Business Cycles around the Globe[*]

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Abstract

We document massive heterogeneity in basic cyclical patterns between (and within) groups of developed and emerging market economies. In order to evaluate the relative importance of shocks vs. financial frictions in explaining cross-country heterogeneities in the business cycle, we then estimate a canonical small open economy model of the business cycle. Finally, we quantify to what extent fluctuations are due to differences in shocks to productivity, or financial propagation.

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1 INTRODUCTION

Are all business cycles alike?[1] To answer this classic question in macroeconomics, we characterize heterogeneity in the quantitative properties of economic fluctuations in a number of countries around the globe. Our main contribution is to bring about more and better data. In addition, through the lenses of a canonical small open economy model of the business cycle, we quantify the relative importance of shocks to productivity versus frictions in access to international capital markets in driving fluctuations.

We seek to improve on earlier efforts studying comparative features of macroeconomic fluctuations in several dimensions. First, we document business cycle facts in 58 countries around the globe, in terms of the choice of variables, time frame and country coverage, arguably the most extensive meaningful panel in this context. The large country dimension allows us to split the sample into the two groups of 29 developed (industrial) and 29 developing (emerging) economies. We further refine country groupings by geography and historical origin. Second, to facilitate international comparisons, we focus our data analysis on the same, post-1995 time period in every country in the sample. This is motivated by the fact that, relative to prior time periods, this era of the 'Great Moderation' features reduced time-series variability in world shocks, and improved quality and increased uniformity in standards in international data collection.

We start out with providing a systematic account of quarterly frequency unconditional facts of volatility, cyclicality and persistence in detrended components of basic macroeconomic aggregates in a large number of countries around the globe, including both emerging and developing ones. We establish a number of stylized facts, partly confirming results obtained in other, less comprehensive datasets.[2] First, output is more volatile in emerging market countries than in industrial ones. Second, the first order autocorrelation coefficient in detrended output is about 0.8, with the emerging market county group showing somewhat smaller persistence. Third, consumption is in general about as volatile as output in industrial economies, but significantly more volatile in emerging market ones. Fourth, relative investment volatilities are on the same order of magnitude in the different country groups. And finally, net exports are more countercyclical in emerging markets than industrial economies; the result mainly being due to observations in countries of the G7 versus Latin America.

We then estimate country-specific innovations to the level and the growth rate in productivity, specified in a dynamic general equilibrium open-economy business cycle model. The idea we pursue is to condense differentials in countries' cyclical fluctuations into differences in the underlying shock processes

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[1] Blanchard and Watson (1986) ask the exact same question, with the interest of studying the time-series variation in the intensity of US business cycle fluctuations over the twentieth century.

and other key structural parameters related to frictions in financing temporarily high expenditures. As in Aguiar and Gopinath (2007), we specify processes of shocks to productivity with permanent and transitory components. Permanent shocks to productivity add extra volatility to consumption and make net exports more countercyclical. We formalize the notion of financial frictions as the spread in domestic borrowing rates, related to the extra debt burden of the country relative to its steady state stock of debt. Besides making debt a stationary process in the model, this approach captures the idea that the increased threat of default induced by excessive indebtedness makes investor demand a higher premium to purchase assets issued in the small open economy. It is also consistent with the notion that rarely binding liquidity constraints make debt dynamics stationary and (shadow) interest rates respond to debt (see Anagnostopoulos, 2009).

While the vast majority of related research focuses on the business cycle in a handful number of developed economies[3], there is also a growing literature analyzing developing countries, though these papers either tend to be limited to a small group of countries, or to a single country[4]. By focusing on the issue of the difference in business cycle fluctuations in emerging versus developed economies, our work is most closely related to the papers by Aguiar and Gopinath (2007), Altug and Bildirici (2010), Garcia-Cicco, Pancrazi and Uribe (2009), Chang and Fernandez (2010), and Neumeyer and Perri (2005).

The rest of the paper proceeds as follows. Section 2 covers data and measurement. Section 3 summaries the small open economy real business cycle model. Section 4 discusses estimation. Section 5 presents the results. Section 6 concludes and indicates directions for further work.

2 MODEL ECONOMY

The benchmark small open economy real business cycle model we employ is similar to the one developed in Aguiar and Gopinath (2007), and then extended by Garcia-Cicco, Pancrazi and Uribe (2009), and Chang and Fernandez (2010), now estimated for each individual economies. Our working assumption is that national economies share the exact same *structure* of shock propagation, but certain linkages (model parameters) and the technological shock processes might differ across countries.

Forward looking consumers maximize the present discounted value of utility over an infinite horizon, using the periodic Cobb-Douglas felicity function of $u_t = C_t^{\gamma}(1-L_t)^{1-\gamma} \; {}^{1-\sigma} \Big/ (1-\sigma)$, where $0 < \gamma < 1$. The resource constraint reflects quadratic costs of capital adjustment in the form of

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[2] See Aguiar and Gopinath (2007), Neumeyer and Perri (2005).

[3] See for example Agresti and Mojon (2001), Christodoulakis et al (1993), Fiorito and Kollintzas (1994), Kydland and Prescott (1990).

[4] For instance, examples for the former category include Alper (2003), Benczur and Ratfai (2010), for the latter one Bjornland (2000), Burgoeing and Soto (2000), Kydland and Zaragaza (1997).

$$C_t + K_{t+1} = Y_t + (1-\delta)K_t - \frac{\varphi}{2}(\frac{K_{t+1}}{K_t} - e^{\mu_g})^2 K_t - B_t + q_t B_{t+1}.$$

International financial transactions are restricted to one-period, risk-free bonds. The level of debt due in period t is denoted by B_t and the time t price of debt due in period $t+1$ is denoted by q_t. To close the model, as in Schmitt-Grohe and Uribe (2001), the price of debt is assumed to be sensitive to the level of debt, with

$$1/q_t = 1 + r_t = 1 + r^* + \psi(e^{B_{t+1}/\Gamma_t - b} - 1),$$

where r^* is the world interest rate, b represents the level of debt in the steady state, and $\psi > 0$ determines the elasticity of the interest rate to changes in debt. The assumption of debt-elastic interest rates makes debt a stationary process. In addition, conceptually, the elasticity parameter ψ gives a metric of financial imperfections, indicating the extent to which investors purchasing this asset respond to changes in the relative debt position of the economy. In this sense, the Finally, the restriction the existence of the steady state puts on parameters is $\beta(1+r^*)^{1/\sigma} = \mu_g$.

Output is produced via a Cobb-Douglas production technology, $Y_t = e^{z_t} K_t^{1-\alpha}(\Gamma_t L_t)^{\alpha}$, with factors of production being labor, L_t, and capital, K_t. The transitory and permanent components in productivity are captured in the variables z_t and Γ_t, respectively. z_t follows an AR(1) process with $z_t = \rho_z z_{t-1} + \varepsilon_t^z$, where $-1 < \rho_z < 1$ and ε_t^z is an i.i.d. mean zero normal process with standard deviation of σ_z. Γ_t, captures the cumulative product of growth shocks, $\Gamma_t = \Gamma_{t-1} e^{g_t}$, with $g_t = (1-\rho_g)\mu_g + \rho_g g_{t-1} + \varepsilon_t^g$. Here again $-1 < \rho_g < 1$ and ε_t^g is an i.i.d. mean zero normal process with standard deviation of σ_g. Innovations in permanent productivity can be thought of as stemming from frictions in policy or regulations.

To make the model stationary, all variables as of time t are normalized by Γ_{t-1}. The solution to the constrained optimization problem is then obtained by the log-linearization of the first order conditions and the resource constraint around the deterministic steady state. Given a solution to the normalized equations, we recover the path of the non-normalized equilibrium by multiplying through by Γ_{t-1}. The theoretical moments are obtained from the coefficients of the log-linearized solution.

The equilibrium in the model reflects consumption smoothing behavior, exhibiting ‘excess sensitivity’ of consumption (Deaton 1991) due to the presence of shocks to trend productivity growth. The key prediction is that consumption gets more volatile and net exports more countercyclical as the persistent component of productivity gains importance.

3 DATA AND MEASUREMENT

By drawing on various national and international, carefully cross-checked data sources, we set up a quarterly frequency dataset of key macroeconomic variables in 58 countries between 1995:1 and 2008:4. Even if a longer sample were available in particular instances, to ensure comparability in terms of time period, external shocks and data quality, we use data restricted to this time period. The resulting panel is almost balanced at the country level.

The choice of countries is constrained by the availability of quarterly frequency National Income and Product Accounts data. Overall, we believe that the quality of the data we use is the best one can possibly achieve in this context. Based on data on income per capita, we first split countries into 2 large groups, industrial and emerging market. This classification roughly overlaps with OECD membership, and also coincides with patterns in financial depth and average inflation. As shown in Table 1 of the Appendix, the two groups are then further divided into 7 subgroups, with countries in Central and Eastern Europe (CEE), the former Soviet Union (CIS), Latin America (LA), and other low- or middle income countries in the emerging market, and G7, traditional European Union (EU), and other high-income countries in the industrial group.

The aggregate variables we consider include (constant price) GDP, private consumption, investment, and net exports.[5] In most cases, constant price data are obtained directly from the data sources. The exceptions are the CIS countries, where we deflate output and consumption by the CPI, and investment, exports and imports by the PPI (if available). We transform the raw data prior to the empirical analysis in several stages. First, all variables are de-seasonalized and transformed into logs. One exception is net exports, where we employ the ratio of net exports to output in percentage terms. In separating the trend from the cyclical component in the data, our default filter is the H-P one, with parameter 1600, the standard choice for quarterly data.

We compute three key sample statistics. For capturing the volatility in cyclical measures, we calculate standard deviations in absolute and relative terms, for comovement, the contemporaneous correlation with output, and for persistence, the AR(1) coefficient in the series.

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[5] Our complete dataset (not utilized here) includes observations on government consumption, employment, real wage, productivity, money, CPI, inflation, interest rate, nominal exchange rate, real exchange rate and net capital flows as well. An extended, going back to 1990:1, though less comprehensive version of the database is also available.

4 STRUCTURAL ESTIMATION

Similarly to Aguiar and Gopinath (2007), we estimate model parameters country by country. Instead of their second moment matching calibration method, as advocated by, among others, Smets and Wouters, 2003, Lubik and Schorfheide, 2005, and An and Schorfheide, 2007, we employ a Bayesian estimation procedure on the H-P filtered series of output, consumption, investment, and net exports per GDP. This technique has a number of advantages. First, it fits the model on the full time series, as opposed to its second moments. It produces confidence intervals and a likelihood value as well, providing an unambiguous measure of model fit. Finally, the procedure allows for measurement error in the data series, clearly an important issue in working with aggregate data.

