Technical appendix for "Fiscal retrenchments and the transmission mechanism of sovereign risk channel for highly indebted countries"

(Not for Publication)

A Data and data transformations

For each domestic economy model, 16 transformed time series are considered in the estimates, and 4 for the foreign sector SVAR. A total of 20 variables is thus considered in the country-specific estimates. The domestic economy variables are: (log differences of) real per capita GDP[1] $\left(\Delta y_t^{obs}\right)$, consumption $\left(\Delta c_t^{obs}\right)$, investment $\left(\Delta i_t^{obs}\right)$, imports $\left(\Delta m_t^{obs}\right)$, exports$\left(\Delta x_t^{obs}\right)$, the real wage $\left(\Delta w_t^{obs}\right)$ and the public debt $\left(\Delta b_t^{obs}\right)$; the unemployment rate $\left(u_t^{obs}\right)$, the (quarterly) rates of change of the consumption $(\pi_t^{c,obs})$, import $(\pi_t^{m,obs})$, export $(\pi_t^{x,obs})$ and domestic sector $(\pi_t^{y,obs})$ price deflators; the nominal effective exchange rate $\left(e_t^{obs}\right)$, the (quarterly) short-term interest rate, the 10-years government bond rate and the lending rate to non financial corporations (r_t^{obs}, $r_{b,t}^{obs}$ and $r_{l,t}^{obs}$, respectively). The variables for the foreign sector are: the log difference of real output $(y_t^{*,obs})$, obtained from the OECD area real output, the short and long-term interest rates ($r_{s,t}^{*,obs}$ and $r_{b,t}^{*,obs}$, respectively), approximated by those for the US and the foreign price deflator $(\pi_t^{*,obs})$ is obtained from the real effective exchange rate definition equation using observed data on domestic inflation, the nominal and the real effective exchange rates. All data are taken from official sources and cover the period 1999:1-2017:4[2].

Real variables are expressed in chained 2005 euros. Nominal GDP, consumption, private investment, imports and exports are deflated with the respective price deflators. Nominal wages are deflated with the consumer price index (CPI), while government debt is deflated with the GDP deflator. All real and labor market variables are scaled with respect to the labor force, which is thus normalized to one.

All series are seasonally adjusted and are entered in logs. The log quarterly nominal rates are obtained employing the transformation $r = \log\left(1 + R/400\right)$ to the original variables. Table A1 below summarizes data sources and the data manipulations from which the operational data sets are obtained.

[1] Per capita variables are obtained considering the labor force as the normalizing variable.

[2] The choice of using a limited time span is made with the purpose of avoiding the potential estimation biases implied by the switch to the common currency in 1999 (2001 for Greece).

TABLE A1 - SOURCE OF DATA AND DATA TRANSFORMATIONS

Variable	Definition	Source	Database	Transformation used
Y_t	Gross domestic product	OECD	EO	$y_t^{obs} = \log\left(\frac{Y_t}{LF_t \times YPI_t/100}\right)$
C_t	Private consumption	OECD	EO	$c_t^{obs} = \log\left(\frac{C_t}{LF_t \times CPI_t/100}\right)$
I_t	Private investment	OECD	EO	$i_t^{obs} = \log\left(\frac{I_t}{LF_t \times IPI_t/100}\right)$
X_t	Exports	OECD	EO	$x_t^{obs} = \log\left(\frac{X_t}{LF_t \times XPI_t/100}\right)$
M_t	Imports	OECD	EO	$m_t^{obs} = \log\left(\frac{M_t}{LF_t \times MPI_t/100}\right)$
W_t	Labor compensation	OECD	EO	$w_t^{obs} = \log\left(\frac{W_t}{N_t \times CPI_t/100}\right)$
b_t	Government debt	Eurostat	QGD	$b_t^{obs} = \log\left(\frac{B_t}{LF_t \times YPI_t/100}\right)$
YPI_t	GDP price index	OECD	EO	$\pi_t^{y,obs} = \log\left(\frac{YPI_t}{YPI_{t-1}}\right)$
U_t	Unemployment rate	OECD	QLFS	$u_t^{obs} = \frac{U_t}{100}$
CPI_t	Private consumption price index	OECD	EO	$\pi_t^{c,obs} = \log\left(\frac{CPI_t}{CPI_{t-1}}\right)$
IPI_t	Private investment price index	OECD	EO	-
XPI_t	Export price index	OECD	EO	$\pi_t^{x,obs} = \log\left(\frac{XPI_t}{XPI_{t-1}}\right)$
MPI_t	Import price index	OECD	EO	$\pi_t^{m,obs} = \log\left(\frac{MPI_t}{MPI_{t-1}}\right)$
R_t	Short term interest rate, EZ	OECD	EO	$r_t^{obs} = \log\left(1 + \frac{R_t}{400}\right)$
$R_{g,t}$	10 years gov. bond rate	OECD	EO	$r_{g,t}^{obs} = \log\left(1 + \frac{R_{g,t}}{400}\right)$
$R_{l,t}$	Lending rate to nonfinancial corp	IMF	IFS	$r_{l,t}^{obs} = \log\left(1 + \frac{R_{l,t}}{400}\right)$
E_t	Nominal effective exch. rate	IMF	IFS	$e_t^{obs} = \log\left(\frac{E_t}{100}\right)$
RE_t	Real effective exch. rate	IMF	IFS	-
YPI_t^*	GDP price index - foreign sector	-	-	$\pi_t^{*,obs} = \log\left(\frac{E_t YPI_t / RE_t}{E_{t-1} YPI_{t-1} / RE_{t-1}}\right)$
Y_t^*	OECD real output	OECD	EO	$y_t^{*,obs} = \log\left(\frac{Y_t^*}{100}\right)$
$R_{s,t}^{*(EU-US)}$	Short term interest rate EU-US	OECD	EO	$r_{s,t}^{*,obs} = \log\left(1 + \frac{0.7R_{s,t}^{EU}}{400} + \frac{0.3R_{s,t}^{US}}{400}\right)$
$R_{g,t}^{*(EU-US)}$	Long term interest rate EU-US	OECD	EO	$r_{g,t}^{*,obs} = \log\left(1 + \frac{0.7R_{g,t}^{EU}}{400} + \frac{0.3R_{g,t}^{US}}{400}\right)$

