Business Fluctuations in CIS vs. Developed Markets. Theoretic-Empirical approach.

by
Kamran Mammadov

Submitted to
Central European University
Department of Economics

In partial fulfillment of the requirements for the degree of Master of Arts

Supervisor: Professor Attila Rátfai

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Budapest, Hungary
2007

Abstract

This paper investigates whether a standard business cycle model can be used to characterize both CIS and Developed markets business fluctuations. This model demonstrates which moments are informative. My methodology of estimating theoretical moments is calibration. The procedure of comparison is based on using the data containing output, consumption, investment and net exports for CIS and Developed European markets to identify the underlying productivity processes by comparing the empirical data results for these informative moments. Based on the model, I find that autocorrelation of net exports to income with income as well as relative volatility of consumption and net exports to income appears to be informative. The empirical results show that, consumption of households is forty percent more volatile relatively to output while output itself is four times more volatile in CIS countries than in developed countries. Moreover, a net export to income volatility is four times volatile in CIS countries than their counterpart group. Thoroughly analyzing the model shows robust results for these informative moments in regard to empirical ones.

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1 Introduction

Real Business Cycle models explaining the business fluctuations in different economies have been the center of interest for a long time. They even become more interesting after the collapse of Soviet Union. The major concern was how successful are these models if used for formerly closed economies.

This paper evaluates the fitness of Real Business Cycle Model for the economies, focusing particularly on former soviet republics – Commonwealth of Independent States (CIS) and a group of developed European countries. The model I am concentrated is Dynamic Stochastic Equilibrium Model. While there are several similar models developed in the literature, the very model used by Mark Aguiar and Gita Gopinath (2007) is very interesting. This dynamic model where the output is nonstationary and follows a stochastic trend, examines the resulting general equilibrium. This model like others includes shocks to the level and growth of productivity. But the main difference is its growth shocks as the cumulative product expressed in output function.

The purpose of this paper is to test the model for explaining the differences between CIS and developed countries. Since the model has been used for emerging countries, it would be useful to inspect it for different group of countries. My study is based on evaluation of the model by calibration method from where I get theoretical moments which are informative in explaining business cycle fluctuations. Afterwards, I do matching of these moments with empirical counterparts.

In addition to the identifications from the model, analyzing the data, I found some stylized facts about the business frequencies in the approaching groups – comparing CIS countries with a group of developed economies. As in the model, macroeconomic variables of

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interest are GDP, consumption of households, investment, exports and imports. The CIS countries group I investigate comprises eight countries: Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia and Ukraine[1]. The developed markets group of countries includes eleven developed European economies: Austria, Belgium, Denmark, Finland, Greece, Ireland, Luxembourg, Netherlands, Portugal, Spain, and Sweden.

By analyzing the model I found that income volatility, consumption volatility relative to income volatility and correlation of trade balance to income with income can be safely used as basic instruments to identify the underlying productivity processes in these economies. Meanwhile the empirical counterparts of these moments prove this assertion. Besides these, the empirical results show that the principal differences of business cycles in CIS countries from those of developed countries are their large volatility and significantly big current account reversals, the so called "sudden stop" phenomenon as Calvo and Reinhart (2000) argue. Shocks to the trend growth are the primary source of fluctuations in these markets as opposed to transitory fluctuations around the trend; On the other hand developed markets are characterized by a relatively stable trend.

Throughout the empirical analysis I found series of interesting facts. Specifically the results show that, Consumption is forty percent more volatile than income at business cycle frequencies for CIS as compared to developed markets where it is slightly different than one. Moreover income and income growth are found to be four times more volatile in CIS countries. Further, net exports to GDP are estimated to be roughly four times more volatile in CIS countries. Generally speaking, the information about consumption, investment and net exports are particularly informative where agents receive info regarding the persistence of shocks and are acting in an optimizing manner.

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[1] Due to the shortage of data from other CIS countries like Azerbaijan, Tajikistan, Turkmenistan and Uzbekistan we excluded them from the list.

Moreover, throughout my study I found that the model I discuss is robust to the empirical findings. Much precisely, the model can generate theoretical moments which have qualitatively the same properties like their empirical counterparts. But some of them are a bit far from exact numerical matchings.

One of the issues of my concern is the shortage of time series data for CIS countries. On the other hand extending the data back in time would not be useful. The reasons are: First since they are not available, second these countries did follow absolutely different political, economical paths - they were basically closed economies.

The structure of the paper is as follows: In the second part I describe and analyze the model afterwards estimate it in the third part where I get theoretical results by giving shocks. Following a brief description of data and methodology in fourth part, in fifth part in the first section I discuss empirical results in details and compare them with the model findings. In the second section I estimate model parameters and finally in sixth part I conclude.

2 Stochastic Growth Model

The model I describe here is developed by Aguiar and Gopinath (2007) which is a standard model augmented to include two different shocks: transitory and trend shocks. In the model, the technology is given by Cobb-Douglass production function which uses capital, $\mathbf{K_t}$, and Labor, $\mathbf{L_t}$ as inputs.

$$Y_t = e^{z_t} K_t^{1-\alpha} (\Gamma_t L_t)^{\alpha} \qquad \alpha \in (0, 1)$$

The parameters z_t and Γ_t show productivity processes. They are characterized by different stochastic properties. Specifically $\mathbf{z_t}$ is the shock to the level of productivity and follows an AR(1) process, whereas $\mathbf{\Gamma_t}$ represent the cumulative growth shocks (g_t- shock to growth of