The model has 13 parameters, plus the standard errors of the 4 measurement error series. 7 of the parameters are common in the country-specific model economies and take on values picked in Aguiar and Gopinath (2007), while we estimate the rest of the parameters separately. The estimated county-specific parameters include the variance and persistence in the two productivity processes, the capital adjustment cost parameter, ϕ, and the debt elasticity of the interest rate premium, ψ. The common parameters are the time preference rate (β = 0.98), the consumption exponent in the utility function (γ = 0.36), the steady state normalized debt (10%), the labor exponent in the production function (a = 0.68), the risk aversion parameter (σ = 2), the mean growth rate of the permanent component of productivity (μ_g = 1.006) and the depreciation rate (δ = 0.05).[6]

Besides the benchmark (full) specification, we consider the following four variants. (1) Fix ψ at the same value as in Aguiar and Gopinath (2007), ψ = 0.001; (2) Fix ψ at the cross-country median estimate of the benchmark model, ψ = 0.11; (3) Fix ρ_g and ρ_z at the median estimate of ρ_g = 0.73 and ρ_z = 0.85; (4) Fix ψ, ρ_g and ρ_z at the median of the benchmark.

To perform the estimation sequence, we used the MCMH method built into Dynare 4.1.[7] The priors are chosen to be relatively uninformative, given that we work with the same distributions for all the 58 countries. We started from the results of Magyari (2010), who performed a similar estimation exercise of a richer model (a variant of Chang and Fernandez, 2010 and Garcia-Cicco, Pancrazi and Uribe, 2009) for Central European countries. In the case of the technology shock persistence and the measurement error standard deviation parameters, we worked with a much wider prior distribution, since those parameters are

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[6] In their benchmark specification, Aguiar and Gopinath (2007) also estimate μ_g. To decrease the number of parameters to be estimated, we decided to fix its value instead, similarly to their scenario 1-3.

[7] Method 6, with 100,000 draws both for the first and the second chain. We tuned the scaling parameter of the jumping distribution to obtain an approximately 1/3 acceptance ratio. Finally, we also conducted

likely to differ substantially across such a large set of countries. The prior distributions are summarized in Table 2.

Parameter	Name of the parameter	Prior shape	Prior mean	Prior st. dv.
$\rho_{g,z}$	Persistence of the TFP shocks	Beta	0.7	0.15
$\sigma_{g,z}$	Standard deviation of the TFP shocks	Gamma	0.1	0.05
ϕ	Capital adjustment cost parameter	Gamma	6	2
ψ	Debt elasticity of the interest premium	Gamma	0.15	0.05
σ_{meas}	Standard deviation of the measurement error processes	Gamma	0.05	0.02

Table 2: Common priors

Based on our parameter estimates, we then perform the Beveridge-Nelson decomposition of the Solow residual (overall TFP growth) into a stationary and a random walk (with drift) process, and then calculate the relative importance of trend shocks in the overall variance of the Solow residual *sr* as

$$\frac{\alpha^2\sigma_g^2}{1-\rho_g{}^2\,\sigma_{\Delta sr}^2}.$$

5 RESULTS

5.1 Stylized Facts: Heterogeneity in Fluctuation Characteristics

Figures 1-5 show the distribution of cyclical data moments. The first two columns display the sample moments in the industrial versus the emerging market group, respectively. The next seven columns collect the same information, grouped together country group by group as shown in Table 1. The dark diamond indicates the median statistic in the particular country grouping.

Before turning to particular findings, the first striking general observation is the sheer degree of heterogeneity, both across and within country groups. As previous studies of international business cycles

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convergence diagnostics and checked whether posteriors are unimodal. Based on these criteria, we have temporarily removed 1-2 countries from each variant.

tend to employ data in G7 and/or Latin American economies, it is also interesting to observe that these two particular country groups may not always be representative of patterns in the full spectrum of industrial versus emerging economies, respectively.

Figure 1 first documents the volatility of the cyclical component of output. The data clearly show that output is about twice as volatile in emerging market countries as in industrial ones. Output volatility is most muted in the G7 economies, while it is far the highest in CIS countries. The most volatile country is Venezuela, while the least volatile one is the UK. Volatility in industrial economies is in general more homogenous than in emerging market ones.

Figure 2 provides information on the first-order autocorrelation coefficient in the cyclical component of output fluctuations. The mean value for the AR(1) coefficient is about 0.8. A comparison of the two major country groups reveals that emerging market countries are slightly less persistent that industrial ones, the result mainly driven by the CEE country group. Canada and the US, countries typically used to calibrate structural business cycle models, exhibit quite high AR(1) coefficients, both above 0.86.

Figure 3 confirms the fact first identified in Aguiar and Gopinath (2007) that private consumption on average is significantly more volatile than output in emerging market economies, and about as volatile as output in more developed countries. The excess volatility of consumption is particularly pronounced in CEE economies. On the other end of the spectrum, Canada exhibits one of the least volatile private consumption, relative to output. While Latin America is markedly different from the G7 group along this dimension, its consumption volatility is very similar to the one in many developed economies including old EU member states.

Relative investment volatilities, as shown in Figure 4, display only modest differences between the two large blocks of countries, with the ratio of the investment and output standard deviation figures fluctuating between 2 and 5 with only a handful number of exceptions, mainly in the industrial group.

As portrayed in Figure 5, net exports are more countercyclical in the emerging market group than in the industrial one. In the industrial group, the large number of correlation coefficients in the proximity of zero point to an acyclical pattern in net exports. At the same time, many of these countries exhibit procyclical net exports, particularly in the G7 group. While the emerging market group is dominantly countercyclical, it is most strongly so in Latin America, the patterns primarily originating from the reduced procyclicality of exporting behavior. In this sense, contrasting the net export behavior of countries of the G7 group versus ones in Latin America may not be representative for a more general industrial versus emerging comparison.

5.2 Mapping Facts Heterogeneity into Parameter Heterogeneity

Figures 6-11 display the implied parameter heterogeneity in our benchmark model, in which all the six relevant model parameters are estimated: the variance and persistence in the two productivity processes, the capital adjustment cost parameter, ϕ, and the debt elasticity of the interest rate premium, ψ. Overall, the figures display that there is ample heterogeneity in the estimated parameter values across countries, but most of it is unrelated to their level of development. With the exception of the standard deviation of both temporary and permanent TFP shocks, there is no strong difference between the distributions of estimated parameter distributions for industrial versus emerging economies.

Model fit (Figure 12), on the other hand, is uniformly much larger for industrial economies. This indicates that many additional factors are at play in emerging market business cycles. Such extra factors can include additional shocks (like foreign interest rate or risk premium shocks), additional sources of parameter heterogeneity (the long run debt position, for example), or a richer propagation mechanism (most notably, links between productivity shocks and the risk premium).

Similarly to Aguiar and Gopinath (2007), emerging economies do exhibit a somewhat higher random walk component of their productivity shocks, mainly driven by observation in CEE and CIS economies (Figure 13). Looking back to the much more pronounced heterogeneity in the relative volatility of consumption and the cyclicality of net exports, this indicates that the model's propagation mechanism succeeds in magnifying differences in the productivity process into much larger differences in business cycle moments.

5.3 Shocks versus Propagation

We now turn to the question of evaluating the relative importance of heterogeneity in shocks versus heterogeneity in financial imperfections in making developed versus emerging countries produce distinct patterns in fluctuations. We identify shock heterogeneity with differences in the persistence of both components of productivity, and heterogeneity in financial propagation with differences in the debt elasticity of interest rates. Our main focus is on performing counterfactual estimations, with restricting some of the model parameters. In particular, we make two sets of comparisons. The first is about the role of the financial friction parameter (ψ) in shaping the Aguiar and Gopinath (2007) finding whether the random walk component of TFP shocks is higher in emerging economies than in industrial ones. The other exercise checks the relative importance of heterogeneity in the strength of financial frictions (ψ) versus ρ_g and ρ_z for model fit and the importance of the random walk component.

Figure 14 displays the size of the random walk component for the Aguiar-Gopinath (2007) model calibration, with a common and low degree of financial frictions (ψ). One can see that there is no marked difference between industrial and emerging economies. This is also true when one looks at the US, Canada, Argentina and Mexico separately, thus the sample period and the estimation method make the Aguiar-Gopinath finding disappear.

In terms of the median of the distributions, it starts to reappear when one increases ψ (Figure 15), and when one allows ψ to vary across countries (Figure 13). Based on the information in Figures 13-15, it seems that the crucial element is to allow ψ to vary across countries. However, when looking at the distribution (in particular the median) of the changes (Figures 16-17), it turns out that setting ψ at a high level is contributing the most.

Maybe surprisingly, allowing ψ to vary across countries does not influence the overall model fit (Figure 18). The most notable impact of a country specific ψ is the large increase in the persistence of the permanent TFP shock (Figure 19), and the large drop in the persistence of the temporary TFP shock (Figure 20). In fact, the estimated ρ_z parameters are alarmingly close to unity in the case of ψ=0.001, indicating potential problems at the numerical optimization steps of the estimation procedure.

From the second exercise, we discuss the following two comparisons. The first is between the case when all three parameters are estimated for all countries separately (the benchmark) and when all three are restricted to the sample median of the benchmark. The second is a "horserace" between ψ-heterogeneity (allowing ψ to vary, but restricting ρ_g and ρ_z to the sample median) and ρ-heterogeneity (restricting ψ, estimating ρ_g and ρ_z).

Figure 21 shows that restricting ψ, ρ_g and ρ_z to a common value across countries has no major influence over the importance of the random walk component in industrial economies, while it slightly increases its importance for emerging economies. The latter means that if one does not allow for sufficient heterogeneity in ρ_g and ρ_z among emerging markets, one would find an artificially larger role for permanent shocks.

As for the model fit, it is quite important to allow for these parameters to vary across countries, particularly among emerging markets (Figure 22). Combining this information with the comparison displayed on Figure 23, we get that ψ-heterogeneity is somewhat more responsible for this increase in model fit. It also means that in terms of model fit, the horserace is won by ψ-heterogeneity, but by a very tiny margin. Finally, restricting the persistence parameters tends to strengthen the Aguiar-Gopinath result, since the random walk component is somewhat higher in the common ρ case than in the common ψ case.

6 CONCLUSIONS AND DIRECTIONS

Much of existing business cycle theory is motivated and evaluated by data observed in a handful number of highly developed economies, primarily in the United States.[8] Drawing on a large sample of quarterly frequency observations, this paper highlights the existence of extensive significant cross-country differences in cyclical properties of key macroeconomic variables, both within and across country groups.

We empirically document massive heterogeneity in basic cyclical patterns between (and within) groups of developed and emerging market economies. In order to gain a better and broader understanding of the importance of alternative sources and propagating mechanisms of macroeconomic fluctuations in different countries around the globe, the focus is first on establishing unconditional facts, such as volatility, comovement and persistence in deviation cycles, and relating these facts to canonical models of the business cycle. Then we structurally estimate a small open economy model of the business cycle to obtain country-specific parameters in temporary and permanent productivity innovations. Overall, we demonstrate that one can go quite far, though definitely cannot travel the full distance, in accounting for heterogeneity in key sample moments.

