Is Informality a Barrier to Convergence?

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Abstract

In this paper we ask whether informal economy acts as a barrier to growth of GDP per-capita. Cross-country panel regressions for the period between 1960 and 2012 including 160 countries provide evidence for a robust negative relationship between size of informal economy and relative per capita income. Building on this evidence we simulate a simple two-sector (formal and informal) dynamic general equilibrium model and show that under the presence of an informal sector a larger fraction of the observed per capita income differences across countries can be accounted for.

JEL codes: E26; O17; O47.

Keywords: convergence; two-sector DGE models; informal sector

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1 Introduction

The main determinants of long-run economic growth still remain as a central item in the macroeconomic agenda. In this study, our intention is to contribute to this strand of literature by questioning whether the prevalence of informal sector acts as a barrier to growth, more specifically a barrier to per capita income convergence.

The presence of informality and its connection with economic growth has been a contentious issue on which the current literature has failed to arrive at an agreement. On one hand, there are studies that claim a positive relationship between informality and growth such as Nabi and Drine (2009), Eliat and Zinnes (2000). On the other hand others like Loayza (1997), Massenot and Straub (2011), De Soto (1989) Benjamin and Mbaye(2010) assert that the relationship is negative on the grounds that efficiency is hindered by informality.

The barriers to growth literature investigates what accounts for the observed income disparities across countries. In a vast number of studies, barriers are introduced in various forms such as barriers to trade, technological adoption, capital accumulation etc.

Parente and Prescott (1994) argue that the standard neoclassical growth model falls short of explaining the actual income differences as opposed to a model that takes barriers to technological adoption into account. They provide quantitative evidence to this idea by showing that under plausible parametrization of the model, the development theory that they propose is able to explain the growth miracles of

East Asia.

Ngai (2004) argues that the differences in income across countries are mostly transitory. The paper sets up a two sector model where the individual countries need to be able to accumulate capital so as to gradually replace the stagnant traditional Malthus technology with the modern Solow technology. The barriers are introduced as exogenous parameters that reduce the capital-output ratio therefore affect the endogenously determined date of the turning point and steady state levels of model variables.

Similarly, Restuccia (2004) employs a two sector model, traditional and modern sectors, and incorporates barriers in the form of a technology parameter that lowers the rate at which output is transformed into capital or equivalently increases the relative price of investment. In this setting, the presence of barriers works at expense of a technological choice that employs modern technology more intensely compared to the traditional sector. This in turn leads to a lower economy wide aggregate total factor productivity.

This study employs a two sector dynamic general equilibrium model where production either occurs in formal or the informal sector. While the formal sector is subject to taxation, for the informal sector there is only partial tax enforcement. In this setting, household chooses how much time to allocate in leisure, formal sector and informal sector. The tax rate and tax enforcement parameter will affect the labor allocation and the size of the informal sector, therefore the formal output. In such an environment, we will show that informality poses a threat to per capita income convergence.

The rest of the paper is organized as follows. In section 2, we introduce our data set and some facts about the relationship between informal sector size and economic growth that motivates this study. In section 3, the results of further empirical analysis are presented. One set of panel regressions will show that relative (to US) GDP per capita and informal sector size as percent of GDP are negatively related. Further, by using the income accounting method, we will decompose relative GDP per capita into three accounts; relative capital-output ratio, relative employment per capita and relative total factor productivity. The panel regressions using these three accounts will show that informal sector size and relative capital-output ratio are significantly and negatively correlated. Section 4 describes the two sector (formal and informal) dynamic general equilibrium model that we employ. The quantitative results obtained through simulations of the model with different informal sector size determinants are examined in section 5.

2 Data and facts

In our empirical analysis, we make use of the data set provided by Elgin and Oztunali (2012). This dataset comprises of model-based estimates of informal sector size for 160 countries covering the period 1950-2012. The authors employ a two sector (formal and informal) dynamic general equilibrium model where they calibrate the key parameters of the model that yield the observable data, which in turn are used to calculate the size of the shadow economy as % of formal GDP.