Notes: EO: Economic Outlook; QGD: Quarterly Government Debt Statistics; IFS: International Financial Statistics; QLFS: Quarterly Labor Force Statistics.

B Estimated coefficients of shock processes

TABLE B1 - PRIOR DISTRIBUTIONS AND POSTERIOR MEAN ESTIMATES: AR(1) COEFICIENTS OF SHOCKS

	Description	Prior distribution		Posterior mean			
		Density	Mean (s.d.)	Greece [c.i.]	Italy [c.i.]	Portugal [c.i.]	Spain [c.i.]
ρ_a	TFP shock	$\mathcal{B}$	0.50 (0.15)	0.926 [0.892 − 0.960]	0.873 [0.834 − 0.912]	0.833 [0.753 − 0.907]	0.845 [0.790 − 0.901]
ρ_c	Preference shock cons	$\mathcal{B}$	0.50 (0.15)	0.965 [0.943 − 0.987]	0.953 [0.937 − 0.969]	0.938 [0.919 − 0.958]	0.970 [0.960 − 0.979]
ρ_n	Preference shock labor	$\mathcal{B}$	0.50 (0.15)	0.271 [0.143 − 0.392]	0.114 [0.039 − 0.182]	0.144 [0.056 − 0.232]	0.320 [0.150 − 0.492]
ρ_{inv}	Investment shock	$\mathcal{B}$	0.50 (0.15)	0.281 [0.114 − 0.430]	0.537 [0.382 − 0.700]	0.267 [0.125 − 0.400]	0.697 [0.590 − 0.802]
ρ_{uip}	UIP premium shock	$\mathcal{B}$	0.50 (0.15)	0.857 [0.793 − 0.923]	0.858 [0.806 − 0.911]	0.821 [0.757 − 0.886]	0.816 [0.753 − 0.889]
ρ_{arc}	Resource constr. shock	$\mathcal{B}$	0.50 (0.15)	0.753 [0.663 − 0.841]	0.772 [0.699 − 0.834]	0.761 [0.720 − 0.814]	0.797 [0.725 − 0.873]
ρ_m	Import shock	$\mathcal{B}$	0.50 (0.15)	0.805 [0.715 − 0.893]	0.913 [0.889 − 0.938]	0.827 [0.741 − 0.915]	0.840 [0.776 − 0.907]
ρ_x	Export shock	$\mathcal{B}$	0.50 (0.15)	0.729 [0.601 − 0.861]	0.864 [0.797 − 0.937]	0.826 [0.760 − 0.898]	0.897 [0.841 − 0.954]
ρ_{rg}	Gov. risk premium shock	$\mathcal{B}$	0.50 (0.15)	0.838 [0.793 − 0.882]	0.872 [0.824 − 0.925]	0.899 [0.861 − 0.939]	0.867 [0.815 − 0.922]
ρ_{rl}	Bank markup shock	$\mathcal{B}$	0.50 (0.15)	0.752 [0.651 − 0.860]	0.831 [0.753 − 0.913]	0.826 [0.746 − 0.911]	0.950 [0.925 − 0.976]

Notes: B represents the Beta distribution. Posterior mean estimates for the AR(1) coefficients of shocks are obtained with 250000 M-H replications on two parallel chains.