We are currently extending and refining this research in several directions. A first avenue is more of technical nature: (1) exploring different prior distributions for the whole set of countries (narrower for some, wider for another parameters), (2) making some priors differ across regions, (3) estimating more parameters (like μ_g or b),and (4) utilizing the sum of squared deviation between data and model second moments as another measure of model fit. The second direction would expand the set of financial frictions and/or shocks in the model. It could involve a stochastic world interest rate, a persistent exogenous innovation to the country spread, various endogenous components of the spread (reflecting temporary and permanent productivity shocks), and working capital constraints.

At the more ambitious level, we would link the estimated cross-country heterogeneity in financial friction (or technology shocks) parameters to observable country characteristics like institutions, development, trade and financial openness. Finally, we also seek to provide a microfoundation for the aggregate spread equation, based on firm-level heterogeneity in productivity and an external financing premium mechanism.

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[8] “No study is interesting if it looks at one single country. Except if it is the US.” (Chris Carroll, unofficial)

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TABLE 1
Country groups

G7	EU	DE	CE	LA	EM2	CIS
Canada	Austria	Australia	Bulgaria	Argentina	Malaysia	Georgia
France	Belgium	Cyprus	Croatia	Bolivia	Philippines	Kazakhstan
Germany	Denmark	Hong Kong	Czech Republic	Brazil	South Africa	Moldova
Italy	Finland	Iceland	Estonia	Chile	Thailand	Russia
Japan	Greece	Israel	Hungary	Colombia	Turkey	Ukraine
UK	Ireland	Malta	Latvia	Ecuador		
USA	Luxembourg	New Zealand	Lithuania	Mexico		
	Netherlands	Norway	Poland	Peru		
	Portugal	South Korea	Romania	Uruguay		
	Spain	Switzerland	Slovakia	Venezuela		
	Sweden	Taiwan	Slovenia			

Sources: CBs and SOs, IFS, OECD, DataStream, ILO, BIS, EuroStat, WIIW, ECB DW, 'direct contacts'

