

Environmental Policy and Macroeconomic Dynamics in a New Keynesian Model

SUPPLEMENTARY MATERIAL*

October 2014

1 The Economy without Damage Function¹

Table S.1: Deterministic Steady State

	No-Policy	Environmental Policy
<i>Y</i>	0.783979	0.764492
<i>C</i>	0.549393	0.536317
<i>I</i>	0.155104	0.147569
<i>L</i>	0.199889	0.197336
<i>MC</i>	0.833333	0.833333
<i>Z</i>	0.352791	0.282233
<i>M</i>	801.275	767.675
<i>U</i>	0	0.179608
<i>pz</i>	0	0.0509337
\mathcal{C}_A/Y	0	0.0014702
$\Gamma(M)$	0	0
<i>Welfare</i>	-99.5328	-100.935

*This document complements the analysis of the paper presenting additional results and examples.

¹The results reported in this Section have been obtained starting from the model presented in the paper setting $\Gamma_0 = \Gamma_1 = \Gamma_2 = 0$ and leaving all the other parameters at their baseline values (see Table 1 of the main text). In this case the level of economic activity will be higher than that reported in Table 2 of the main text.

Table S.2: Means

		No Policy	Cap-and-Trade	Intensity Target	Tax
$\xi = 3/4$	<i>Y</i>	0.7841	0.7645	0.7646	0.7646
	<i>C</i>	0.5494	0.5363	0.5363	0.5363
	<i>I</i>	0.1551	0.1476	0.1476	0.1476
	<i>L</i>	0.1999	0.1973	0.1973	0.1973
	<i>MC</i>	0.8331	0.8331	0.8330	0.8331
	<i>Z</i>	0.3528	0.2822	0.2823	0.2822
	<i>M</i>	801.2862	767.6755	767.6883	767.6827
	<i>U</i>		0.1792	0.1796	0.1796
	<i>p_Z</i>		0.0511	0.0510	0.0509
	<i>C_A</i>			0.0012	0.0011
$\xi = 0$	<i>Y</i>	0.7842	0.7646	0.7647	0.7647
	<i>C</i>	0.5495	0.5364	0.5364	0.5364
	<i>I</i>	0.1552	0.1476	0.1476	0.1476
	<i>L</i>	0.1999	0.1973	0.1973	0.1973
	<i>MC</i>	0.8333	0.8333	0.8333	0.8333
	<i>Z</i>	0.3529	0.2822	0.2823	0.2823
	<i>M</i>	801.3135	767.6755	767.7066	767.7066
	<i>U</i>		0.1794	0.1796	0.1796
	<i>p_Z</i>		0.0511	0.0509	0.0509
	<i>C_A</i>			0.0011	0.0011
$\xi = 4/5$	<i>Y</i>	0.7831	0.7639	0.7646	0.7634
	<i>C</i>	0.5482	0.5356	0.5338	0.5340
	<i>I</i>	0.1553	0.1476	0.1497	0.1485
	<i>L</i>	0.1992	0.1970	0.1942	0.1953
	<i>MC</i>	0.8275	0.8307	0.8073	0.8168
	<i>Z</i>	0.3517	0.2822	0.2823	0.2799
	<i>M</i>	800.7738	767.6755	767.6986	766.5678
	<i>U</i>		0.1768	0.1751	0.1796
	<i>p_Z</i>		0.0510	0.0502	0.0509
	<i>C_A</i>			0.0012	0.0011