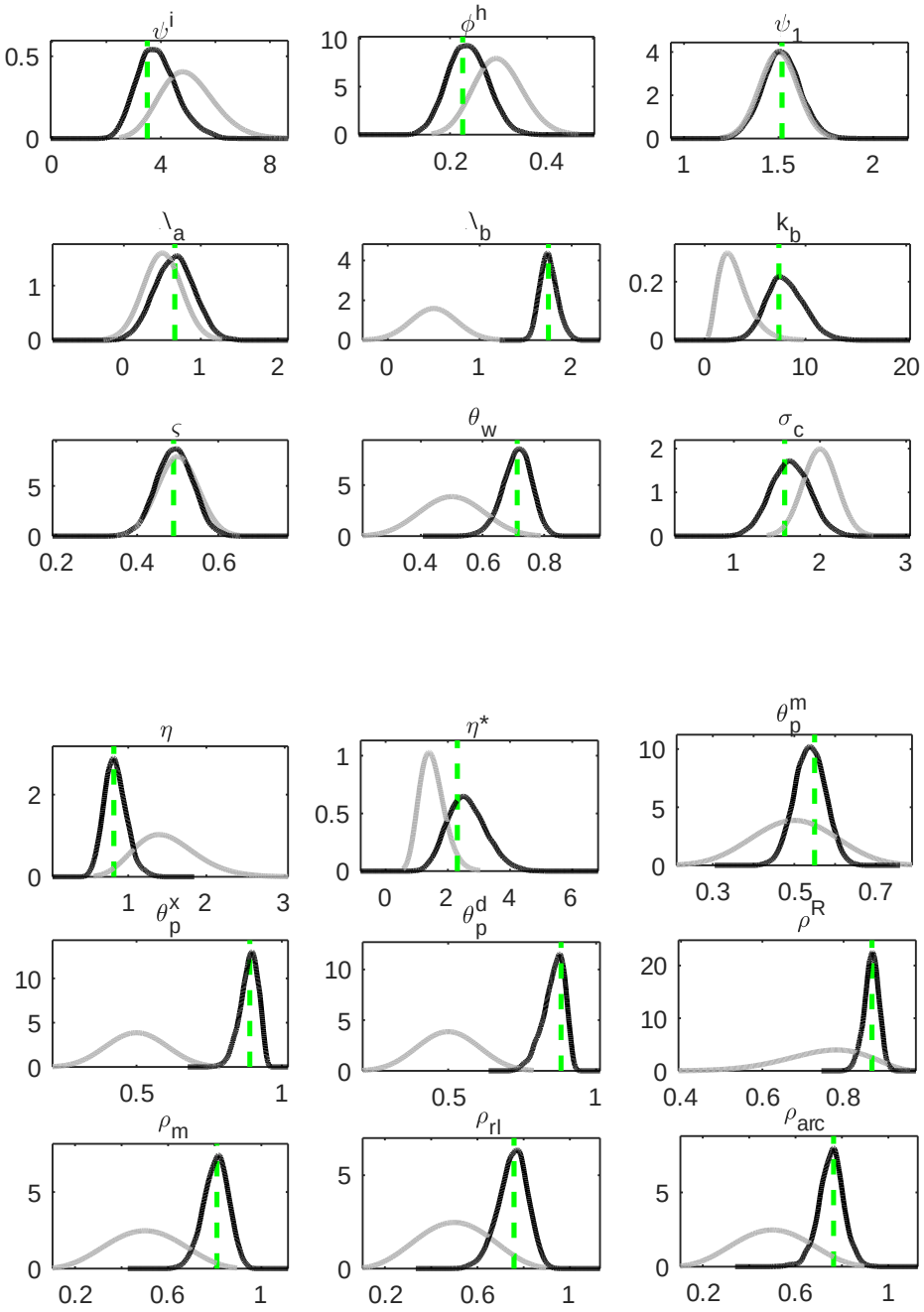
TABLE B2 - PRIOR DISTRIBUTIONS AND POSTERIOR MEAN ESTIMATES: S.D. OF SHOCKS

	Description	Prior distribution		Posterior mean			
		Density	Mean (s.d.)	Greece [c.i.]	Italy [c.i.]	Portugal [c.i.]	Spain [c.i.]
$\varepsilon_{a,t}$	TFP	$\mathcal{G}^{-1}$	0.01 (2.00)	0.018 [0.015 − 0.021]	0.009 [0.008 − 0.011]	0.009 [0.008 − 0.010]	0.006 [0.005 − 0.007]
$\varepsilon_{mp,t}$	Monetary policy	$\mathcal{G}^{-1}$	0.01 (2.00)	0.001 [0.001 − 0.001]	0.001 [0.001 − 0.001]	0.001 [0.001 − 0.001]	0.001 [0.001 − 0.001]
$\varepsilon_{d,t}^{mup}$	Markup domestic	$\mathcal{G}^{-1}$	0.01 (2.00)	0.009 [0.008 − 0.010]	0.005 [0.004 − 0.006]	0.005 [0.004 − 0.005]	0.005 [0.004 − 0.006]
$\varepsilon_{m,t}^{mup}$	Markup import	$\mathcal{G}^{-1}$	0.01 (2.00)	0.067 [0.051 − 0.083]	0.024 [0.020 − 0.029]	0.027 [0.021 − 0.032]	0.026 [0.021 − 0.032]
$\varepsilon_{x,t}^{mup}$	Markup export	$\mathcal{G}^{-1}$	0.01 (2.00)	0.013 [0.011 − 0.015]	0.007 [0.006 − 0.009]	0.015 [0.012 − 0.017]	0.013 [0.010 − 0.015]
$\varepsilon_{inv,t}$	Investment specific	$\mathcal{G}^{-1}$	0.01 (2.00)	0.229 [0.152 − 0.306]	0.063 [0.038 − 0.088]	0.156 [0.105 − 0.202]	0.043 [0.027 − 0.059]
$\varepsilon_{uip,t}$	UIP premium	$\mathcal{G}^{-1}$	0.01 (2.00)	0.026 [0.015 − 0.036]	0.012 [0.008 − 0.016]	0.016 [0.010 − 0.022]	0.015 [0.010 − 0.021]
$\varepsilon_{c,t}$	Cons. preference	$\mathcal{G}^{-1}$	0.01 (2.00)	0.052 [0.035 − 0.067]	0.023 [0.018 − 0.028]	0.010 [0.035 − 0.027]	0.039 [0.029 − 0.049]
$\varepsilon_{n,t}$	Labor preference	$\mathcal{G}^{-1}$	0.01 (2.00)	0.041 [0.031 − 0.051]	0.031 [0.024 − 0.039]	0.030 [0.023 − 0.035]	0.038 [0.029 − 0.047]
$\varepsilon_{x,t}$	Export shock	$\mathcal{G}^{-1}$	0.01 (2.00)	0.066 [0.054 − 0.078]	0.025 [0.021 − 0.029]	0.023 [0.019 − 0.026]	0.023 [0.019 − 0.026]