FIGURE 1
Output volatility

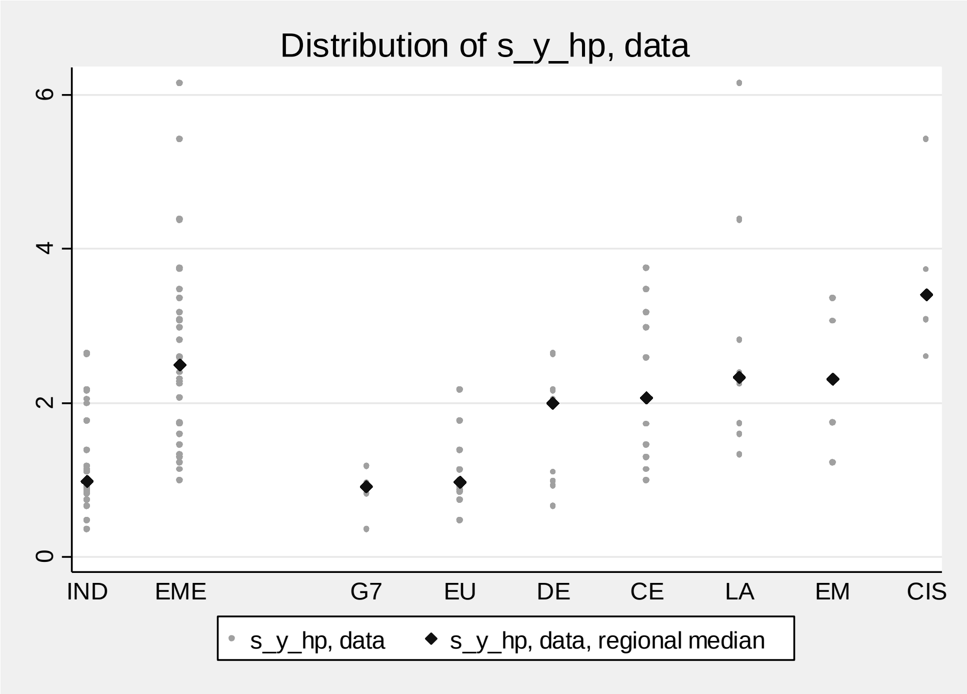

FIGURE 2
Output persistence

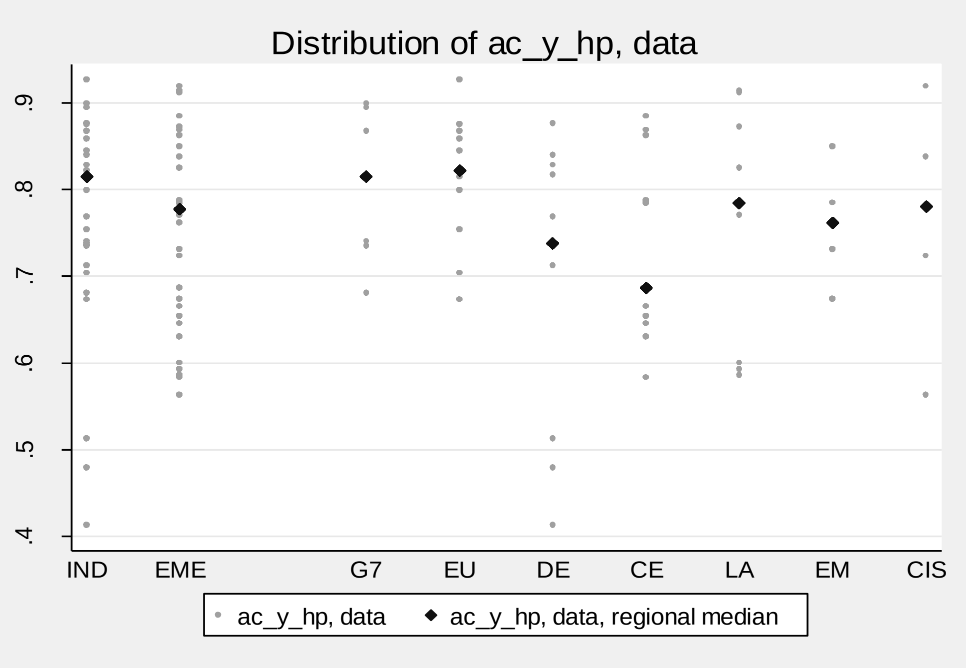

FIGURE 3
Consumption volatility

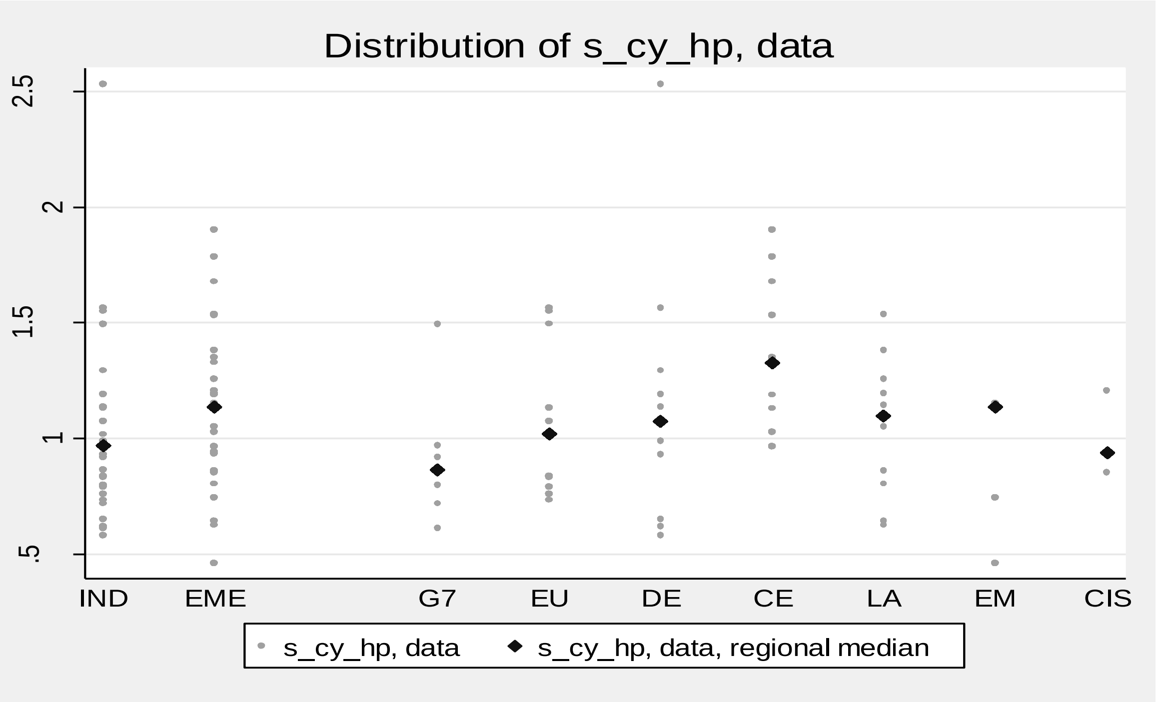

FIGURE 4
Investment volatility

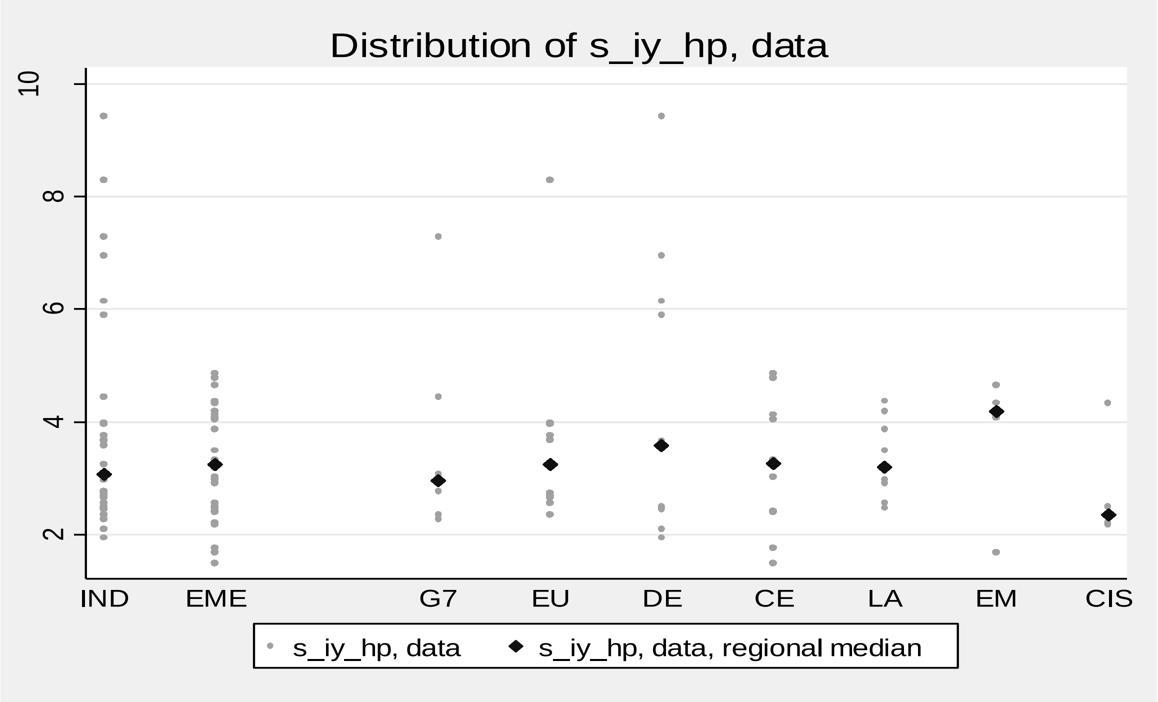

FIGURE 5

Net exports cyclicality

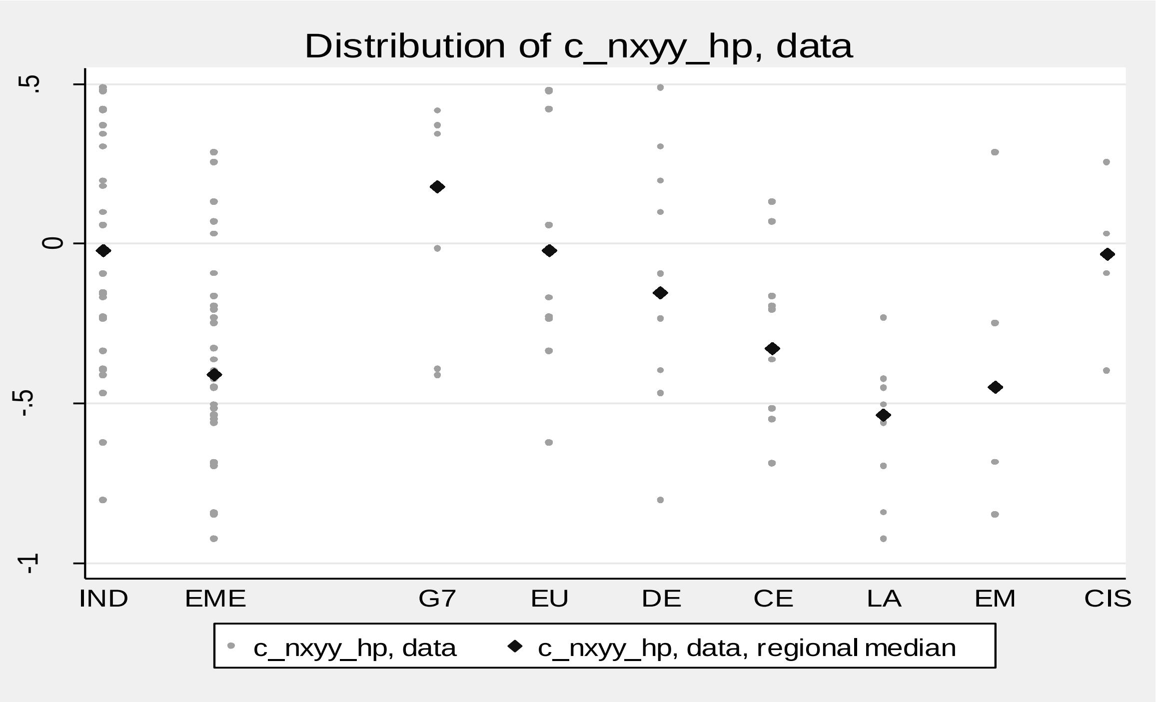

Figure 6

Parameter heterogeneity in the benchmark version, st. dev. of temporary TFP shocks, σ_z

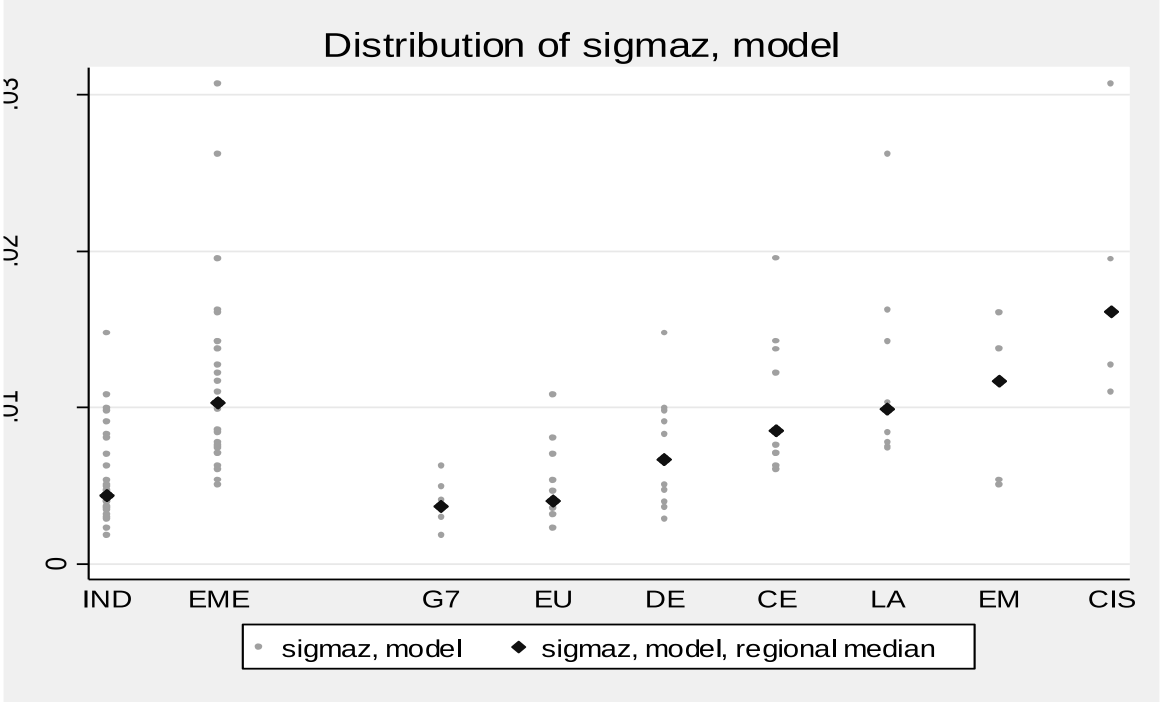

Figure 7

Parameter heterogeneity in the benchmark version, st. dev. of permanent TFP shocks, σ_g

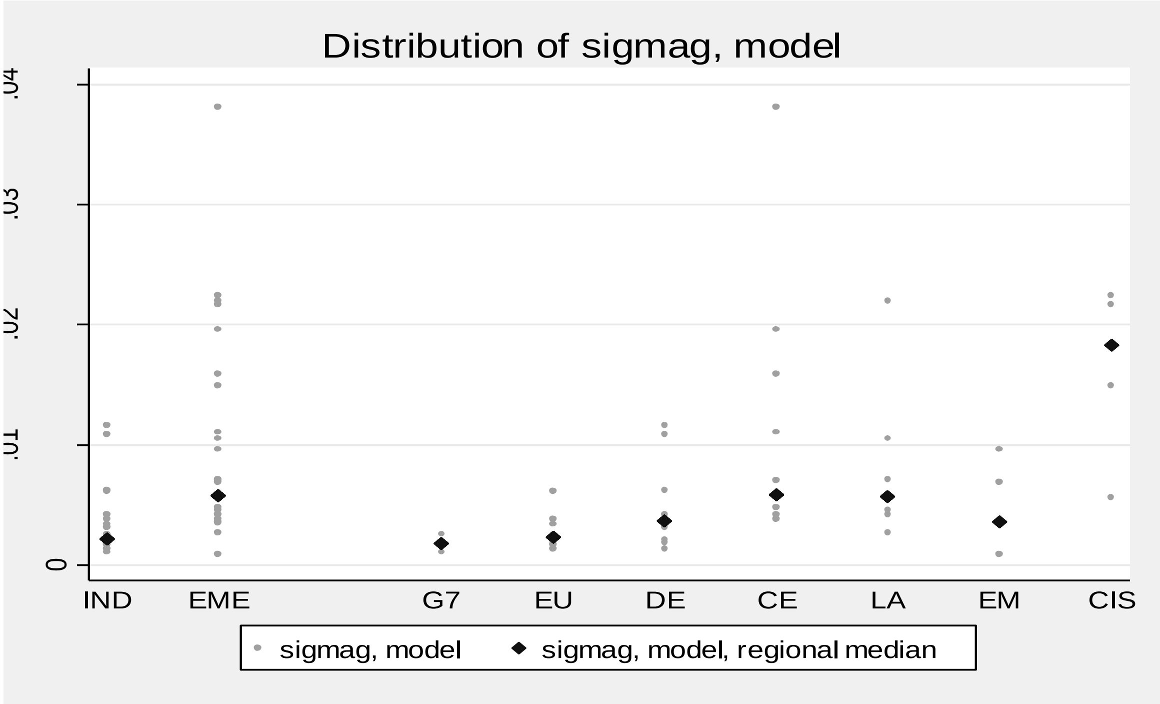

Figure 8

Parameter heterogeneity in the benchmark version, autocorr. of temporary TFP shocks, ρ_z