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productivity). It is notable that, these definitions of shocks are parsimonious in the model and are given as follows:

$$z_t = \rho_z z_{t-1} + \varepsilon_t^z$$

$$\Gamma_t = e^{g_t}\Gamma_{t-1} = \prod_{s=0}^{t} e^{g_s}$$

$$g_t = (1-\rho_g)\mu_g + \rho_g g_{t-1} + \varepsilon_t^g$$

Whereas $|\boldsymbol{\rho_z}|< 1$, ε_t^z is i.i.d. with zero mean and standard deviation $\boldsymbol{\sigma_z}$. Similarly $|\boldsymbol{\rho_g}|< 1$, ε_t^g is i.i.d. with zero mean and standard deviation $\boldsymbol{\sigma_g}$. Here $\boldsymbol{\mu}$ represents productivity's long-run mean growth rate. Actually the above mentioned representations make this model unique. The models developed till now did not include the growth shock in this like cumulative product form[2].

`Utility function is also given by Cobb-Douglass:

$$u_t = \frac{(C_t^{\gamma}(1-L_t)^{1-\gamma})^{1-\sigma}}{1-\sigma} \quad 0 < \boldsymbol{\gamma} < 1$$

For well-behaved consumption of the linearized model in the steady state it is required that $\beta(1+r^*) = e^{\mu_g(1-\gamma(1-\sigma))}$ whereas r^* is the world interest rate. The above described shocks could be associated with the utility function as in Greenwood et al. (1988). From where we could easily extract the responses of consumption to these shocks. But for the sake of simplicity it is omitted.

The equilibrium of the model is reached by maximizing present discounted value of utility function subject to the production function and the per-period resource constraint:

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

[2] The main idea about the trend and transitive shocks is widely discussed in Aguiar and Gopinath (2007) where they decompose the empirical variables into these shocks using Kalman filter.

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Here δ is the capital depreciation rate, $\mathbf{B_t}$ is the level of debt due in period t, q_t is the time t price of debt due in period t+1. And taking the form of dependence of price of debt to the level of outstanding debt from Schmidt-Grohe and Uribe (2003)

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

Where b is the steady state level of normalized debt and ψ is the elasticity of the interest rate to changes in indebtedness.

I solve the normalized model[3] numerically by log-linearizing the first-order conditions and resource constraints around the deterministic steady state. As stated in the introduction, my purpose of using this dynamic stochastic model is to show how the above mentioned macro aggregates- consumption of households, investment and net exports are effected by the above described shocks. Further, the model will show whether they can be used to describe the economies' fluctuations. A similar approach has been used by Cochrane (1994), where he uses consumption to identify permanent innovations to GDP. Campbell and Deaton (1989), also did a similar research where they found that if consumption is less volatile than income, then fluctuations in the permanent component of income are a relatively small part of overall income volatility and vice versa.

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3 Model estimation

I use the above described model to explore which moments are particularly informative regarding the parameters of the underlying productivity process. To assess, I construct an impulse response function which I first estimate by giving 1 percent growth shock (ε_t^g = 0.01) then by setting 1 percent transitory shock (ε_t^z = 0.01). The method I

[3] For the solution of the model see Mark Aguiar and Gita Gopinath 2007 Appendix.

implement here is calibration, where I set non-productivity parameters to be the standard constant values I obtained from the literature. The whole list of these non-productivity benchmark parameters is given in Table 6. I take the period equal to a quarter. Quarterly discount rate β is set to equal 0.98 per quarter. I take $\gamma = 0.36$ that is, steady state share of time allocated for labor. It is calculated as 1 is the total available time. Depreciation rate of capital δ is set to equal 5%. Coefficient on interest rate premium ϕ is set at slightly different from zero 0.001. Steady-state debt to GDP b is set to equal 10%. Risk aversion parameter σ is set to equal 2. And finally the capital adjustment cost is set to equal 4.

Figure 1 shows the responses under the above given parameters together with transitory productivity shock autocorrelation (ρ_g) set equal to 0.95 whereas growth productivity shock autocorrelation (ρ_z) is set to equal 0.01. As can be seen from figure 1, the ratio of net exports to income has a positive response to the transitory shock. On the other hand, 1 percent growth shock generates a trade deficit equal to 0.5% of GDP and this deficit persists for 3.5 years following the shock. This difference can be explained with help of differential response of consumption. Since trend shock implies increase in income, consumption is to react more to such shocks. This fact is evident from the response of consumption to the growth shock where consumption responds more than income. This is a normal, expected feature. Since the shock to the growth rate is known not to die out and capital will adjust gradually. Furthermore, as seen from the figure 1 the growth is positively correlated. Besides, transitory shock also generates positive response of consumption which does not die out. About the investment- the response of investment to either of the shocks are persistent which is as expected.

As can be seen the responses of these variables- consumption of households, investment and net exports to trend and transitory shocks differ in all characteristics. This fact

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highlights the importance of these variables in defining the productivity processes. Especially the consumption and net exports are much informative.

Analyzing thoroughly which moments are particularly informative, in Figure 2, I plot the theoretical moments of the model for different values of the ratio of the shocks $\frac{\sigma_g}{\sigma_x}$. In this case also, benchmark parameters are kept constant given in Table 6. For the sake of simplicity, here I set σ_z to be constant at 0.5 percent and increase σ_g so that the ratio gets values 0, 0.5, 1 and so on.

The top panel plots the standard deviation of filtered investment, consumption and net exports as a ratios to the standard deviation of filtered income. Here I increase the relative variance of trend shocks σ_g/σ_z, and see that all the above given aggregates change their relative volatility to income - they all increase. Evidently, the percentage increase is highest for net exports and consumption.