$\varepsilon_{m,t}$	Import shock	$\mathcal{G}^{-1}$	0.01 (2.00)	0.041 [0.035 − 0.048]	0.004 [0.033 − 0.046]	0.032 [0.027 − 0.037]	0.041 [0.034 − 0.047]
$\varepsilon_{cpi,t}$	Meas. error cpi	$\mathcal{G}^{-1}$	0.01 (2.00)	0.013 [0.011 − 0.015]	0.004 [0.003 − 0.004]	0.004 [0.003 − 0.004]	0.003 [0.002 − 0.003]
$\varepsilon_{arc,t}$	Meas. error res. constraint	$\mathcal{G}^{-1}$	0.01 (2.00)	0.012 [0.010 − 0.014]	0.004 [0.003 − 0.005]	0.003 [0.003 − 0.004]	0.002 [0.002 − 0.003]
$\varepsilon_{b,t}$	Government debt	$\mathcal{G}^{-1}$	0.01 (2.00)	0.046 [0.039 − 0.053]	0.019 [0.017 − 0.022]	0.023 [0.020 − 0.027]	0.026 [0.022 − 0.029]
$\varepsilon_{rg,t}$	Gov. risk premium	$\mathcal{G}^{-1}$	0.01 (2.00)	0.005 [0.004 − 0.005]	0.001 [0.001 − 0.001]	0.002 [0.002 − 0.002]	0.001 [0.001 − 0.001]
$\varepsilon_{rl,t}$	Bank markup	$\mathcal{G}^{-1}$	0.01 (2.00)	0.015 [0.012 − 0.018]	0.006 [0.005 − 0.008]	0.009 [0.008 − 0.011]	0.004 [0.003 − 0.004]
$\varepsilon_{dp,t}^{*}$	Foreign price	$\mathcal{G}^{-1}$	0.005 (2.00)	0.006 [0.006 − 0.007]	0.006 [0.006 − 0.007]	0.006 [0.006 − 0.007]	0.006 [0.006 − 0.007]
$\varepsilon_{y,t}^{*}$	Foreign output	$\mathcal{G}^{-1}$	0.005 (2.00)	0.006 [0.005 − 0.006]	0.006 [0.005 − 0.006]	0.006 [0.005 − 0.006]	0.006 [0.005 − 0.006]
$\varepsilon_{r,t}^{*}$	Foreign int. rate	$\mathcal{G}^{-1}$	0.005 (2.00)	0.002 [0.002 − 0.002]	0.002 [0.002 − 0.002]	0.002 [0.002 − 0.002]	0.002 [0.002 − 0.002]
$\varepsilon_{rl,t}^{*}$	Foreign long term int. rate	$\mathcal{G}^{-1}$	0.005 (2.00)	0.001 [0.001 − 0.001]	0.001 [0.001 − 0.001]	0.001 [0.001 − 0.001]	0.001 [0.001 − 0.001]

Notes: G represents the Gamma distribution. Posterior mean estimates for the standard deviation of shock processes are obtained with 250000 M-H replications on two parallel chains.