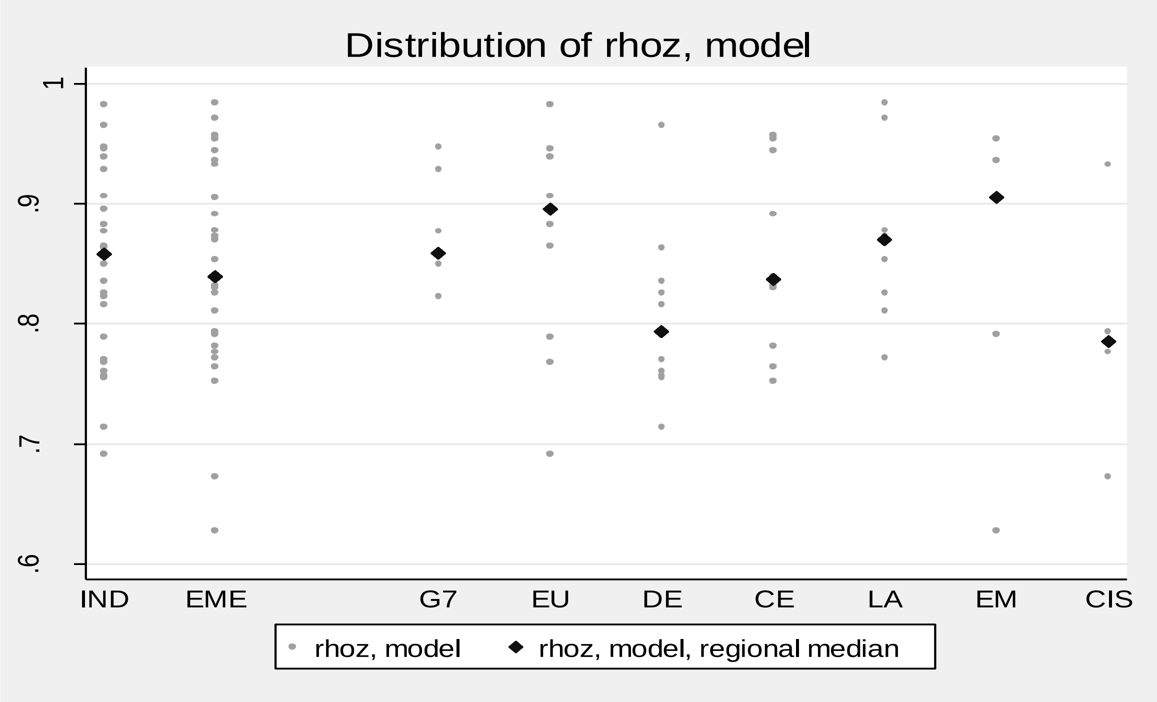

Figure 9

Parameter heterogeneity in the benchmark version, autocorr. of temporary TFP shocks, ρ_g

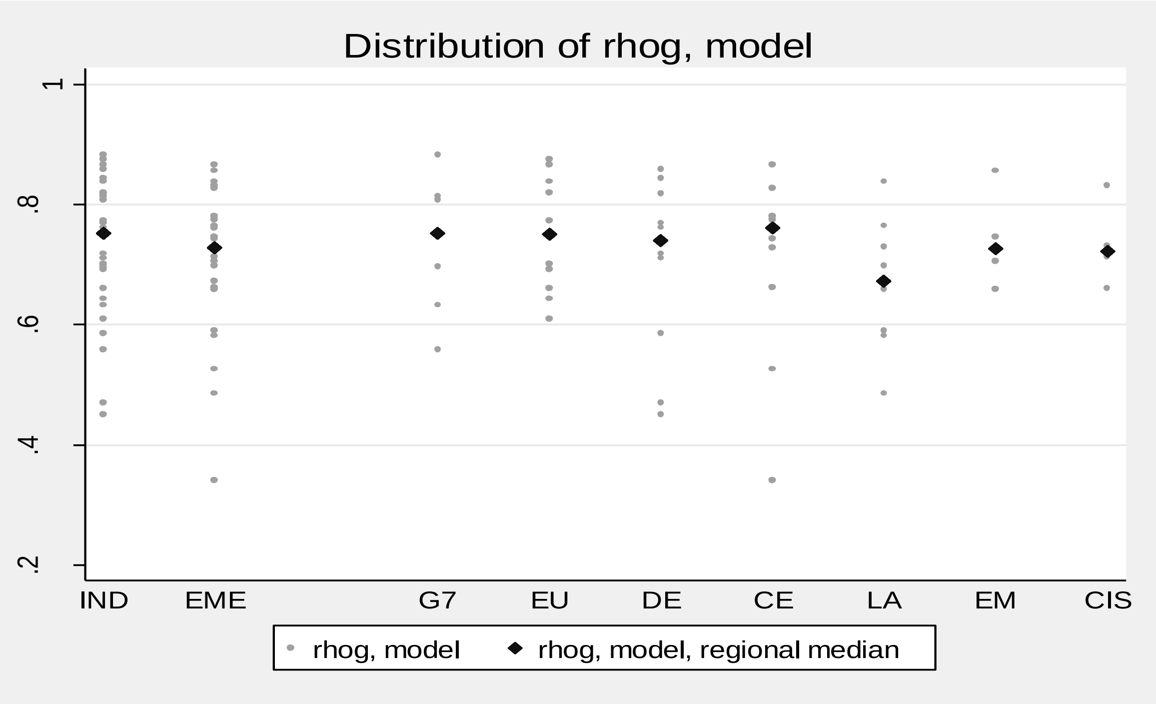

Figure 10

Parameter heterogeneity in the benchmark version, capital adjustment costs, φ

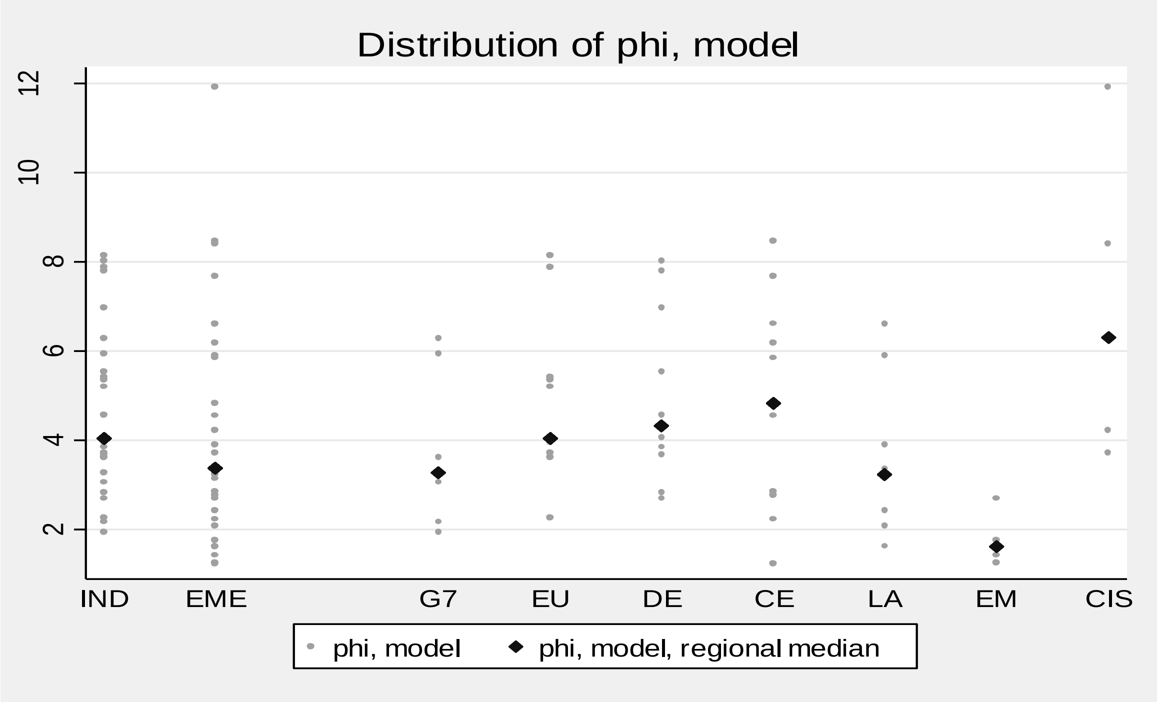

Figure 11

Parameter heterogeneity in the benchmark version, debt elasticity of the premium, ψ

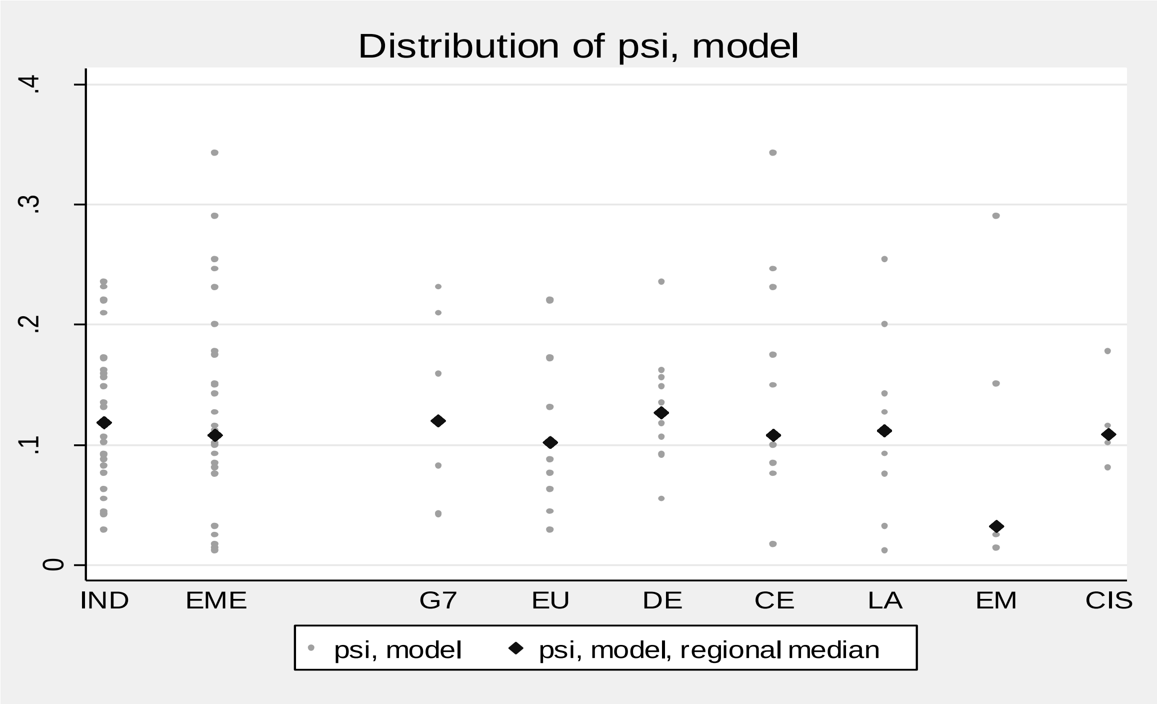

Figure 12

Model fit in the benchmark version: log density (Laplace)

