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Will policies to promote renewable electricity generation be effective? Evidence from panel stationarity and unit root tests for 115 countries

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ABSTRACT

This study examines whether policies to promote renewable electricity generation are likely to be effective by applying panel unit root and stationarity tests to time series data on renewable electricity generation for 115 countries over the period 1980–2008. We find that for the panel as a whole, and almost three quarters of the individual countries, renewable electricity generation is characterized by a unit root. This result implies that policies to promote renewable electricity generation, such as renewable portfolio standards, which result in annual increases in renewable energy and, as such, which represent permanent positive shocks to the long-run growth path of renewable electricity generation, will be more effective in increasing renewable electricity generation than policies with a pre-specified time horizon.

Contents

1. Introduction

The world's demand for energy is expected to rise [1]. There is considerable concern about the potential for fossil fuels to continue to contribute the lion's share of energy in the future for two reasons. The first is that reserves of fossil fuels are expected to peak by 2030 and decline thereafter. The other is concern about the adverse environmental effects of burning fossil fuels [2]. At the same time, there have been setbacks to the development of nuclear energy, such as the Fukushima nuclear disaster in Japan in 2011, which has raised serious concerns about the safety of nuclear energy. Some see renewable energy as representing one answer to the world's energy needs [2–6]. The Kyoto Protocol on Climate Change was a catalyst for countries setting targets for increasing renewable energy in the energy mix. There are now 66 countries which have targets for renewable energy, specified in terms of a proportion of electricity generation, primary energy and/or final energy. These include 27 European Union countries, 29 states in the United States and nine Canadian provinces. For example, China has a target of making 15 per cent of primary energy come from renewable sources by 2020, while the European Union has the objective of making 20 per cent of its energy consumption come from renewable sources by 2020 [7]. To realize these objectives, several policies have been introduced to increase the share of renewable energy in the energy mix. Several of these policies are reviewed in depth in Refs. [5–6,8–13]. Policies to promote renewable energy include policies with a limited time horizon, such as one-off investment incentives or tax

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Table 1
Summary statistics for all countries: total renewable electricity generation (billion kW h) (1980–2008).

Country	Mean	Std. Dev.	Maximum	Minimum
Afghanistan	0.5738	0.1696	0.7700	0.2920
Albania	3.9287	0.8923	5.6690	2.7600
Algeria	0.2606	0.1504	0.6390	0.0530
Angola	1.1196	0.8086	3.8040	0.5300
Argentina	24.8028	7.3960	38.9553	12.9480
Australia	16.0919	1.9593	19.1407	12.3940
Austria	35.9800	4.9592	44.2749	26.2570
Bangladesh	0.8658	0.2730	1.4590	0.4500
Belgium	1.5439	1.1465	5.2263	0.5390
Bhutan	1.8262	1.7042	7.0630	0.0060
Bolivia	1.6202	0.4569	2.4529	1.1150
Brazil	248.9921	75.2406	387.7673	130.3588
Bulgaria	2.7444	0.6845	4.3148	1.4530
Burundi	0.0903	0.0440	0.2060	0.0020
Caledonia	0.3750	0.0728	0.5270	0.2540
Cambodia	0.0506	0.0136	0.0770	0.0280
Cameroon	2.8411	0.6997	4.1900	1.3500
Canada	324.6522	37.2437	390.3670	252.2330
Central African Republic	0.0813	0.0165	0.1300	0.0600
Chile	16.9153	6.6074	29.8561	7.4430
China	199.8443	128.2375	537.2981	57.6180
Colombia	29.3179	8.1745	43.6968	14.5330
Congo	5.9536	1.0666	8.0790	4.2280
Costa Rica	4.7932	2.1299	8.6535	2.0980
Cuba	0.8913	0.2316	1.2820	0.4372
Denmark	3.5278	3.8022	10.5151	0.0280
Dominica	0.0208	0.0079	0.0340	0.0090
Dominican Republic	0.9679	0.4188	1.9045	0.4160
Ecuador	5.5241	2.4996	11.5811	0.7830
Egypt	11.2347	2.5108	16.1440	7.8210
El Salvador	1.9623	0.5794	3.5608	1.2570
Equatorial Guinea	0.0029	0.0018	0.0070	0.0020
Ethiopia	1.5117	0.8496	3.3510	0.4730
Faroe Islands	0.0722	0.0176	0.1034	0.0490
Finland	17.7749	4.9402	27.4149	10.1150
France	67.1675	7.1229	80.4530	47.8050
Gabon	0.7268	0.1568	0.9426	0.2570
Germany	36.6771	20.2943	91.2524	20.3925
Ghana	5.1323	1.2679	6.7820	1.7990
Greece	3.7355	1.4372	7.5531	1.7520
Guatemala	2.4075	1.2696	5.1494	0.3940
Haiti	0.2727	0.0496	0.3680	0.1520
Honduras	1.6849	0.5327	2.4551	0.7720
Hungary	0.4816	0.6139	2.3562	0.1110
Iceland	6.0910	2.9295	16.1401	3.1030
India	74.0094	23.7001	132.4604	46.5400
Indonesia	10.1421	5.3080	19.3502	2.2340
Iran	7.9405	3.6618	18.2018	3.6250
Iraq	0.5707	0.0835	0.7030	0.3070
Ireland	1.1238	0.6500	3.4015	0.6730
Italy	46.8016	5.1470	59.3982	34.5586
Cote dIvoire (IvoryCoast)	1.4752	0.3656	1.9911	0.3690
Jamaica	0.2115	0.0499	0.3169	0.1240
Japan	100.0254	9.3125	115.9754	79.5804
Kenya	3.1015	0.9941	4.7272	1.1820
Korea, North	12.3593	1.6796	15.4440	10.0980
Korea, South	3.4475	1.0501	5.1200	1.5390
Laos	1.6988	1.1022	3.6798	0.4870
Lebanon	0.6627	0.2386	1.3490	0.2970
Luxembourg	0.1575	0.0598	0.3115	0.0990
Madagascar	0.4054	0.1579	0.7350	0.1460
Malawi	0.8334	0.3338	1.4850	0.3790
Malaysia	4.8217	1.7419	7.4450	1.2900
Mali	0.1960	0.0553	0.2750	0.0820
Mauritania	0.0333	0.0101	0.0600	0.0180
Mauritius	0.0935	0.0274	0.1470	0.0300
Mexico	30.2707	6.4223	46.5133	17.6000
Morocco	1.0590	0.4582	2.0620	0.3620
Mozambique	5.2677	5.9130	15.9020	0.0240
Burma (Myanmar)	1.6362	0.8253	3.9880	0.7880
Nepal	1.2186	0.8900	3.0420	0.1760
Netherlands	3.1456	3.0536	10.6355	0.0160
Nicaragua	0.6606	0.1829	1.1565	0.3500
Nigeria	5.0344	1.7684	8.1520	1.8560
Norway	112.6786	14.0375	139.4993	82.7170