C Prior and posterior densities

FIGURE C1. PRIOR AND POSTERIOR DISTRIBUTIONS - GREECE



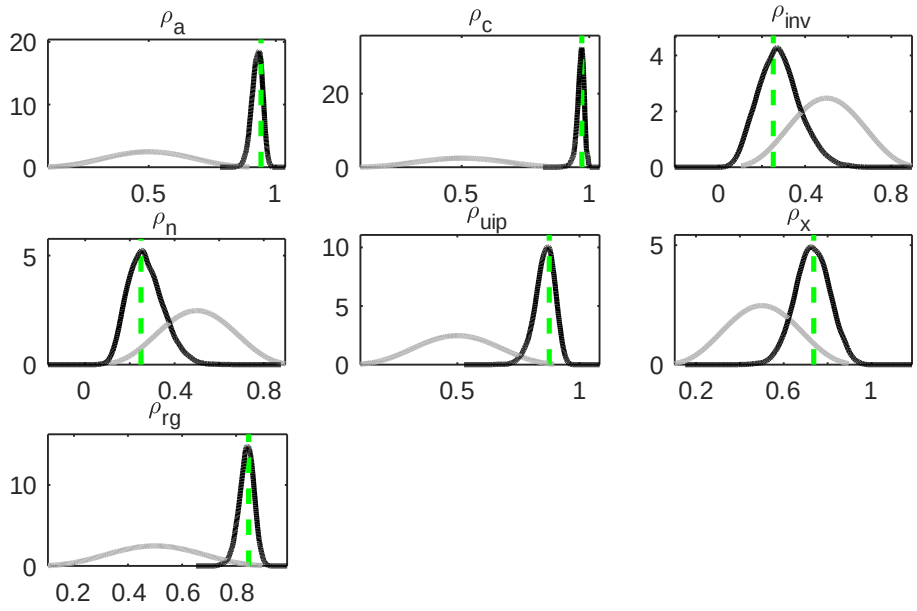
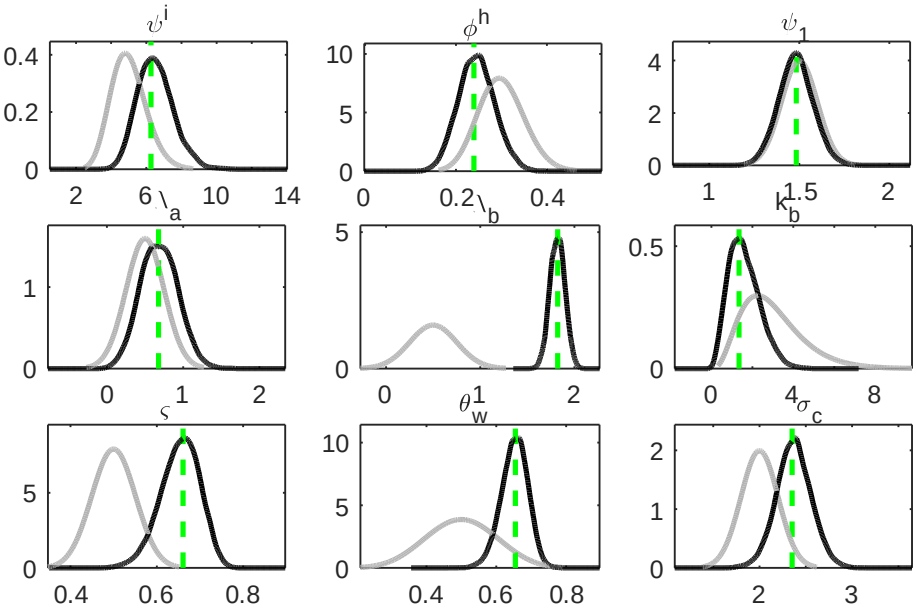