Table S.3: Standard Deviations

		No Policy		Cap-and-Trade		Intensity Target		Tax	
		$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$
$\xi = 3/4$	<i>Y</i>	0.0229	1	0.0200	1	0.0234	1	0.0228	1
	<i>C</i>	0.0107	0.4662	0.0093	0.4621	0.0105	0.4492	0.0105	0.4612
	<i>I</i>	0.0163	0.7128	0.0141	0.7035	0.0173	0.7358	0.0164	0.7189
	<i>L</i>	0.0040	0.1754	0.0035	0.1767	0.0045	0.1901	0.0042	0.1829
	<i>MC</i>	0.0186	0.8133	0.0178	0.8901	0.0198	0.8446	0.0193	0.8450
	<i>Z</i>	0.0089	0.3886	0	0	0.0087	0.3692	0.0072	0.3168
	<i>M</i>	0.8514	37.1271	0	0	0.6823	29.1024	0.6820	29.9058
	<i>U</i>			0.0183	0.9124	0.0065	0.2758	0	0
	<i>p_Z</i>			0.0093	0.4658	0.0033	0.1408	0	0
	<i>C_A</i>			0.0003	0.0172	0.0001	0.0044	0.0000	0.0013
$\xi = 0$	<i>Y</i>	0.0171	1	0.0146	1	0.0167	1	0.0167	1
	<i>C</i>	0.0106	0.6181	0.0092	0.6258	0.0104	0.6233	0.0104	0.6233
	<i>I</i>	0.0081	0.4720	0.0064	0.4360	0.0077	0.4644	0.0077	0.4644
	<i>L</i>	0.0008	0.0470	0.0006	0.0400	0.0008	0.0469	0.0008	0.0469
	<i>MC</i>	0	0	0	0	0	0	0	0
	<i>Z</i>	0.0077	0.4500	0	0	0.0062	0.3692	0.0062	0.3692
	<i>M</i>	0.8513	49.75118	0	0	0.6820	40.8762	0.6820	40.8762
	<i>U</i>			0.0157	1.0731	0	0.0000	0	0.0000
	<i>p_Z</i>			0.0080	0.5478	0	0.0000	0	0.0000
	<i>C_A</i>			0.0003	0.0203	0.0000	0.0015	0.0000	0.0015
$\xi = 4/5$	<i>Y</i>	0.0677	1	0.0441	1	0.1419	1	0.1115	1
	<i>C</i>	0.0115	0.1700	0.0097	0.2189	0.0139	0.0976	0.0127	0.1138
	<i>I</i>	0.0619	0.9136	0.0388	0.8797	0.1327	0.9351	0.1034	0.9275
	<i>L</i>	0.0194	0.2872	0.0123	0.2788	0.0426	0.3002	0.0333	0.2985
	<i>MC</i>	0.0992	1.4645	0.0678	1.5364	0.2082	1.4674	0.1679	1.5063
	<i>Z</i>	0.0235	0.3477	0	0	0.0524	0.3692	0.0315	0.2825
	<i>M</i>	0.8530	12.5953	0	0	0.6853	4.8294	0.6842	6.1387
	<i>U</i>			0.0367	0.8303	0.0371	0.2614	0	0.0000
	<i>p_Z</i>			0.0187	0.4238	0.0189	0.1334	0	0.0000
	<i>C_A</i>			0.0007	0.0157	0.0005	0.0035	0.0001	0.0011

Table S.4: Welfare Mean and Standard Deviations

	No Policy		Cap-and-Trade		Intensity Target		Tax	
	mean	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd
$\xi = 3/4$	-99.5509	0.6317	-1.4145	0.5568	-1.4143	0.6337	-1.4109	0.6335
$\xi = 0$	-99.5305	0.6302	-1.4171	0.5559	-1.4096	0.6319	-1.4096	0.6319
$\xi = 4/5$	-99.8651	0.6350	-1.2587	0.5586	-2.1420	0.6414	-1.8335	0.6391

2 The Economy with Low Adjustment Costs on Capital²

Table S.5: Means

		No Policy	Cap-and-Trade	Intensity Target	Tax
$\xi = 3/4$	<i>Y</i>	0.7781	0.7592	0.7593	0.7593
	<i>C</i>	0.5447	0.5320	0.5321	0.5321
	<i>I</i>	0.1540	0.1465	0.1466	0.1466
	<i>L</i>	0.2000	0.1974	0.1974	0.1974
	<i>MC</i>	0.8332	0.8332	0.8331	0.8332
	<i>Z</i>	0.3502	0.2801	0.2801	0.2801
	<i>M</i>	800.0206	766.6558	766.6722	766.6714
	<i>U</i>		0.1798	0.1802	0.1801
	<i>p_Z</i>		0.0514	0.0513	0.0512
	<i>C_A</i>		0.0012	0.0011	0.0011
$\xi = 0$	<i>Y</i>	0.7782	0.7593	0.7594	0.7594
	<i>C</i>	0.5447	0.5321	0.5322	0.5322
	<i>I</i>	0.1540	0.1465	0.1466	0.1466
	<i>L</i>	0.2000	0.1974	0.1974	0.1974
	<i>MC</i>	0.8333	0.8333	0.8333	0.8333
	<i>Z</i>	0.3502	0.2801	0.2802	0.2802
	<i>M</i>	800.0395	766.6558	766.6875	766.6875
	<i>U</i>		0.1799	0.1801	0.1801
	<i>p_Z</i>		0.0514	0.0512	0.0512
	<i>C_A</i>		0.0011	0.0011	0.0011
$\xi = 4/5$	<i>Y</i>	0.7778	0.7590	0.7589	0.7589
	<i>C</i>	0.5444	0.5318	0.5318	0.5318
	<i>I</i>	0.1539	0.1465	0.1465	0.1465
	<i>L</i>	0.1999	0.1973	0.1973	0.1973
	<i>MC</i>	0.8325	0.8326	0.8325	0.8324
	<i>Z</i>	0.3500	0.2801	0.2800	0.2800
	<i>M</i>	799.9431	766.6558	766.6102	766.6006
	<i>U</i>		0.1792	0.1802	0.1801
	<i>p_Z</i>		0.0513	0.0513	0.0512
	<i>C_A</i>		0.0012	0.0011	0.0011