The bottom panel plots basically the cyclicalities: the autocorrelation of filtered income; autocorrelation of unfiltered income growth; and the correlations of filtered net exports, consumption and investment with filtered income. Here also I increase the relative variance of trend shocks σ_g/σ_z again, keeping σ_z constant at 0.5 and increasing σ_g. As can be seen from the figure, the most sensitive moment to the change in relative shocks is the correlation of net exports with income. It starts from 0.9 at zero value of relative variance of trend shocks and declines to -0.6 when relative variance of trend shocks equals to 5.

Interesting features of the figure include the fact that autocorrelation of filtered income appers to be almost nonsensitive to the change in shocks - starting from 0.74 going to 0.78. Meanwhile, the autocorrelation of consumption despite of its very close start and end point values, has relatively more fluctuations, and it can be used as an informative moment. Moreover since the path for the autocorrelaion of investment with output does not seem to be

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strongly sensitive to the given shock increases it is hard to assess how informative it is and needs further investigation.

In the coming sections of the paper, I will compare these findings with the findings of empirical data and see how they match each other.

4 Data and methodology

The data sources and length of the periods covered are given in Table 1. All the data are of quarterly frequency. The data for CIS countries come from different sources. They are basically from Local Statistics Offices, Local Central Banks and International Financial Statistics of IMF. Data for CIS countries generally covers time period from 1995:1 till 2006:2. The data for developed countries are from Local Statistics offices and EuroStat. For the sake of analyzing the same period for developed markets I took the time period 1995:1-2006:2. Table 1 presents the list of countries included, overall explanation about the Data sources and periods.

In dataset Consumption is the consumption of households while Investment is defined as gross fixed capital formation and Net exports are constructed as the difference between exports and imports.

Following the same path of thinking in Lucas (1977) and Kydland and Prescott (1990) I consider fluctuations as deviation cycles. To acquire the cyclical components of the series for empirical analysis I do series of transformations. For CIS countries' data, since all the data is in current prices, the data is first deflated by using consumer price index (CPI)[4] to obtain constant price measures of the variables. Afterwards the data is de-seasonalized using the X-11 procedure, with multiplicative adjustment. The exception is the ratio of the net export to

[4] Another alternative of deflating current price variables is by using (Producer Price index) PPI. Since I obtained the results to be very similar, I stick to using CPI.

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the income. Next, I filter each of the series using Hodrick-Prescott (HP) filter with parameter 1600 which is standard for quarter data. The filtration is applied to the natural logarithm of the series with the exception of the ratio of net exports to income. For Developed Markets, since the data is in constant prices, I omit the first step, where I first deflate these variables.

5 Results

5.1 Empirical Results

In this section I focus on the comparison of the relative volatility and autocorrelation of the above spoken variables- macro aggregates those are used by the real business cycle model and which are showed to be much informative. The comparison will be carried out between CIS and developed European countries. Absolute volatility is defined as the standard deviation of the series while relative volatility is defined as the ratio of standard deviation of the series to the standard deviation of constant price GDP. For net exports case I use standard deviation of ratio of net exports to the GDP. Along with volatility, I provide cyclicality of the variables which are defined as contemporaneous correlation between base macro aggregates with output.

In Table 2 I have shown the key moments of the cyclical fluctuations that are worth exploring based on the model. These moments include standard deviation of filtered log output, standard deviation of first difference of unfiltered log output, autocorrelation of filtered income, autocorrelation of unfiltered income growth, standard deviation of consumption, investment and ratio of net exports to output as a ratio to the standard deviation of filtered income, correlations of consumption, investment, the ratio of net exports to output with filtered income. These are averaged moments over CIS and developed European

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countries. In the following tables I have shown the break-down for each economy in our research.

Table 3 reports the absolute volatility of filtered log income and first difference of unfiltered log output along with their autocorrelations. As can be seen from the Table 3, CIS countries have a business cycle four times as volatile as the developed markets. The bigger volatility difference in the country groups exists in the second column – for the volatility of first difference of unfiltered output five times more volatility. However as it can be seen from the table Russia is an outlier of the CIS country sample. In the following two columns I present the first order autocorrelation of filtered output and unfiltered output growth. As seen from the fourth column of the table, the autocorrelation of first difference of unfiltered log output displays sixty percentage difference between the groups. It is worth to mention that, this result is consistent with our result from the model, that autocorrelation of income growth rates is informative. Regarding the autocorrelation of filtered log output, nevertheless the model showed that this moment is uninformative; the data showed the opposite outcome. But for inferring these indicators to be different further study is needed to test if these numbers are statistically significantly different.

In Table 4 I present the results for the relative volatilities of filtered consumption, investment, and net exports to output expressed as a percentage of volatility of filtered outcome. It can be rightly argued that the variables are all regarded as procyclical since they move in the same direction. Here the most interesting fact regards to consumption and the ratio of net exports to the output. As can be concluded from the table, the consumption is forty percent more volatile than income in CIS countries in business cycle frequencies. Conversely the very indicator for developed economies is very close to unit for developed markets group. As in the previous table there are economies in both groups showing the exceptions to the average. For developed markets group, Spain is evident exception with its

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value close to thirty-five percentage excessive volatility in consumption compared to income. So it can be truly stated that, as the results show for the data show consumption follows much volatile pattern in CIS countries even controlling for the incomparable volatility of output. This fact is consistent with the findings from the model that relative volatility of consumption is informative.