FIGURE C2. PRIOR AND POSTERIOR DISTRIBUTIONS - ITALY



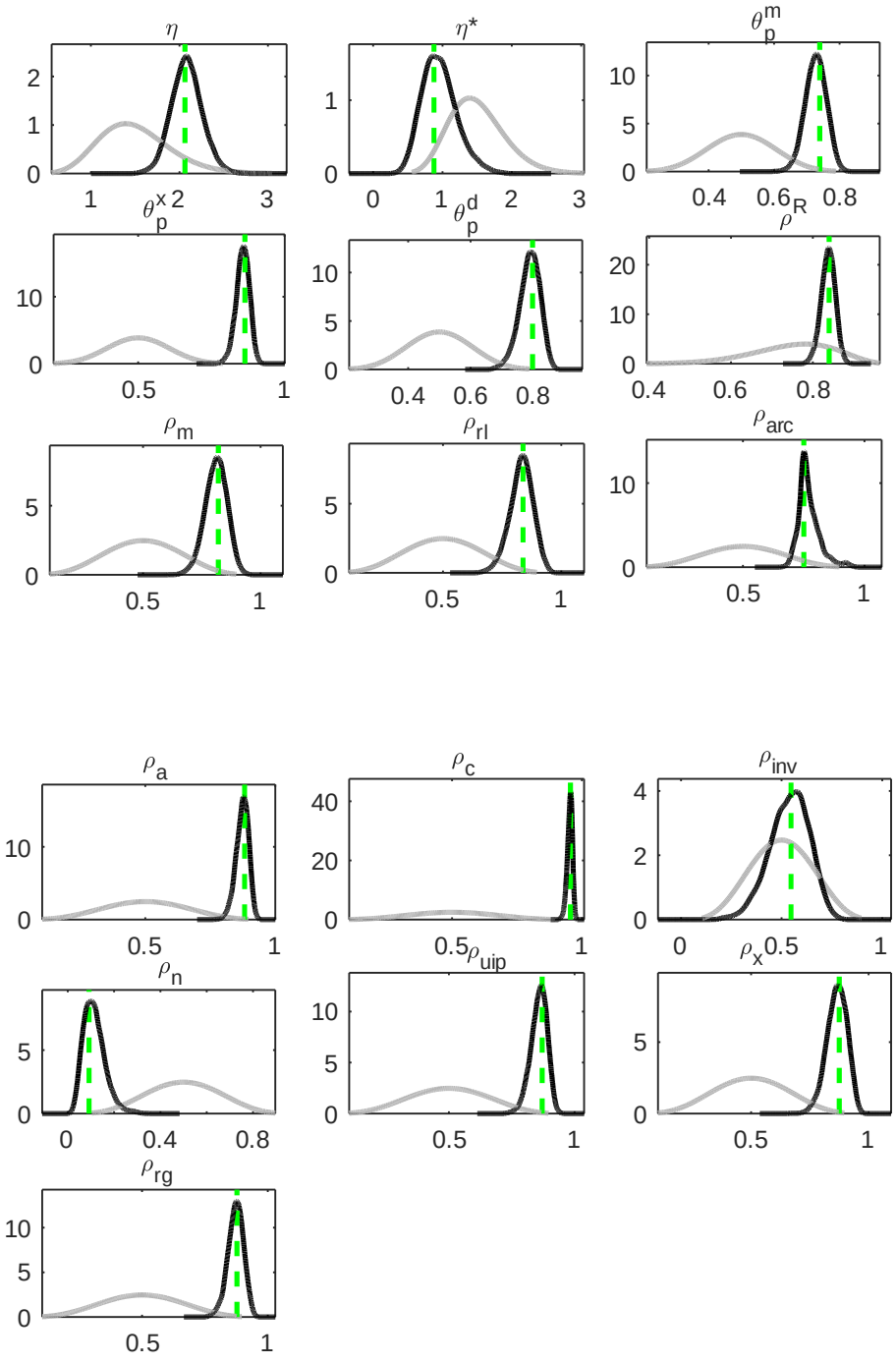
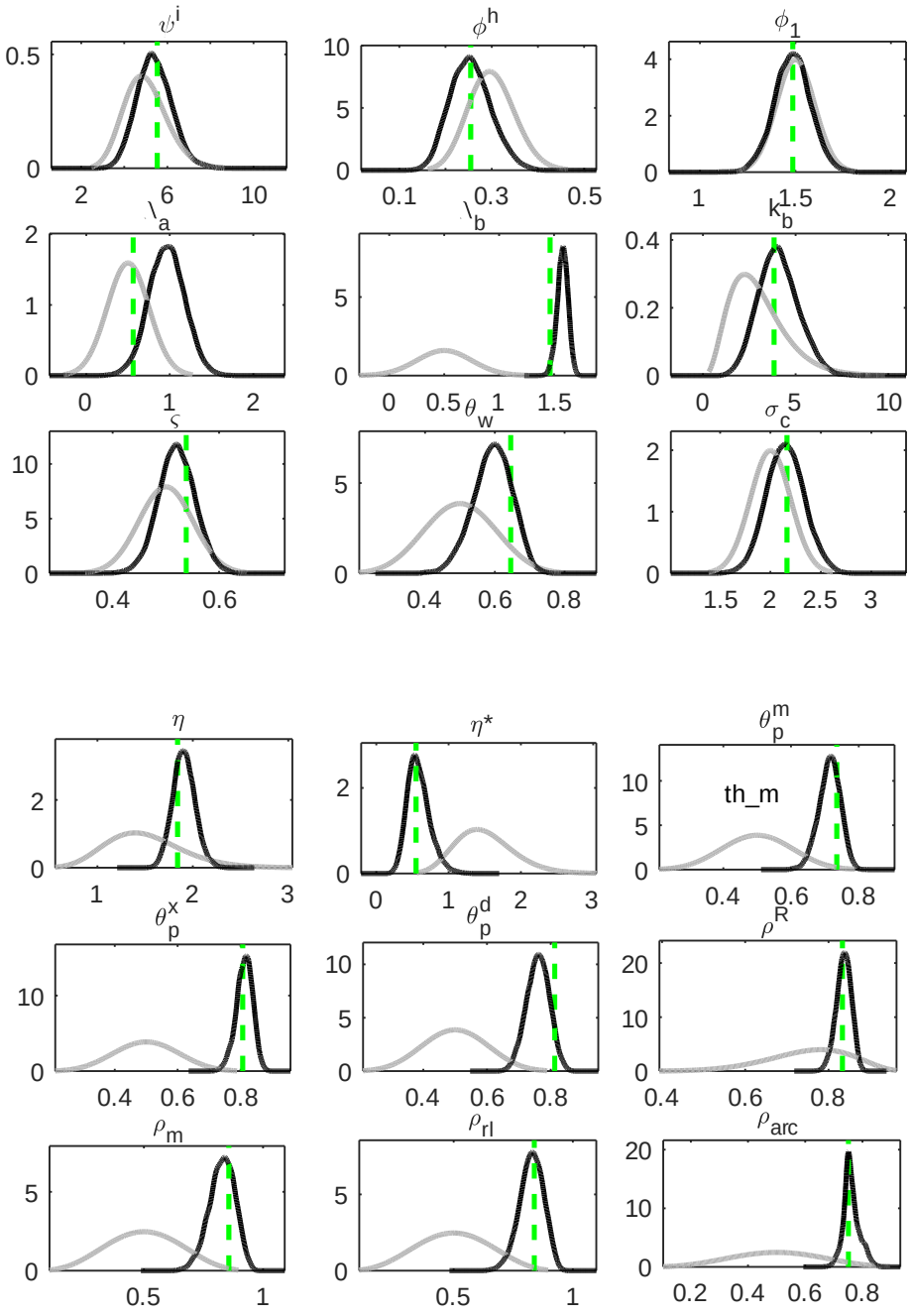