²The results reported in this Section have been obtained starting from the model presented in the paper setting $\gamma_I = 7.5$ and leaving all the other parameters at their baseline values (see Table 1 of the main text). In this case the steady state remains unchanged (see Table 2 of the main text).

Table S.6: Standard Deviations

		No Policy		Cap-and-Trade		Intensity Target		Tax	
		$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$
$\xi = 3/4$	<i>Y</i>	0.0209	1	0.0183	1	0.0209	1	0.0206	1
	<i>C</i>	0.0106	0.5070	0.0092	0.5014	0.0104	0.4998	0.0104	0.5068
	<i>I</i>	0.0140	0.6695	0.0121	0.6627	0.0143	0.6839	0.0138	0.6713
	<i>L</i>	0.0032	0.1554	0.0029	0.1584	0.0035	0.1663	0.0033	0.1608
	<i>MC</i>	0.0147	0.7008	0.0143	0.7804	0.0150	0.7194	0.0149	0.7230
	<i>Z</i>	0.0085	0.4044	0	0	0.0077	0.3689	0.0068	0.3305
	<i>M</i>	0.8454	40.4400	0	0	0.6779	32.4495	0.6776	32.9148
	<i>U</i>			0.0175	0.9555	0.0050	0.2415	0	0.0000
	<i>p_Z</i>			0.0089	0.4889	0.0026	0.1236	0	0.0000
	<i>C_A</i>			0.0003	0.0180	0.0001	0.0039	0.0000	0.0013
$\xi = 0$	<i>Y</i>	0.0171	1	0.0146	1	0.0166	1	0.0166	1
	<i>C</i>	0.0105	0.6165	0.0091	0.6241	0.0104	0.6218	0.0104	0.6218
	<i>I</i>	0.0081	0.4767	0.0064	0.4403	0.0078	0.4690	0.0078	0.4690
	<i>L</i>	0.0008	0.0482	0.0006	0.0409	0.0008	0.0481	0.0008	0.0481
	<i>MC</i>	0	0	0	0	0	0	0	0
	<i>Z</i>	0.0077	0.4500	0	0	0.0061	0.3689	0.0061	0.3689
	<i>M</i>	0.8455	49.5622	0	0	0.6777	40.7138	0.6777	40.7138
	<i>U</i>			0.0158	1.0799	0	0	0	0
	<i>p_Z</i>			0.0081	0.5525	0	0	0	0
	<i>C_A</i>			0.0003	0.0204	0.0000	0.0015	0.0000	0.0015
$\xi = 4/5$	<i>Y</i>	0.0290	1	0.0251	1	0.0293	1	0.0294	1
	<i>C</i>	0.0107	0.3694	0.0093	0.3689	0.0105	0.3598	0.0105	0.3590
	<i>I</i>	0.0236	0.8141	0.0201	0.7994	0.0242	0.8252	0.0241	0.8220
	<i>L</i>	0.0070	0.2416	0.0061	0.2414	0.0073	0.2502	0.0074	0.2505
	<i>MC</i>	0.0352	1.2145	0.0329	1.3118	0.0355	1.2116	0.0367	1.2506
	<i>Z</i>	0.0110	0.3798	0	0	0.0108	0.3689	0.0091	0.3099
	<i>M</i>	0.8456	29.198	0	0	0.6782	23.1362	0.6778	23.0895
	<i>U</i>			0.0226	0.9004	0.0074	0.2521	0	0
	<i>p_Z</i>			0.0116	0.4607	0.0038	0.1290	0	0
	<i>C_A</i>			0.0004	0.0170	0.0001	0.0038	0.0000	0.00125