As can be seen from the table, another distinguishable pattern of CIS countries' economies is the volatility of ratio of net exports to output. The table exhibits the fact that according to the data, this indicator is four times as volatile as in developed market group. Although the model showed that one of the informative moments is the relative volatility of investment, the data fails to strongly show similar result.

In table 5, I expose the contemporaneous correlation of filtered consumption, investment and ratio of net exports to output with output. The results for consumption show that the groups of countries differ significantly. Furthermore, the outcome for investment is inconclusive. While from the model figures it is not easy to call these moments as informative, the data shows that its empirical counterpart is different across the country groups. For definitely inferring these results about the values for consumption and investment, further study is needed. Another moment – autocorrelation of net exports to outcome with outcome proves to be informative according to the data results. Again there are some exceptions in both groups to the average: For CIS group these are Kazakhstan, Kyrgyzstan and Ukraine, while for developed markets the outliers are Luxembourg with its value of 0.4 and Austria with 0.19.

It is worth to mention that the autocorrelation of net exports to GDP with GDP is much informative. Besides explaining the differences across the country groups, the very moment is able to demonstrate the so called "sudden stops" in particular economies. Figure 3 plots the empirical ratio of net exports to income in Russia. As evidently seen from the figure, it

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includes the Russian Crisis in 1998 where there was a 20 percentage point reversal in the ratio of trade balance to GDP. This starts from 3.1 percentage deficit in the first quarter of 1998 to a 17.6 point surplus in the fourth quarter of 1998. Analyzing the same period shows sharp decrease in all of the variables – in output, consumption and investment.

5.2 Parameter Estimation

In this section I take Russia as the center of study. Here, I estimate the productivity shock standard deviations - σ_g and σ_z of the model by matching the informative moments discussed in the previous sections with their empirical counterparts. Here I fix other parameters at their benchmark values reported in Table 6. Column I in Table 7 reports the estimates of σ_g and σ_z by matching the empirical standard deviation of income and consumption with their theoretical counterparts. Here I match two empirical moments exactly. I get σ_g = 2.41 and σ_z = 1.09. In the second column I report the estimates for productivity shock standard deviations by matching standard deviation of income with contemporaneous correlation of net exports to income with income. Here also, I match them exactly. Much precisely I get σ_g = 3.17 and σ_z = 0.55.

In Table 8 I report the empirical results for informative moments from Russian data together with theoretical moments estimated using parameters in Table 7 in columns I and II. As can be seen from Column I, standard deviation of first difference of unfiltered income, autocorrelation of filtered income match the empirical ones. Moreover, autocorrelation of investment and consumption with income are close. However autocorrelation of first difference of unfiltered income, relative volatility of investment, net exports to income and autocorrelation of net exports to income with income did not match their empirical ones. Besides, as can be seen from Column II, while standard deviation of first difference of

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unfiltered income, autocorrelation of filtered income are almost exact of the empirical ones, other moments are still different from empirical ones. But judging in a comparing way, it can inferred that, second column is much closer to the data results than Column I. This can be another argument supporting the claim that net exports to income are much informative.

Analysis showed that, though some moments can be exactly matched; other moments of interest still remain unmatched. But the results showed robustness about the autocorrelation of net exports to income with income and relative volatility of consumption. In Column I when I match standard deviation of income and consumption, the results show negative correlation of net exports with income. So it can be stated that model predicts the net exports autocorrelation the right way. Besides, in Column II of Table 8, when I match standard deviation of income and autocorrelation of net exports to income with income though the consumption volatility does not match with its empirical result, it shows that consumption volatility exceeds income volatility. Thus can be inferred that, model predicts relative volatility of consumption to be bigger than one.

6 Conclusion

In my study, I have exposed several business cycle characteristics that are different across CIS from developed market economies. Here I showed that a dynamic stochastic equilibrium model can be used to get insights of informative moments. The model showed that among others, relative volatility of consumption, net exports to income and autocorrelation of net exports to income with income are particularly informative regarding the importance of shocks to the productivity.

Interestingly, in spite of the data limitations for CIS countries I found some interesting facts contributing to the findings. Moreover, analyzing the empirical counterparts of

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informative moments, the results showed that these moments are indeed explanatory, so that these figures differ across the country groups and these moments can be used in explaining the underlying productivity processes in different economies.

The empirical study showed that CIS countries' business-cycle patterns differ significantly from those of developed economies. Output is excessively - four times volatile in CIS countries as compared to developed European economies. This significant difference remains in the pattern of output growth volatility. Consumption appears to be procyclical and in both CIS and Developed countries. The same judgments can be applied for Investment. It is procyclical in both economies. The results showed that the net exports in CIS countries are also countercyclical which is same for developed markets with some exceptions in both groups. Consumption in CIS countries is forty percent more volatile than output. This number is slightly different from one in developed economies. Meanwhile net exports to GDP are found to be four times volatile in CIS group.

It is worth to mention that though while estimating parameters of the model, theoretic moments did not match all of the moments, the model showed robustness about the results. The results for informative moments - consumption volatility and autocorrelation of net exports with income together with other moments did match their empirical counterparts qualitatively.

Together with strengths of the model like the specific representations of the productivity processes, it has a weakness as well. One lacking investigation path of the model is the interesting rates. Since CIS is also characterized with its volatile interest rates, further study of this issue is needed.