The empirical counterparts of the model variables such as growth, GDP per capita, population, employment, investment are obtained through World Development Indicators (WDI) of the World Bank and PWT 8.0. Using these, the capital stock series for the countries are constructed by using the conventional perpetual inventory method.[1]

As an initial attempt to motivate our study, the following three figures illustrate the evolution of GDP per capita over time for countries ranked according to their respective informal sector size for each year. We then regroup countries into deciles, quintiles and quartiles. The average GDP per capita for each group is plotted against time.[2] It can be seen that countries with relatively smaller informal sectors perform better in terms of their relative GDP per capita whereas for the countries with relatively larger informal sector size, relative GDP per capita tends to be almost stagnant over the course of time. The take off of relative income in higher income countries as opposed to the stagnation in lower income countries points out that informality can very well be a barrier to convergence of per capita income.

[1] Perpetual inventory method: Initial capital stock K_{1960} is calculated using the following formula:

$$\frac{K_{1960}}{Y_{1960}} = \frac{I/Y}{g_y + \delta}$$

where g_y is the average growth rate of GDP in the period 1960-2012. δ is the depreciation rate and I/Y is the average investment-to-GDP ratio in the period of interest. The capital stock series $\{K_t\}_{t=1960}^{2012}$ is then calculated using:

$$K_{t+1} = K_t(1 - \delta) + I_t$$

[2] For robustness, we re-classify countries, this time using weights that take the populations into account, in order to avoid country sizes blur our results. Calculating the weighted GDP per capita's for each group and each year then plotting them against time again yields the similar results to the unweighted case.

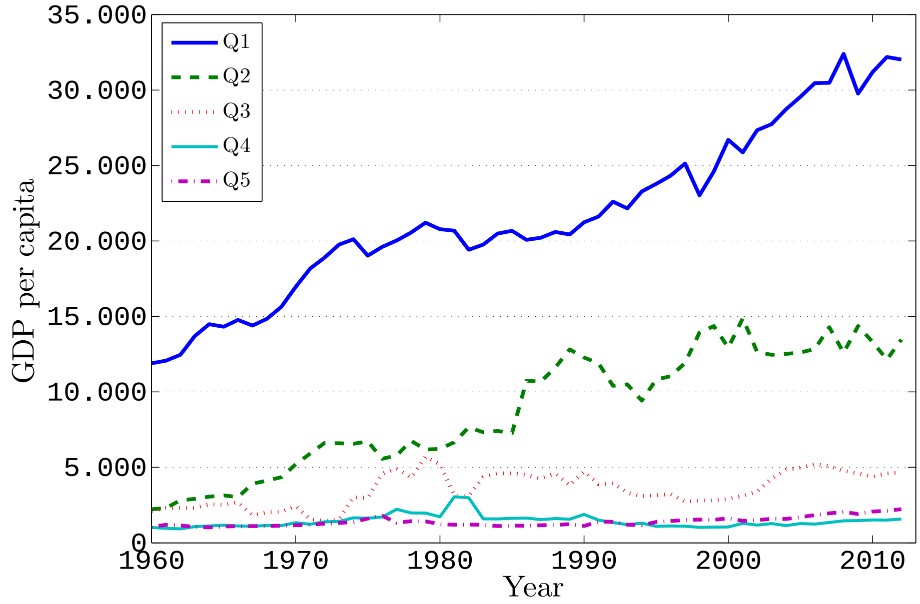


Figure 1: Evolution of unweighted GDP per capita for countries ranked and classified in quintiles according to their informal sector size