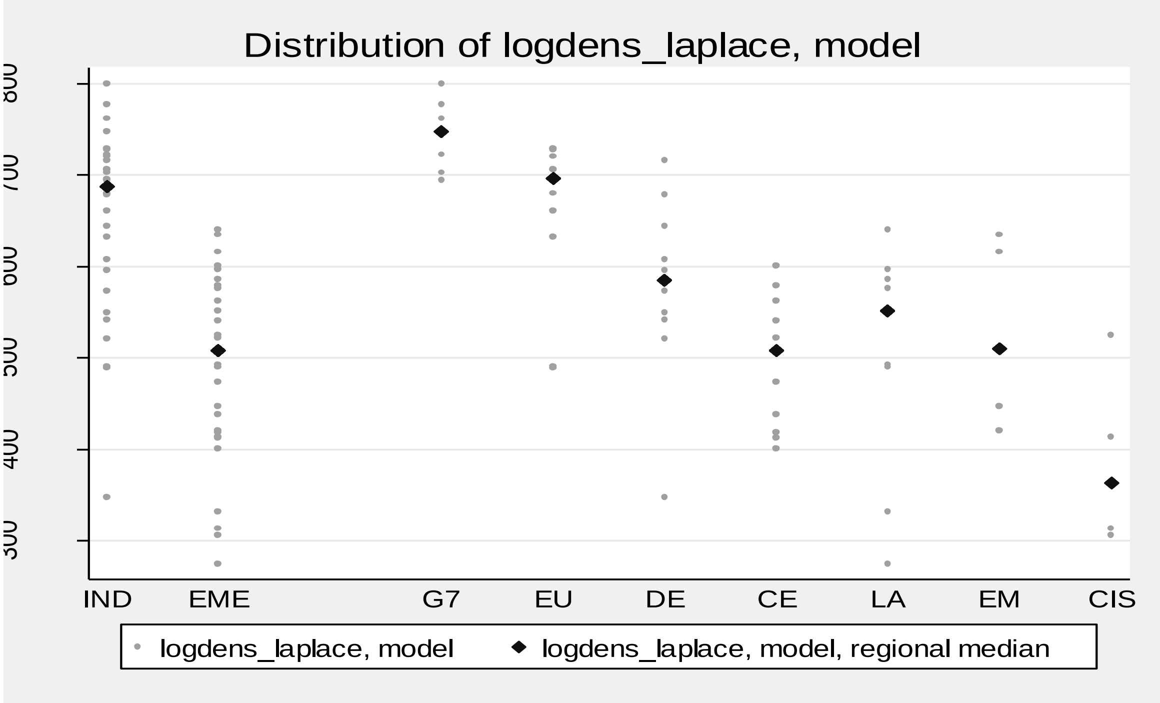

Figure 13

Parameter heterogeneity in the benchmark version, the Beveridge-Nelson decomposition

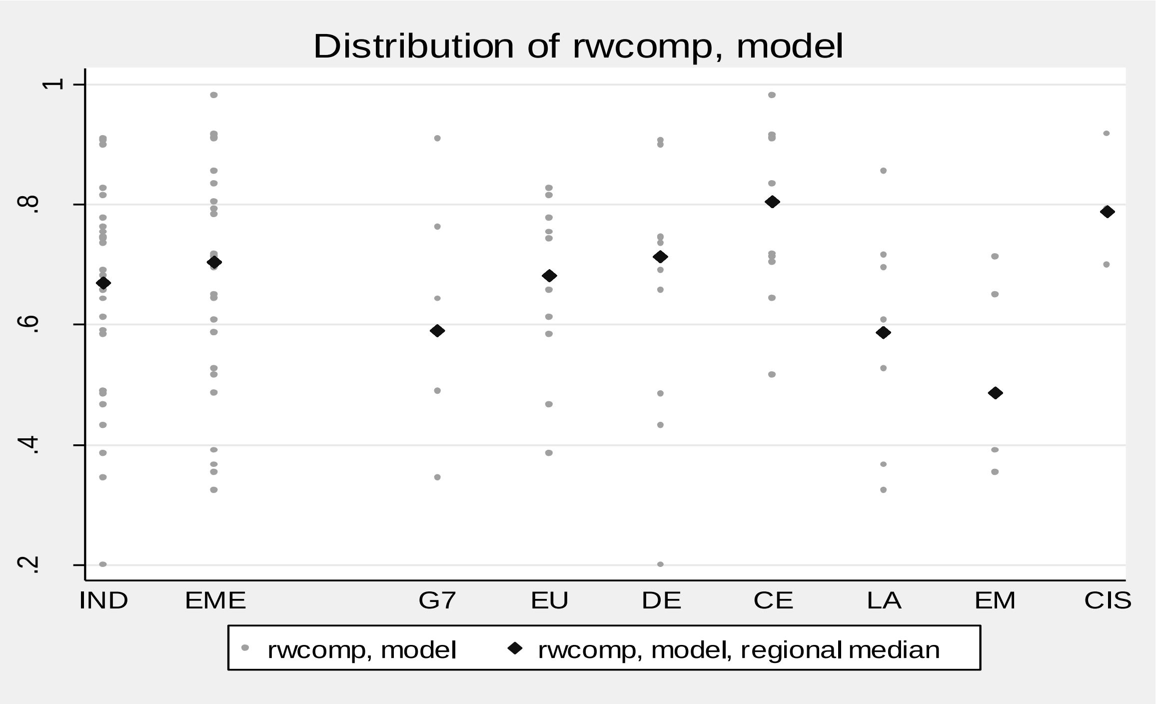

Figure 14

The Beveridge-Nelson decomposition, ψ=0.001 (Aguiar and Gopinath)

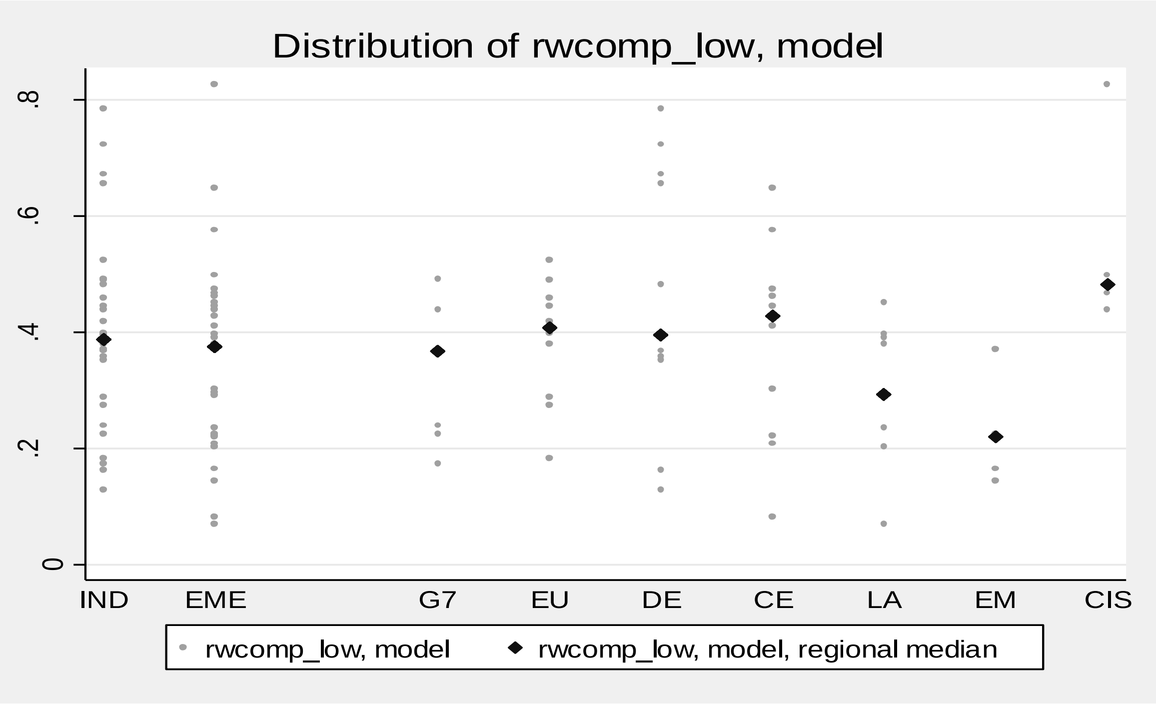

Figure 15

The Beveridge-Nelson decomposition, ψ=0.11 (sample median)