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Tables, Charts

Table 1: Data Sources

	Sources	Quarters
CIS		
Armenia	IFS	1995:1-2006:1
Belarus	IFS	1995:1-2006:1
Georgia	SO	1995:1-2006:2
Kazakhstan	IFS, CB	1996:1-2005:4
Kyrgyzstgan	SO, IFS	1995:1-2006:4
Moldova	SO, IFS	1995:1-2006:1
Russia	SO	1993:1-2006:4
Ukraine	SO, CB	1995:1-2006:1
Latvia	SO	1995:1-2004:4
Lithuania	SO	1995:1-2006:1
Estonia	SO	1995:1-2006:2
Developed Markets		
Austria	EuroStat	1995:1-2006:2
Belgium	EuroStat	1995:1-2006:2
Denmark	SO	1995:1-2006:2
Finland	EuroStat	1995:1-2006:2
Greece	EuroStat	1995:1-2006:2
Ireland	SO	1997:1-2006:2
Luxembourg	SO	1995:1-2006:3
Netherlands	EuroStat	1995:1-2006:2
Portugal	EuroStat	1995:1-2006:4
Spain	EuroStat	1995:1-2006:2
Sweden	EuroStat	1995:1-2006:2

Note: IFS stands for Internatinal Financial Statistics of IMF. SO is Local Statistical Office, CB is Local Central Bank, EuroStat stands for The Statistical Office of the European Communities.

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Table 2: CIS vs. Developed Markets (Averages)

	CIS	Developed Markets
$\sigma(Y)$	4.72	1.15
$\sigma(\Delta Y)$	5.09	1.04
$\rho(Y_t, Y_{t-1})$	0.46	0.59
$\rho(\Delta Y_t, \Delta Y_{t-1})$	-0.1	-0.16
$\sigma(C)/\sigma(Y)$	1.42	0.94
$\sigma(I)/\sigma(Y)$	3.26	3.38
$\sigma(NX/Y)$	4.34	1.05
$\rho(C, Y)$	0.44	0.58
$\rho(I, Y)$	0.45	0.57
$\rho(NX/Y, Y)$	-0.12	-0.21

Note: This table shows the averaged moments for CIS and Developed economies. The break-down values for each country are reported in the following tables. Data are de-seasonalized and de-trended using HP-filter with a smoothing parameter of 1600.

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Table 3: Volatility and Autocorrelation of Filtered Income and Growth Rates

	$\sigma(Y)$	$\sigma(\Delta Y)$	$\rho(Y_t, Y_{t-1})$	$\rho(\Delta Y_t, \Delta Y_{t-1})$
CIS				
Armenia	3.62	3.89	0.41	-0.22
Belarus	6.09	5.88	0.54	0.09
Georgia	3.96	4.4	0.4	-0.26
Kazakhstan	5.51	7.35	0.18	-0.4
Kyrgyzstgan	5.74	8.17	-0.01	-0.52
Moldova	5.44	4.28	0.71	-0.12
Russia	2.72	1.95	0.79	0.33
Ukraine	4.69	4.83	0.67	0.29
MEAN	**4.72**	**5.09**	**0.46**	**-0.1**
Developed Markets				
Austria	0.87	0.74	0.66	-0.17
Belgium	0.81	0.64	0.69	0.05
Denmark	1.01	1.02	0.47	-0.27
Finland	1.19	1.17	0.52	-0.34
Greece	0.69	0.95	0.06	-0.35
Ireland	2.44	2.35	0.56	-0.24
Luxembourg	1.86	1.66	0.61	-0.33
Netherlands	1.01	0.65	0.83	0.14
Portugal	0.86	0.66	0.79	0.19
Spain	0.74	0.61	0.66	-0.17
Sweden	1.13	0.96	0.63	-0.29
MEAN	**1.15**	**1.04**	**0.59**	**-0.16**

Note: The data for CIS is first deflated by using CPI (with the exception of Russia where the values are in real values).Then data for each country was de-seasonalized. The series were then logged (except for NX/Y) and de-trended using an HP filter with a smoothing parameter of 1600. The growth rates of income are from unfiltered output series.

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Table 4: Relative Volatility of Consumption, Investment and Net Exports

	σ(C)/σ(Y)	σ(I)/σ(Y)	σ(NX/Y)
CIS			
Armenia	1.19	3.11	3.17
Belarus	1.04	1.54	3.17
Georgia	1.58	2.49	3.07
Kazakhstan	1.36	3.58	**5.48**
Kyrgyzstgan	2.56	5.93	7.17
Moldova	1.43	4.8	5.48
Russia	1.01	2.99	3.61
Ukraine	1.17	1.61	3.58
MEAN	**1.42**	**3.26**	**4.34**
Developed Markets			
Austria	1.11	3.31	0.69
Belgium	0.85	3.59	0.77
Denmark	1.23	3.82	1.15
Finland	0.58	2.48	1.24
Greece	0.99	4.2	0.69
Ireland	0.6	2.22	1.44
Luxembourg	0.55	4.22	2.52
Netherlands	1	2.82	0.58
Portugal	1.22	4.04	1.06
Spain	1.35	3.22	0.71
Sweden	0.9	3.21	0.66
MEAN	**0.94**	**3.38**	**1.05**

Note: The data for CIS is first deflated by using CPI (with the exception of Russia where the values are in real values).Then data for each country was de-seasonalized. The series were then logged (except for NX/Y) and de-trended using an HP filter with a smoothing parameter of 1600. The standard deviation of the ratio of net exports to income is in percentage terms.