η
η^*
θ_p^m
θ_p^x
θ_p^d
ρ^R
ρ_m
ρ_{rl}
ρ_{arc}
ρ_a
ρ_c
ρ_{inv}
ρ_n
ρ_{uip}
ρ_x
ρ_{rg}

FIGURE C3. PRIOR AND POSTERIOR DISTRIBUTIONS - PORTUGAL



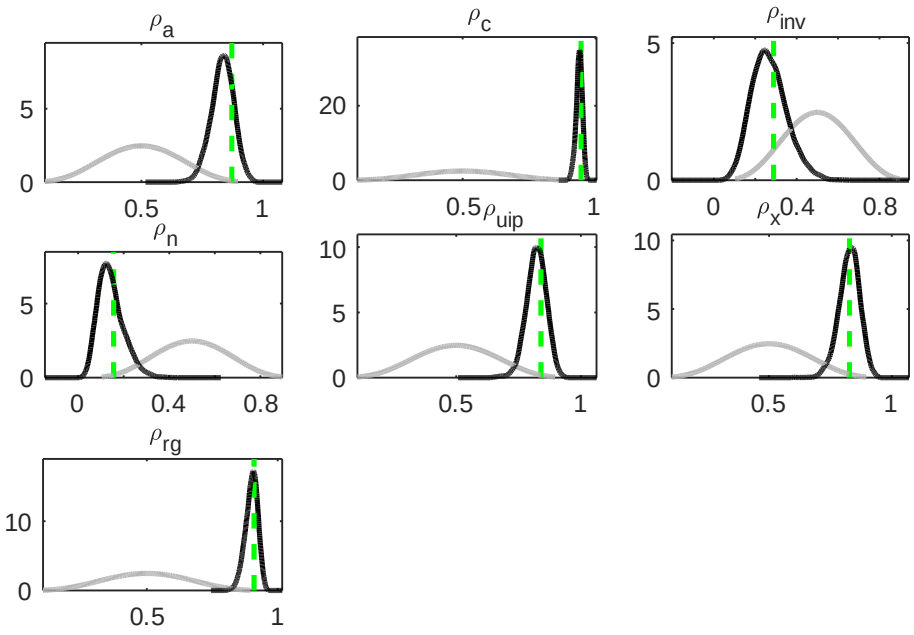
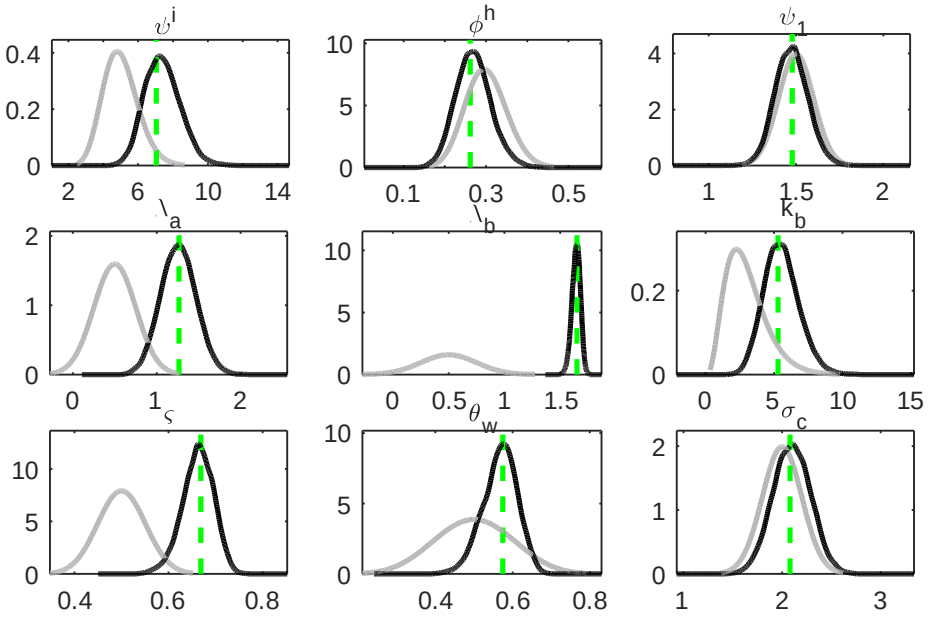