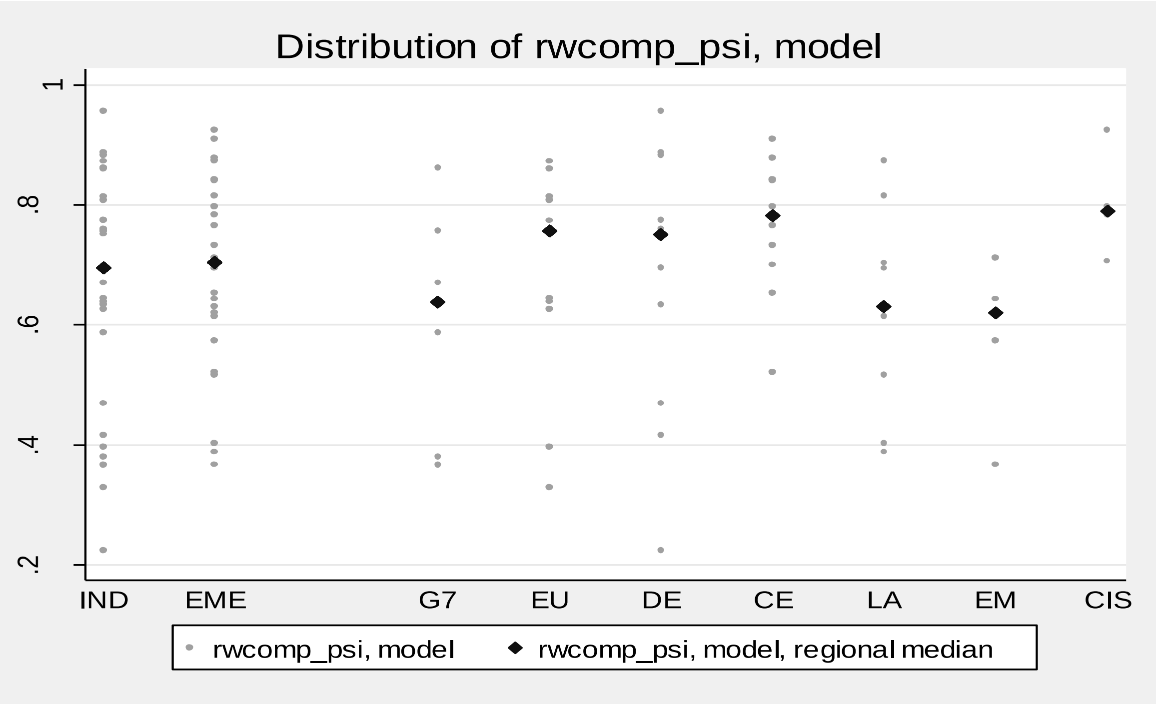

Figure 16

Change in the Beveridge-Nelson decomposition, from ψ=0.001 to ψ=0.11

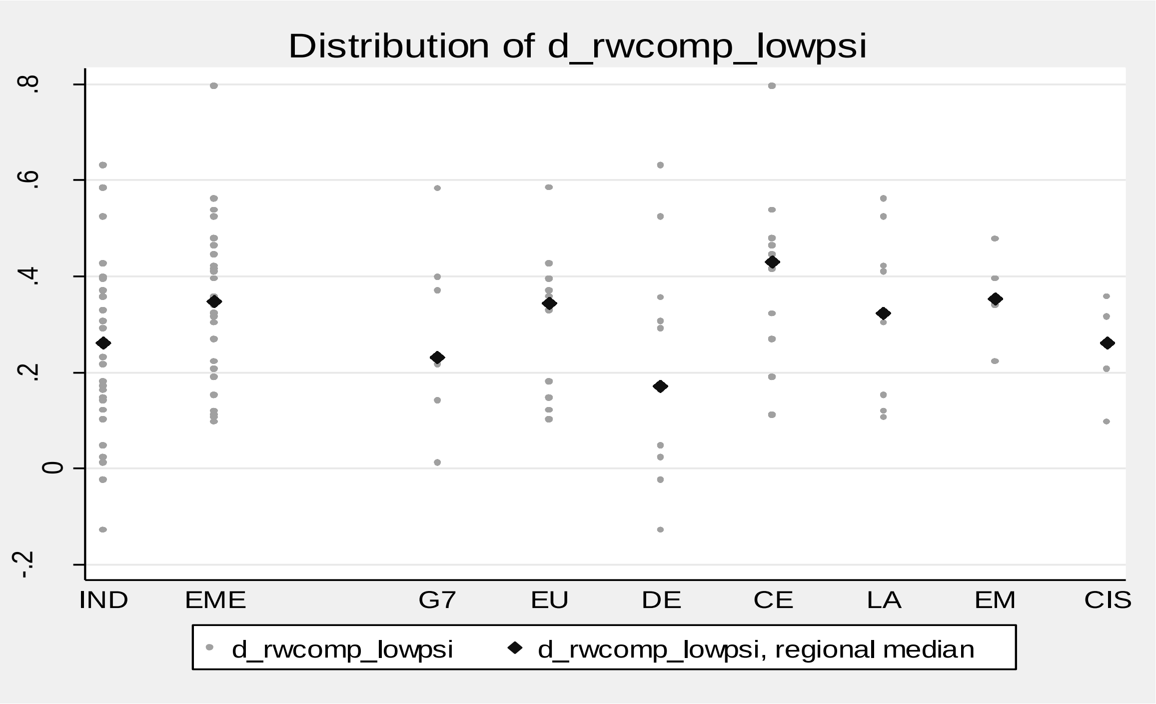

Figure 17

Change in the Beveridge-Nelson decomposition, from ψ=0.11 to the benchmark

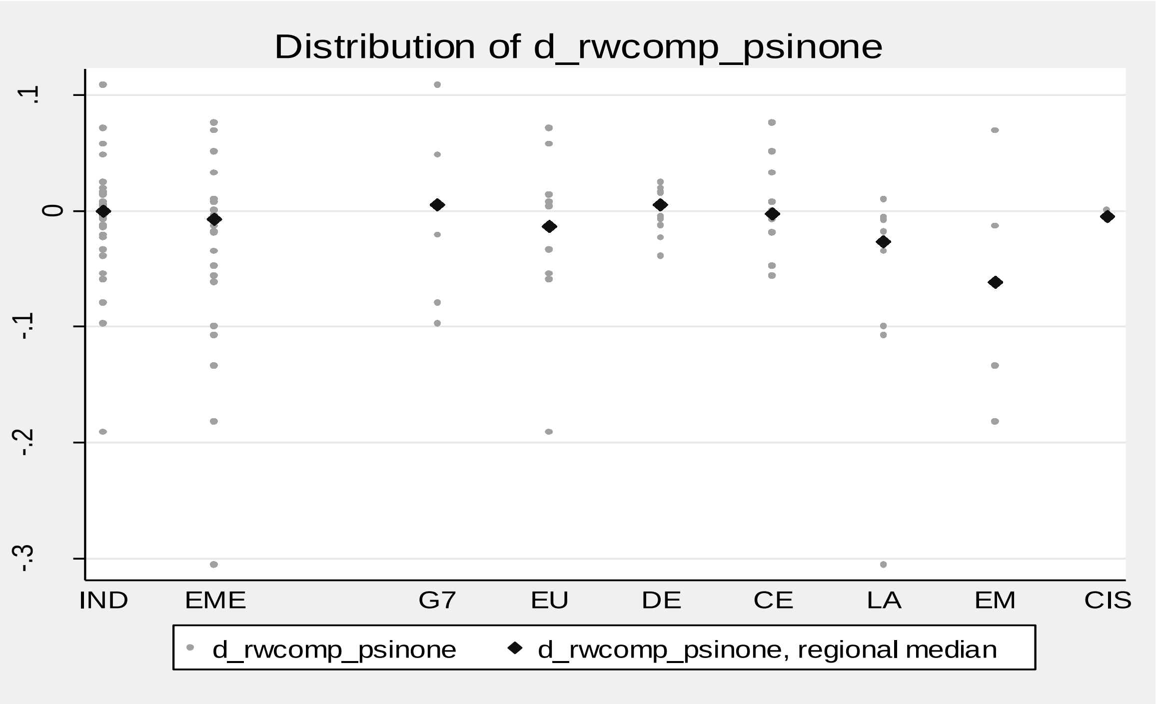

Figure 18

Change in the log density, from ψ=0.001 to the benchmark

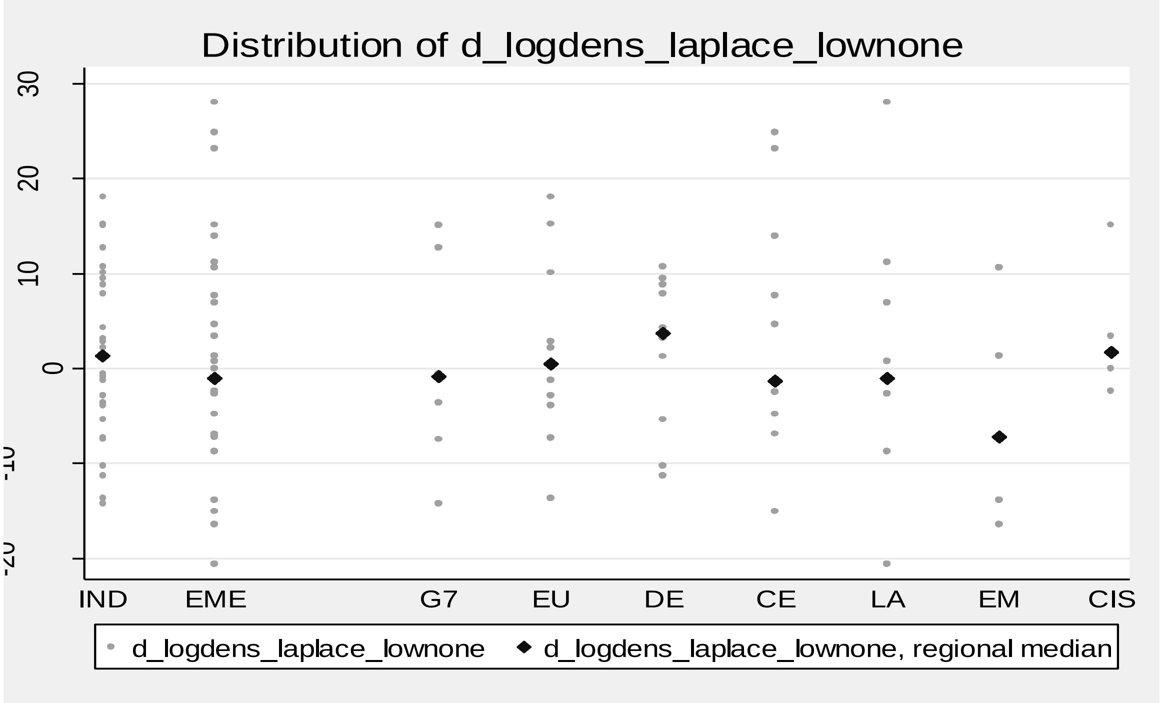

Figure 19

Change in the persistence of the permament TFP shock, from ψ=0.001 to the benchmark

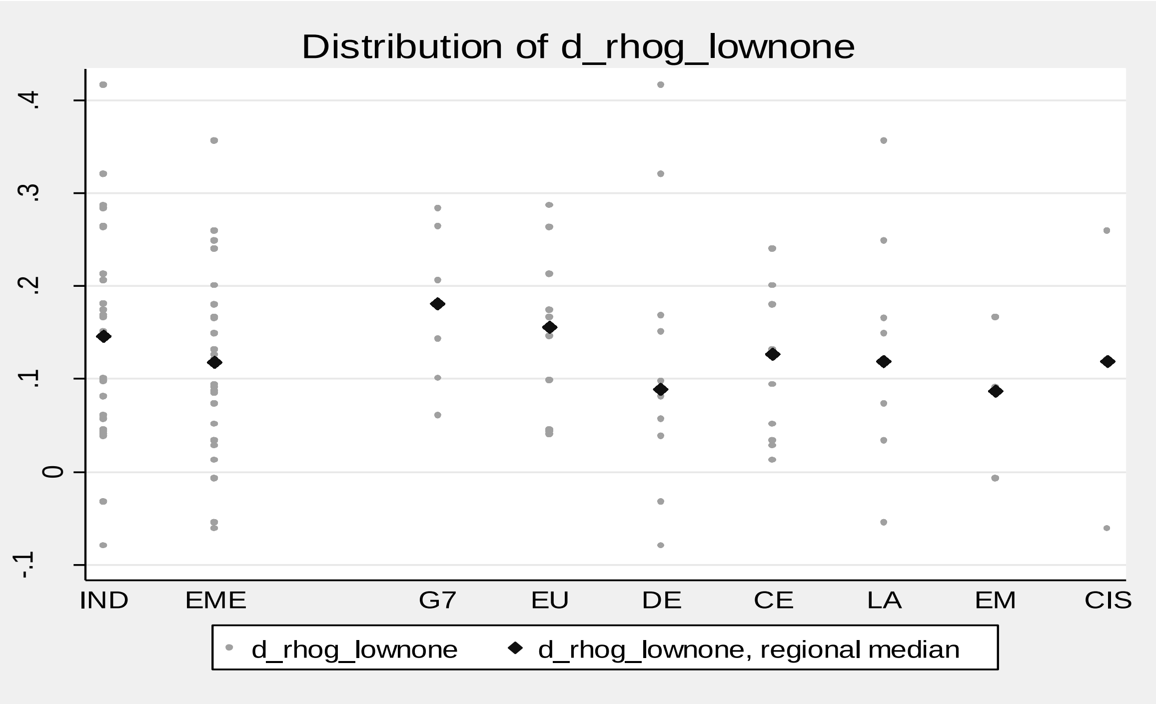

Figure 20

Change in the persistence of the temporary TFP shock, from ψ=0.001 to the benchmark