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Table 5: Contemporaneous Correlation with Output

	ρ(C, Y)	ρ(I, Y)	ρ(NX/Y, Y)
CIS			
Armenia	0.49	0.4	-0.35
Belarus	0.75	0.5	-0.15
Georgia	0.22	0.44	-0.34
Kazakhstan	0.22	0.37	0.41
Kyrgyzstgan	0.12	0.36	0.46
Moldova	0.46	0.31	-0.47
Russia	0.60	0.7	-0.66
Ukraine	0.78	0.84	0.13
MEAN	**0.44**	**0.45**	**-0.12**
Developed Markets			
Austria	0.61	0.7	0.19
Belgium	0.81	0.43	-0.34
Denmark	0.28	0.47	-0.1
Finland	0.29	0.68	-0.29
Greece	0.67	0.6	-0.32
Ireland	0.5	0.43	-0.36
Luxembourg	0.3	0.2	0.4
Netherlands	0.65	0.63	-0.23
Portugal	0.74	0.74	-0.5
Spain	0.7	0.72	-0.51
Sweden	0.82	0.7	-0.29
MEAN	**0.58**	**0.57**	**-0.21**

Note: The data for CIS is first deflated by using CPI (with the exception of Russia where the values are in real values).Then data for each country was de-seasonalized. The series were then logged (except for NX/Y) and de-trended using an HP filter with a smoothing parameter of 1600.

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Table 6: Benchmark Parameter Values

Time Preference Rate	β	0.98
Consumption Exponent (Utility)	γ	0.36
Steady-state debt to GDP	b	10%
Coefficient on interest rate premium	ψ	0.001
Labor Exponent (Production)	α	0.68
Risk Aversion	σ	2
Depreciation Rate	δ	0.05
Capital Adjustment Cost	ϕ	4.0

Note: Benchmark parameters used in all specifications.

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Table 7. Estimated Parameters for Russia

	Russia	
Parameter	**(I)**	**(II)**
σ_g	2.41	3.17
σ_z	1.09	0.55
Moments Used	σ_y σ_c	σ_y, Cov(NX/Y, Y)

Note: Moments used indicates which empirical moments were matched. All other parameters not estimated here are set at their benchmark values reported in Table 6. Additionally, ρ_z = 0.95, ρ_g = 0.01 and μ_g = 1.006

Table 8. Moments for Russia

	Data	**(I)**	**(II)**
$\sigma(Y)$	2.72	2.72	2.72
$\sigma(\Delta Y)$	1.95	1.99	1.96
$\rho(Y_t,Y_{t-1})$	0.79	0.76	0.78
$\rho(\Delta Y_t,\Delta Y_{t-1})$	0.33	0.08	0.13
$\sigma(C)/\sigma(Y)$	1.01	1.01	1.26
$\sigma(I)/\sigma(Y)$	2.99	2.28	2.60
$\sigma(NX/Y)/\sigma(Y)$	1.33	0.56	0.71
$\rho(C, Y)$	0.6	0.88	0.94
$\rho(I, Y)$	0.70	0.92	0.92
$\rho(NX/Y, Y)$	-0.66	-0.29	-0.66

Note: Columns I and II report theoretical moments using parameters from Table 7 column I and II respectively

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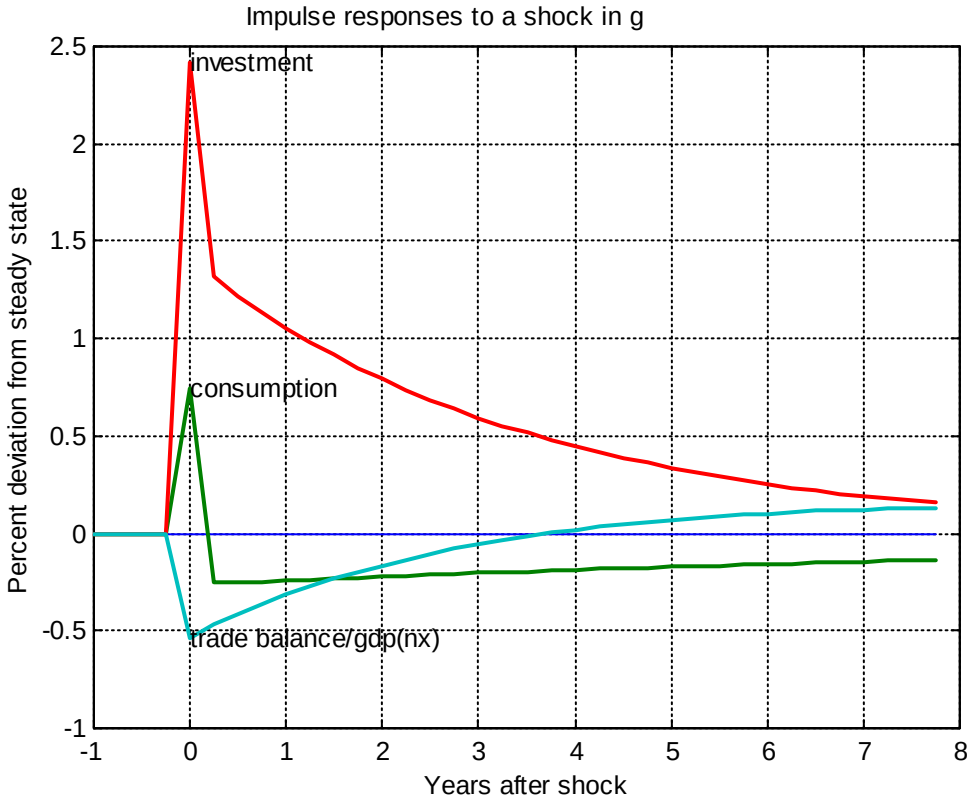
Figure 1. Impulse Responses