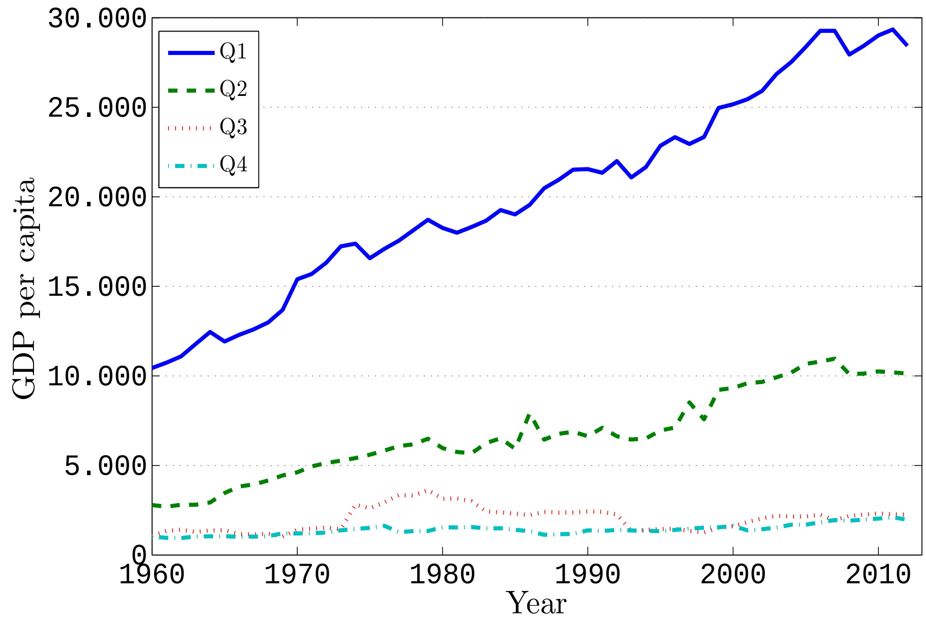


Figure 2: Evolution of unweighted GDP per capita for countries ranked and classified in quartiles according to their informal sector size

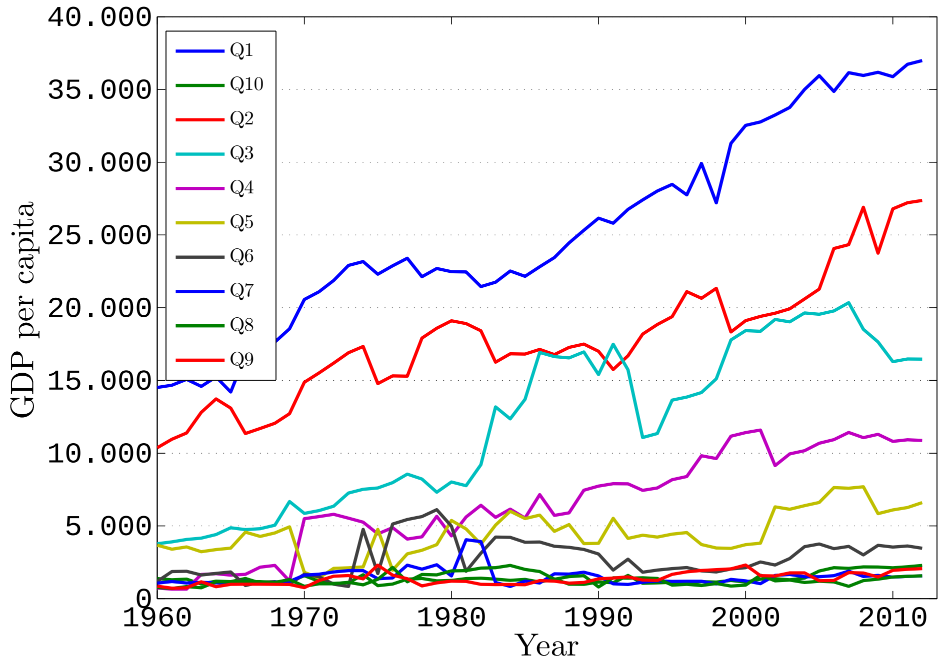


Figure 3: Evolution of unweighted GDP per capita for countries ranked and classified in deciles according to their informal sector size

3 Further empirical analysis

3.1 Relative GDP per capita and Informal Sector

In this subsection we provide further empirical evidence illustrating that informality acts as a barrier for growth and convergence. To do this, we will present results of regression of relative GDP per-capita (relative to US GDP per-capita) on informal sector size in a panel data setting. Moreover, in the next subsection we will also decompose relative GDP per-capita on three different factors (relative TFP, relative employment per capita and relative capital-output ratio) and investigate how each of these factors is associated with informal sector size. Table 1 summarizes the dataset which will be used throughout this section.

Table 1: Complete Dataset Summary Statistics

	Mean	Std. Deviation	Minimum	Maximum
Informal Sector Size (in % GDP)	34.65	14.75	7.97	113.00
(Real) GDP per-capital (thousand USD)	8.42	12.35	0.05	87.72
Relative GDP per-capita (to US)	0.26	0.38	0.001	3.30
Relative TFP	0.37	0.33	0.01	2.15
Relative H/N	0.86	0.25	0.32	5.44
Relative K/Y	0.95	0.51	0.002	11.06

First, we regress relative GDP per-capita on informal sector size. In this case, the benchmark regression we run is of the following form:

$$rel\_gdp\_cap_{i,t} = \beta_0 + \beta_1 is_{i,t} + \gamma_i + \theta_t + \epsilon_{i,t}$$