Table S.7: Welfare Mean and Standard Deviations

	No Policy		Cap-and-Trade		Intensity Target		Tax	
	mean	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd
$\xi = 3/4$	-100.4619	0.6344	-1.3199	0.5595	-1.3166	0.6365	-1.3147	0.6363
$\xi = 0$	-100.4464	0.6329	-1.3216	0.5586	-1.3140	0.6348	-1.3140	0.6348
$\xi = 4/5$	-100.5245	0.6357	-1.3079	0.5603	-1.3217	0.6378	-1.3218	0.6376

3 The Economy without Imperfect Competition and Nominal Rigidities³

Table S.8: Deterministic Steady State

	No-Policy	Environmental Policy
Y	0.9473	0.9274
C	0.6429	0.6309
I	0.2249	0.2156
L	0.2225	0.2199
MC	1	1
Z	0.4263	0.34102
M	836.269	795.671
U		0.18283
pz		0.0526
C_A/Y		0.0015
$\Gamma(M)$	0.0061	0.0054
$Welfare$	-93.2896	-94.0363

³The results reported in this Section have been obtained starting from the model presented in the paper setting the net markup and the probability that prices stay unchanged at zero, while leaving all the other parameters at their baseline values (see Table 1). In this case the level of economic activity will be higher than that reported in Table 2 of the main text.

Table S.9: Means

	No Policy	Cap-and-Trade	Intensity Target	Tax
<i>Y</i>	0.9475	0.9275	0.9276	0.9276
<i>C</i>	0.6430	0.6310	0.6310	0.6310
<i>I</i>	0.2250	0.2156	0.2156	0.2156
<i>L</i>	0.2225	0.2199	0.2199	0.2199
<i>MC</i>	1	1	1	1
<i>Z</i>	0.4264	0.3410	0.3411	0.3411
<i>M</i>	836.3164	795.6713	795.7090	795.7090
<i>U</i>		0.1826	0.1828	0.1828
<i>pZ</i>		0.0528	0.0526	0.0526
<i>C_A</i>		0.0015	0.0014	0.0014

Table S.10: Standard Deviations

	No Policy		Cap-and-Trade		Intensity Target		Tax	
	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$
<i>Y</i>	0.0207	1	0.0181	1	0.0202	1	0.0202	1
<i>C</i>	0.0117	0.5667	0.0104	0.5732	0.0116	0.5715	0.0116	0.5715
<i>I</i>	0.0109	0.5286	0.0089	0.4928	0.0105	0.5216	0.0105	0.5216
<i>L</i>	0.0010	0.0485	0.0007	0.0388	0.0010	0.0483	0.0010	0.0483
<i>MC</i>	0	0	0	0	0	0	0	0
<i>Z</i>	0.0093	0.4500	0	0	0.0074	0.3677	0.0074	0.3677
<i>M</i>	1.0121	49.0043	0	0	0.8115	40.1275	0.8115	40.1275
<i>U</i>			0.0160	0.8812	0	0	0	0
<i>pZ</i>			0.0083	0.4562	0	0	0	0
<i>C_A</i>			0.0004	0.0209	0.0000	0.0015	0.0000	0.0015

Table S.11: Welfare Mean and Standard Deviations

No Policy		Cap-and-Trade		Intensity Target		Tax	
mean	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd
-93.2850	0.6213	-0.8076	0.5640	-0.8007	-0.6222	-0.8007	-0.6222

4 The Economy without Adjustment Costs on Capital, Imperfect Competition, and Nominal Rigidities⁴

Table S.12: Means

	No Policy	Cap-and-Trade	Intensity Target	Tax
Y	0.9475	0.9275	0.9276	0.9276
C	0.6430	0.6310	0.6310	0.6310
I	0.2250	0.2156	0.2156	0.2156
L	0.2225	0.2199	0.2199	0.2199
MC	1.0000	1.0000	1.0000	1.0000
Z	0.4264	0.3410	0.3411	0.3411
M	836.3187	795.6713	795.7108	795.7108
U		0.1826	0.1828	0.1828
p_Z		0.0528	0.0526	0.0526
\mathcal{C}_A		0.0015	0.0014	0.0014

⁴The results reported in this Section have been obtained starting from the model presented in the paper setting the net markup, the probability that prices stay unchanged and the adjustment cost on capital at zero, while leaving all the other parameters at their baseline values (see Table 1). In this case the level of economic activity in steady state will be as in Table S.8.