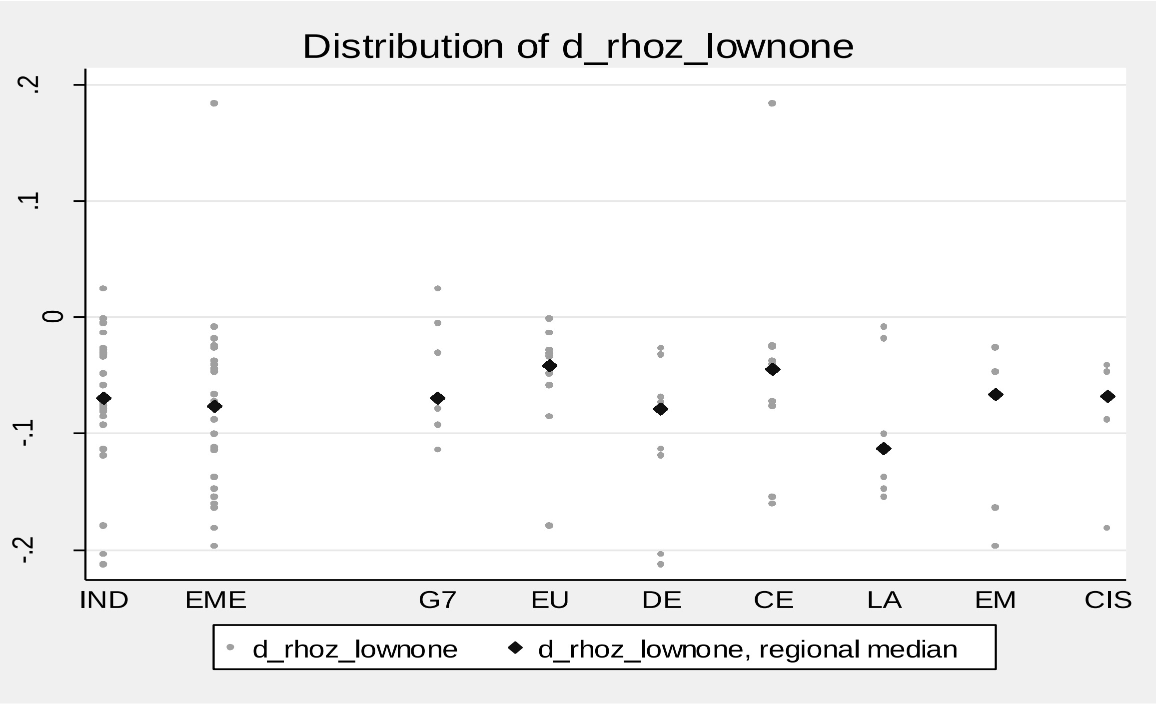

Figure 21

Change in the random walk component, from fixing ψ, ρ_g, and ρ_z to the benchmark

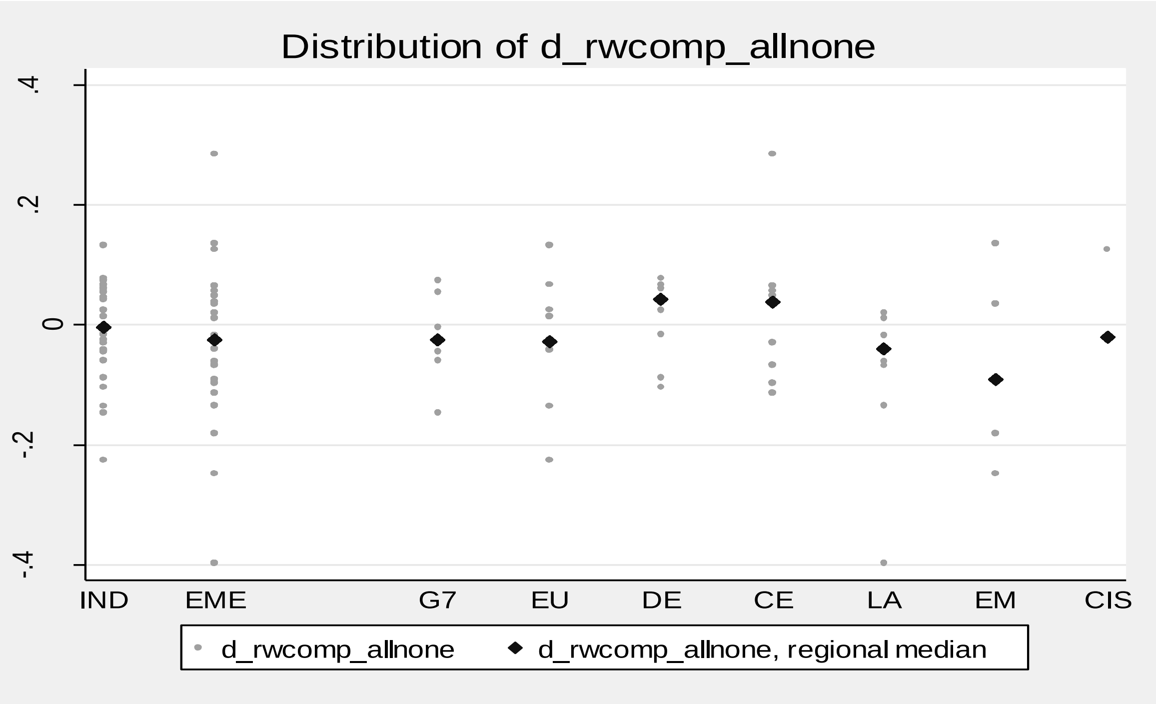

Figure 22

Change in the log density, from fixing ψ, ρ_g, and ρ_z to the benchmark

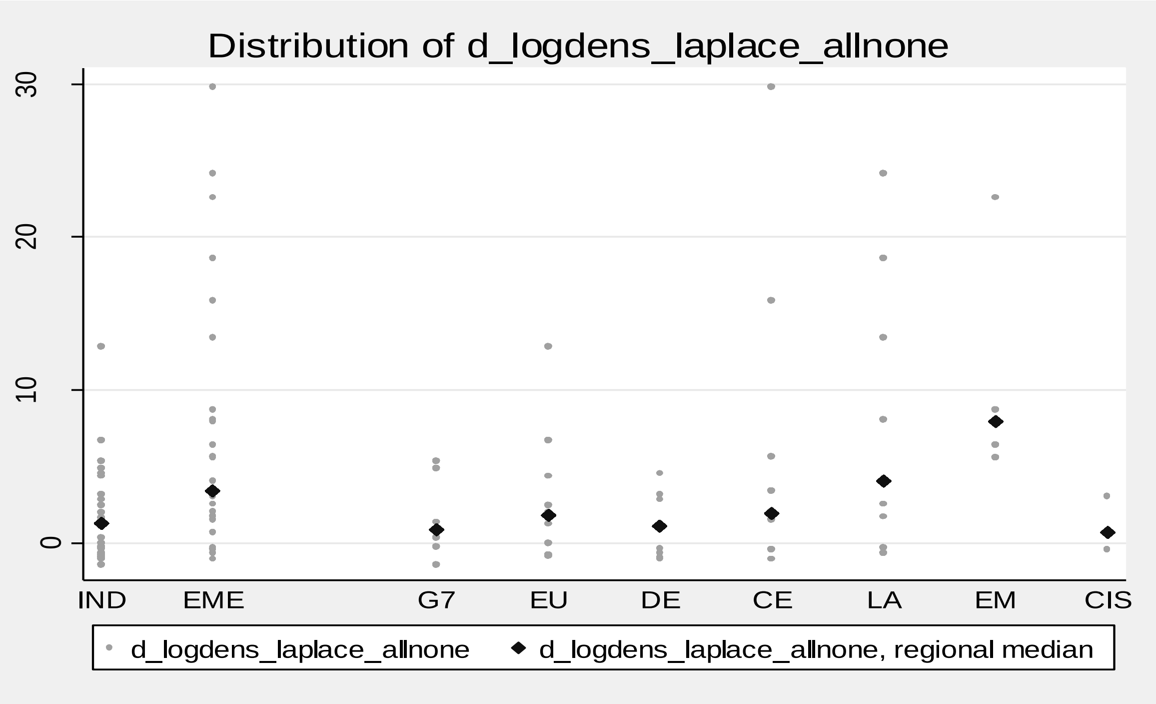

Figure 23

Change in the log density component, from fixing ψ to fixing ρ_g, and ρ_z

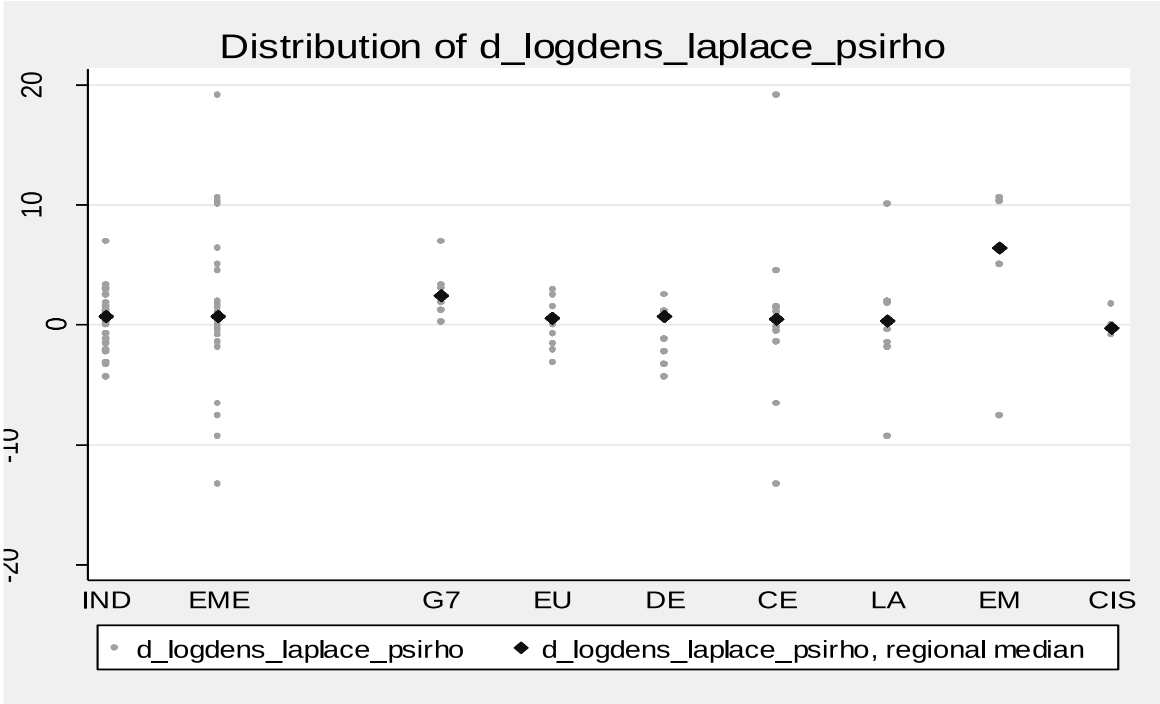

Figure 24

Change in the random walk component, from fixing ψ to fixing ρ_g, and ρ_z