In this specification γ_i and θ_t refer to country and year fixed-effects respectively. The results of all the regressions are reported in Table 2. The first panel regression below is a fixed-effect estimation using 5-year averaged data to rule out possible business cycle effects in the relative GDP per-capita. The second column stands for a fixed effect panel regression with 5-year averaged data but this time includes the lag of dependent variable. The third column is a GMM estimation with 5-year averaged data and lagged dependent variable. The fourth column is an IV estimation with 5-year averaged data and lagged value of the independent variable (IS) is used as an instrument for its level. The fifth column is an OLS estimation with country averaged informal sector size and relative gdp per capita data. The sixth column is a fixed effect estimation with the whole data set under the presence AR(1) disturbances.

The seventh column is a fixed effect estimation with 5 year averaged data using data for countries below the median median level of GDP per-capita whereas column 8 gives the results of the same estimation using above median countries.

The main observation one can make regarding Table 2 is that the coefficient of the size of the informal sector is consistently negative and significant for all of the different specifications.

Table 2: Relative GDP per-capita and Informal Sector Size

Dep. var. Rel. GDP per-capita

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IS	-0.24*	-0.06*	-0.11*	-0.26*	-1.62*	-0.17*	-0.09*	-0.58*
	(0.07)	(0.02)	(0.02)	(0.05*)	(0.07)	(0.03)	(0.01)	(0.23)
Rel GDP-cap (-1)		0.74*	0.90*					
		(0.01)	(0.01)					
Constant	0.34*	0.08*	0.06*	0.34*	0.8*	0.31*	0.08*	0.63*
	(0.03)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)	(0.09)
R-squared	0.35	0.98	0.99	0.36	0.32	0.35	0.02	0.36
Observations	1405	1266	1107	1347	161	6175	700	705
F-Test	3.66	310.16	1998	20353	51.67	369.47	12.78	2.96

All panel regressions include a country fixed effect and year dummies (except specification 5). Robust standard errors are reported in parentheses. * denotes 5% confidence level.

3.2 Relative Income Accounts and Informal Economy

In this section we decompose relative (to US) income per capita for 160 countries into 3 income accounts: relative TFP, relative capital-output ratio, relative employment per capita. To make this decomposition, we make use of the capital series created with perpetual inventory method. We assume a Cobb-Douglas production function of the form $Y_t = A_t K_t^{\alpha} H_t^{1-\alpha}$ and using the employment and income data from PWT 8.0 we obtain total factor productivity (TFP) series for 160 countries. Transforming the production function in per capita terms and then taking the natural logarithm yields:

$$ln(y_t) = ln(A_t) + \alpha ln(k_t) + (1-\alpha)ln(h_t)$$

Rearranging we get:

$$ln(y_t) = ln(h_t) + \frac{\alpha}{1-\alpha}ln(\frac{k_t}{y_t}) + \frac{1}{1-\alpha}ln(A_t)$$

For the country pair i-j, j being USA, the above equation becomes:

$$ln(\frac{y_i}{y_j}) = \frac{1}{1-\alpha}\{ln(A_i) - ln(A_j)\} + \frac{\alpha}{1-\alpha}\{ln(k_i/y_i) - ln(k_j/y_j)\} + ln(h_i) - ln(h_j)$$

Table 3 summarizes different specifications with each of the three income account series created. The first column for each account represents a panel regression with fixed effect estimation using the whole data set under the assumption of AR(1) disturbances. The second column for each account is a fixed effect estimation with the lagged value of the corresponding account included as dependent variable. The third columns are IV estimations using the lagged values independent variable.

Out of the three accounts examined, we observe that relative employment per capita and relative TFP do not seem to have a strong relationship with size of the informal economy. For specifications with relative capital to output as the dependent variable, on the other hand, there is a significant and negative relationship. The estimated equations are as follows:

