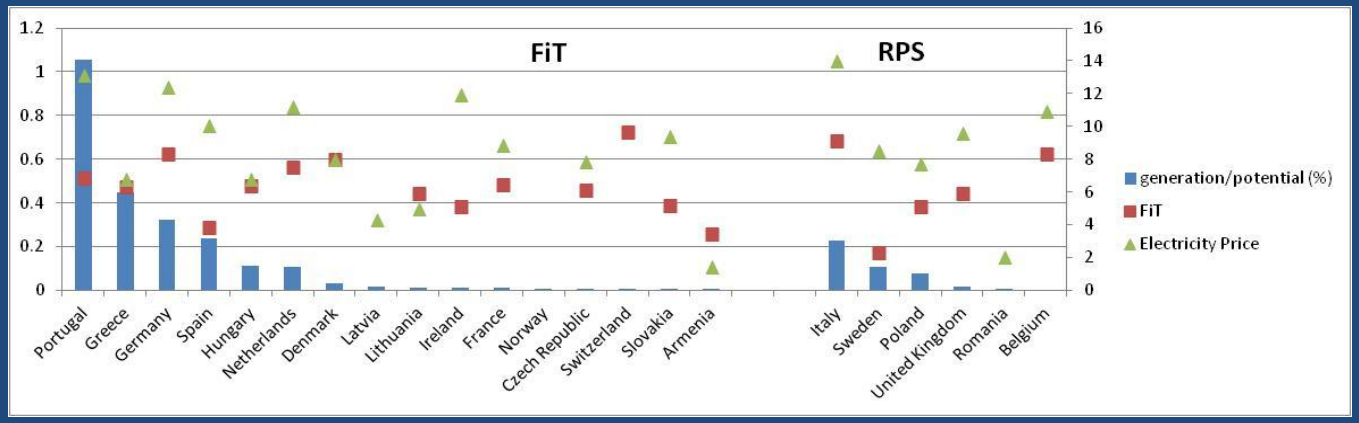
Variable	Standard FiT	Variable FiT	Premium FiT
Annual wind installation (MW)	325	102.60	85.86
Annual wind generation (TWh)	4.16	0.71	1.89
FiT rate / TGC price (euro cents/kWh)	6.69	6.62	4.22
FiT contract length (years)	14.01	9.07	6.88
Grid access	0.99	1	0.5
Avg. end-use electricity price (euro cents/kWh)	7.79	7.86	8.23
Avg. industrial natural gas price (euro/GJ)	5.61	4.97	4.9
Total electricity output (TWh)	152	88.04	70.46
Wind power potential (TWh)	1522	1042	1836
Competitive wholesale market (0/1)	0.58	0.24	0.77
Obs.	165	88	48

3. Policy certainty is an important determinant of renewable development

The level of feed-in tariffs is a poor predictor of deployment







Econometric Analysis

- Estimation Model

$$W_{it} = \beta_0 + \beta_1 FiT_{it} + \beta_2 E_{it} + X_{it}\gamma + c_i + v_t + u_{it}$$

- Methodology
  - Dynamic panel data model
  - System Generalized Methods of Moments
  - Instrumental variables: lagged variables and natural gas prices

Results

- Higher FiT rates do not necessarily lead to higher levels of wind installation.
  - Non-economic barriers
  - Overly generous subsidies may have driven up investment costs by allowing inefficient investment in low wind-speed sites or rent-seeking
- The contract length and guaranteed grid access have a positive and statistically significant effect on wind capacity growth.
  - A 1% increase in contract length increases annual wind installation by 0.3%
  - Providing grid access almost doubles wind installation
- The higher the electricity prices the lower the wind installation; but with a competitive wholesale market, the higher the electricity prices, the higher the wind installation
- The higher the variable FiT rates, the lower the wind generation after controlling for wind capacity
  - High FiT rates allowed inefficient investment in low-wind-speed sites.

Policy Implications

- FiT policies are effective in promoting RE but may not be cost-effective.
- Market structure and the length of the FiT are equally important in determining policy effectiveness.
- To maintain a predictable and stable policy environment can enhance policy effectiveness at lower costs.

References

- Fischer, Carolyn and Preonas, Louis. 2012. "Feed-in tariffs for renewable energy: Effectiveness and social impacts." Background paper for ECA green growth study.

- Zhang, Fan. 2012. "How FiT are Feed-in Tariff Policies? Evidence from the European Wind Market." World Bank Policy Research Working Paper.