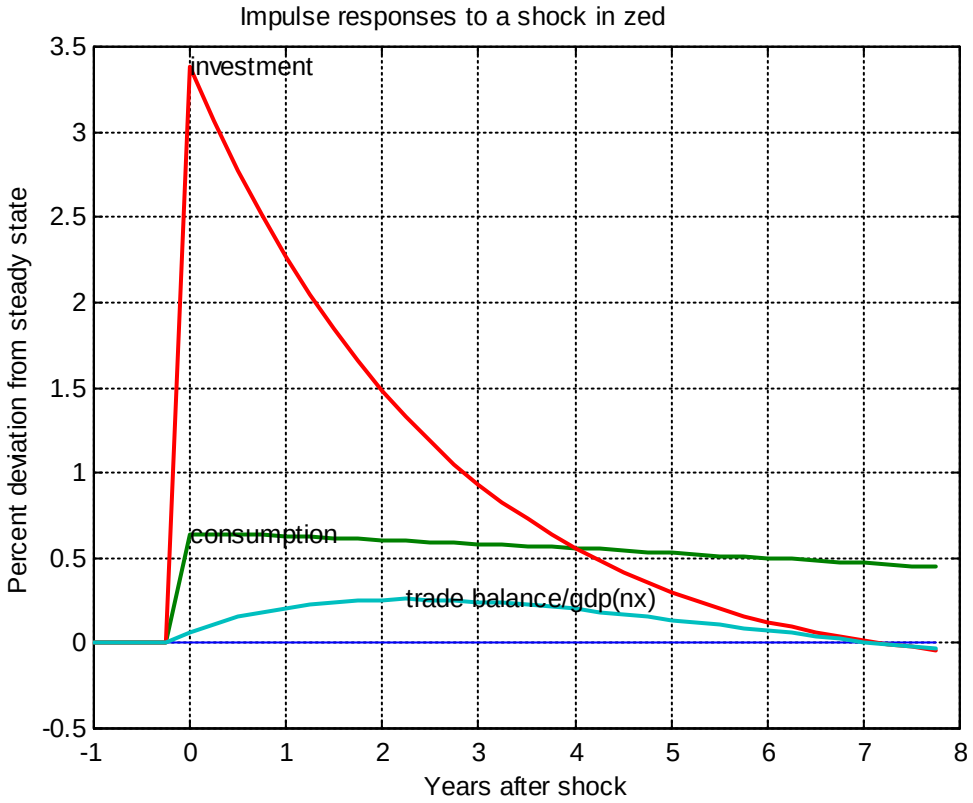


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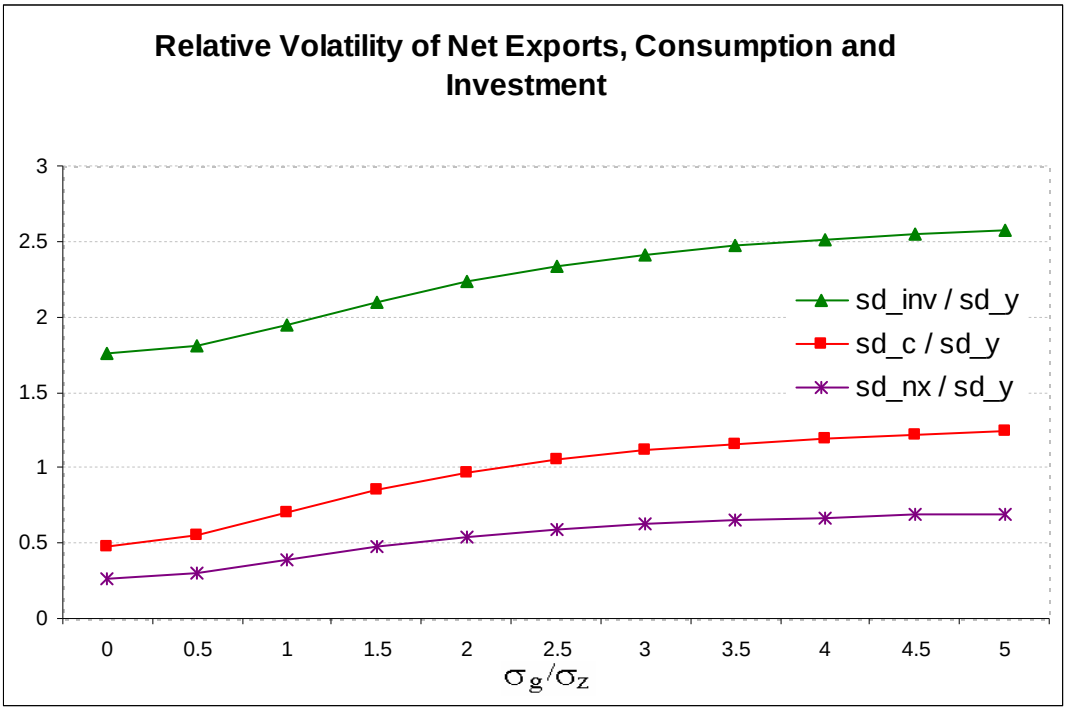
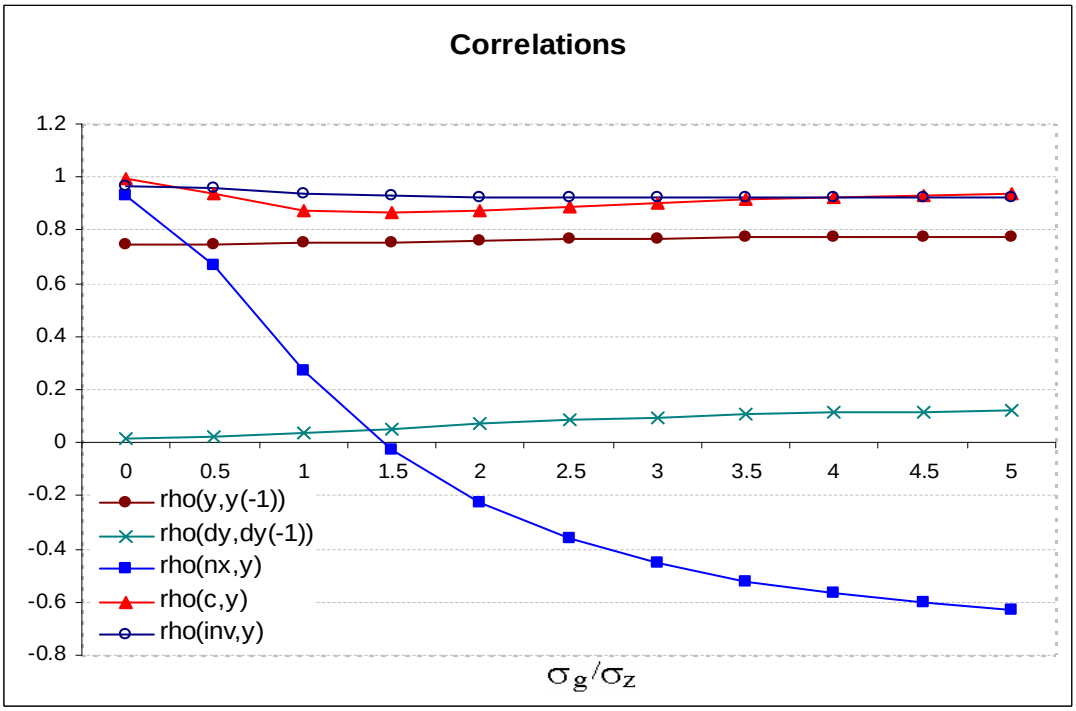
Figure 2. Sensitivity of Moments to the relative Volatility of Trend shocks.