Table S.13: Standard Deviations

	No Policy		Cap-and-Trade		Intensity Target		Tax	
	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$
<i>Y</i>	0.0208	1	0.0183	1	0.0204	1	0.0204	1
<i>C</i>	0.0118	0.5640	0.0104	0.5703	0.0116	0.5688	0.0116	0.5688
<i>I</i>	0.0112	0.5374	0.0091	0.5013	0.0108	0.5304	0.0108	0.5304
<i>L</i>	0.0010	0.0501	0.0007	0.0401	0.0010	0.0500	0.0010	0.0500
<i>MC</i>	0	0	0	0	0	0	0	0
<i>Z</i>	0.0094	0.4500	0	0	0.0075	0.3677	0.0075	0.3677
<i>M</i>	1.0173	48.8150	0	0	0.8158	39.9724	0.8158	39.9724
<i>U</i>			0.0161	0.8812	0	0	0	0
<i>pZ</i>			0.0083	0.4562	0	0	0	0
<i>C_A</i>			0.0004	0.0209	0.0000	0.0015	0.0000	0.0015

Table S.14: Welfare Mean and Standard Deviations

No Policy		Cap-and-Trade		Intensity Target		Tax	
mean	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd
-93.2844	0.6267	-0.8078	0.5683	-0.8007	0.6277	-0.8007	0.6277

5 The Economy without Adjustment Costs on Capital, Imperfect Competition, Nominal Rigidities, and Monetary Policy⁵

Table S.15: Means

	No Policy	Cap-and-Trade	Intensity Target	Tax
Y	0.9476	0.9276	0.9277	0.9277
C	0.6431	0.6310	0.6311	0.6311
I	0.2250	0.2156	0.2157	0.2157
L	0.2225	0.2199	0.2199	0.2199
MC	1	1	1	1
Z	0.4264	0.3410	0.3411	0.3411
M	836.3293	795.6713	795.7214	795.7214
U		0.1827	0.1828	0.1828
p_Z		0.0528	0.0526	0.0526
\mathcal{C}_A		0.0015	0.0014	0.0014

⁵The results reported in this Section have been obtained starting from the model presented in the paper, setting the net markup, the probability that prices stay unchanged and the adjustment cost on capital at zero, while leaving all the other parameters at their baseline values (see Table 1). In addition, we have excluded monetary policy. In this case the level of economic activity in steady state will be as in Table S.8.

Table S.16: Standard Deviations

	No Policy		Cap-and-Trade		Intensity Target		Tax	
	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$	$\sigma(X)$	$\frac{\sigma(X)}{\sigma(Y)}$
<i>Y</i>	0.0208	1	0.0183	1	0.0204	1	0.0204	1
<i>C</i>	0.0118	0.5640	0.0104	0.5703	0.0116	0.5688	0.0116	0.5688
<i>I</i>	0.0112	0.5374	0.0091	0.5013	0.0108	0.5304	0.0108	0.5304
<i>L</i>	0.0010	0.0501	0.0007	0.0401	0.0010	0.0500	0.0010	0.0500
<i>MC</i>	0	0	0	0	0	0	0	0
<i>Z</i>	0.0094	0.4500	0	0	0.0075	0.3677	0.0075	0.3677
<i>M</i>	1.0173	48.8150	0	0	0.8158	39.9728	0.8158	39.9728
<i>U</i>			0.0161	0.8812	0	0	0	0
<i>pZ</i>			0.0083	0.4562	0	0	0	0
<i>C_A</i>			0.0004	0.0209	0.0000	0.0015	0.0000	0.0015

Table S.17: Welfare Mean and Standard Deviations

No Policy		Cap-and-Trade		Intensity Target		Tax	
mean	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd	mean (% dev. no policy)	sd
-93.2824	0.6267	-0.8077	0.5683	-0.8004	0.6277	-0.8004	0.6277