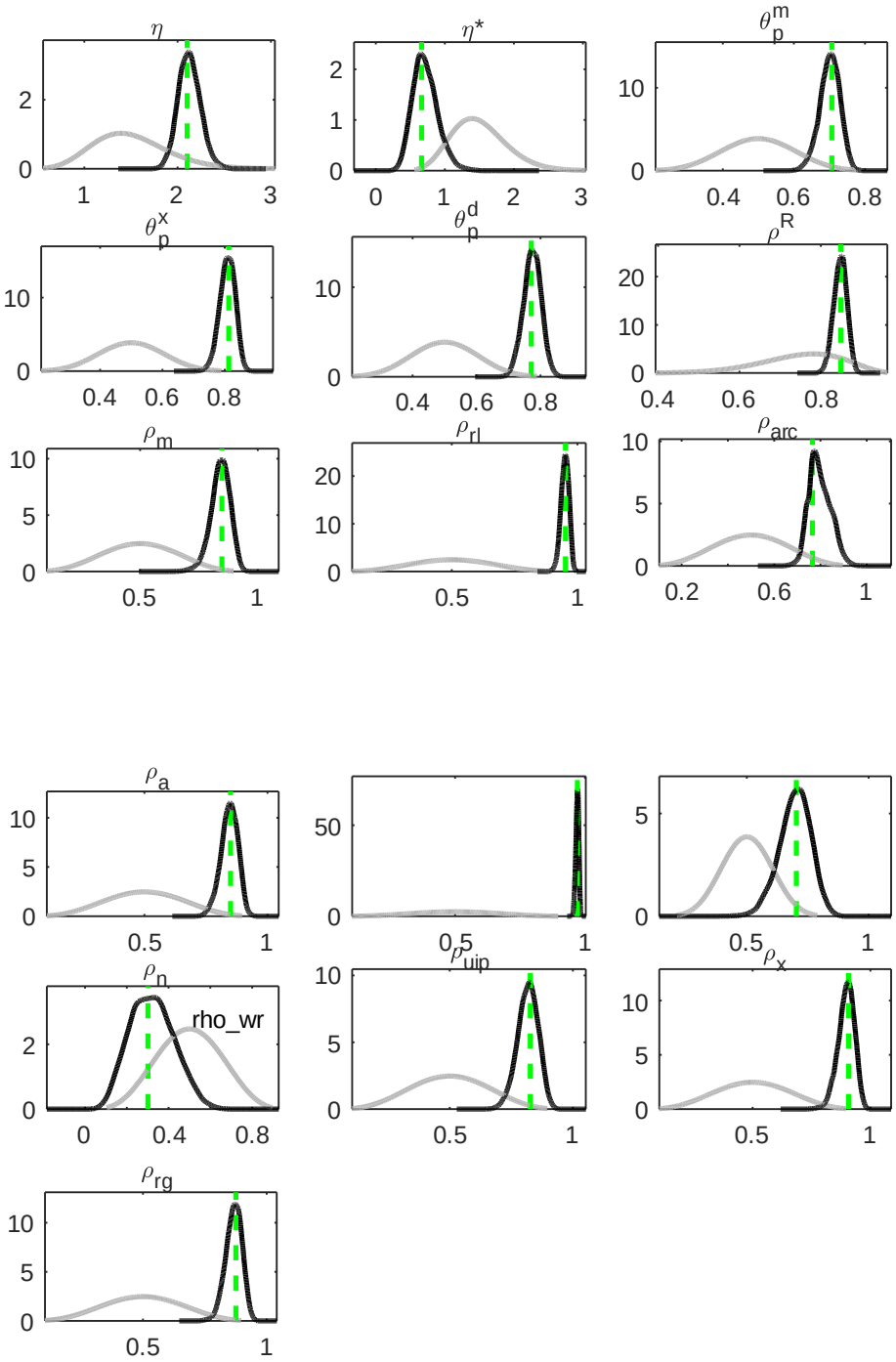


FIGURE C4. PRIOR AND POSTERIOR DISTRIBUTIONS - SPAIN




η
η^*
θ_p^m
θ_p^x
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ρ_m
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rho_wr
ρ_{uip}
ρ_x
ρ_{rg}