Note: First panel shows the paths of standard deviation of filtered consumption. investment and net exports as a ratio to the standard deviation of filtered income as a function of σ_g/σ_z. Second panel shows the paths of autocorrelation of filtered income; autocorrelation of unfiltered income growth; and the correlations of filtered net exports. consumption and investment with filtered income as a function of σ_g/σ_z.

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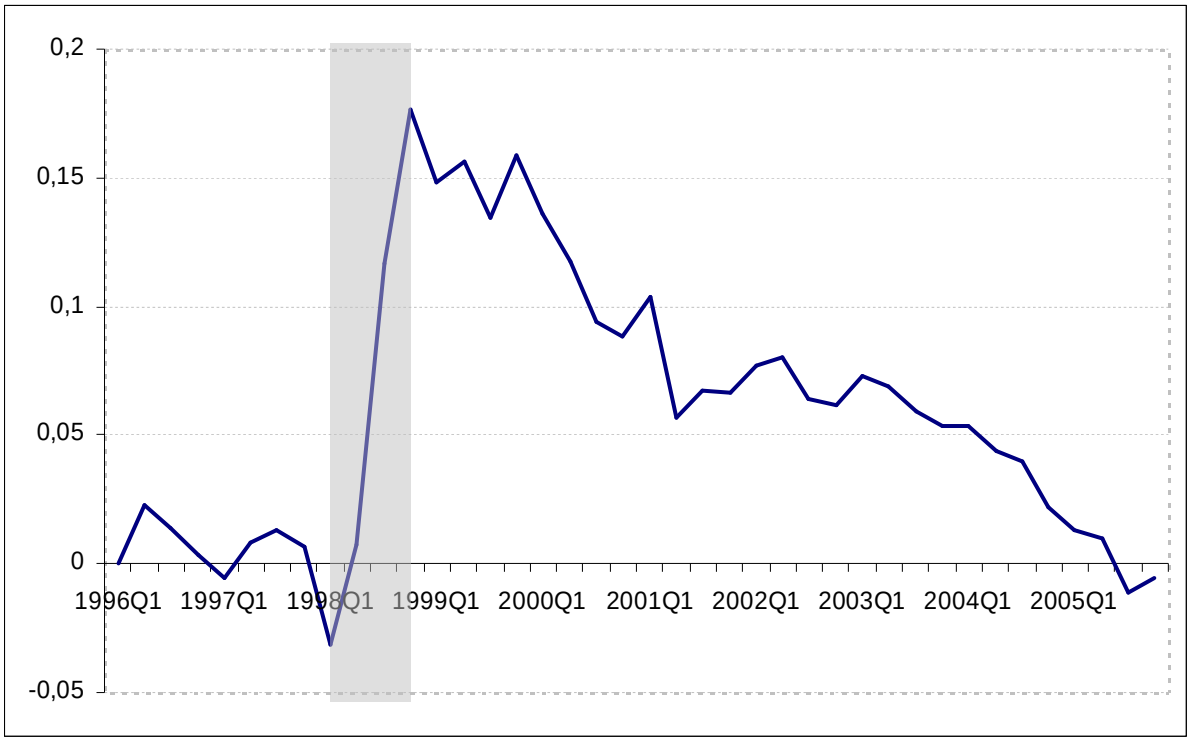
Figure 3. Sudden Stop – Russian Crisis (1998)



Note: The line represents the ratio of net exports to GDP in Russia. The series are deviations from 1996Q1

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