Table 3: Relative Income Accounts and Informal Sector

Dep. var. Income Accounts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	TFP	TFP	TFP	K/Y	K/Y	K/Y	H/N	H/N	H/N
IS	0.13*	0.004	0.004	-2.65*	-0.28*	-0.34*	0.09	-0.003	-0.004
	(0.05)	(0.006)	(0.005)	(0.24)	(0.03)	(0.03)	(0.14)	(0.02)	(0.02)
Rel TFP(-1)		0.95*	1.00*						
		(0.003)	(0.002)						
Rel K/Y(-1)					0.92*	0.83*			
					(0.005)	(0.006)			
Rel H/N(-1)								0.97*	0.97
								(0.004)	(0.005)
Constant	0.78*	0.026*	0.005	1.66	0.17*	0.27*	-0.70*	0.038*	-0.06*
	(0.002)	(0.004)	(0.08)	(23.08)	(0.02)	(0.01)	(0.005)	(0.01)	(0.008)
R-squared	0.0041	0.99	0.80	0.09	0.95	0.94	0.005	0.94	0.94
Observations	6019	6020	5863	6019	6020	5863	6019	6020	5863
F-Test	9.81	1249.61	571108	6.42	654.71	471182	12.85	887.28	1240000

All panel regressions include country fixed effect and year dummies. Robust standard errors are reported in parentheses. * denote 5% confidence levels.

4 Model

In this section we describe the two sector dynamic general equilibrium model that we employ, which, to a great extend, is borrowed from Ihrig and Moe(2004).

Infinitely lived representative household is endowed with K_0 units of productive capital and a total of $T > 0$ units of time each period. The agent chooses how much time to allocate in leisure, formal and informal sector. The formal sector, denoted by F, has a standard Cobb-Douglas production function and is subject to taxation.

On the other hand, the informal sector, denoted by I, uses only labor as input. It is plausible to assume that the informal sector is more labor intensive compared to the formal sector. A possible interpretation of this assumption might be that the informal sector has a fixed amount of productive capital (Ihrig and Moe, 2004). Moreover, the informal sector is subject to taxation only when it is caught by the authorities. Thus we introduce a tax enforcement parameter ρ which captures the event of being caught. We assume that the tax revenue collected by the government is spent for unproductive activities.

The model is characterized as follows:

$$\max_{\{C_t, K_{t+1}, l_t, N_{It}, N_{Ft}\}_{t=0}^{\infty}} \quad \sum_{t=0}^{\infty} \beta^t U(C_t, l_t)$$

$$\text{s.t.} \quad C_t + K_{t+1} - (1-\delta)K_t = (1-\tau)\theta_{F_t} K_t^{\alpha} N_{Ft}^{1-\alpha} + (1-\rho\tau)\theta_{I_t} N_{It}^{\gamma}$$

$$N_{It} + N_{Ft} + l_t = T$$

Definition: Given the government policy variables $\{\tau, \rho\}$, a competitive equilibrium of this two-sector model is a set of sequences $\{C_t, , l_t, K_{t+1}, N_{It}, N_{Ft}, G_t\}_{t=0}^{\infty}$ such that $\{C_t, l_t, K_{t+1}, N_{It}, N_{Ft}\}_{t=0}^{\infty}$ maximizes representative agent's life-time utility.

Assuming logarithmic utility, the maximization problem of the household yields:

$$\frac{C_{t+1}}{C_t} = \beta[(1-\tau)\theta_F \alpha K_{t+1}^{\alpha-1} N_{Ft+1}^{1-\alpha} + 1 - \delta]$$

Since at equilibrium marginal products of two sectors must be equal, we have:

$$(1-\tau)\theta_F(1-\alpha)K_t^{\alpha}N_{Ft}^{-\alpha} = (1-\rho\tau)\theta_I\gamma N_{It}^{\gamma-1}$$

By rearranging the Euler equation, one can obtain K_t in terms of N_{Ft}:

$$K_{t+1} = N_{Ft+1}\left[\frac{(1-\tau)\theta_F\alpha}{(1+g_c)/\beta - 1 + \delta}\right]^{\frac{1}{1-\alpha}}.$$

Moreover, the time spent on informal labor can be obtained now using MP equality:

$$N_{It+1} = \left\{\frac{(1-\rho\tau)\gamma\theta_I}{(1-\tau)(1-\alpha)\theta_F}\left[\frac{(1+g_c)/\beta - 1 + \delta}{\alpha(1-\tau)\theta_F}\right]^{\frac{\alpha}{1-\alpha}}\right\}^{\frac{1}{1-\gamma}}$$

So at the steady state, the informal and formal labor becomes:

$$N_I = \left\{\frac{(1-\rho\tau)\gamma\theta_I}{(1-\tau)(1-\alpha)\theta_F}\left[\frac{1/\beta - 1 + \delta}{\alpha(1-\tau)\theta_F}\right]^{\frac{\alpha}{1-\alpha}}\right\}^{\frac{1}{1-\gamma}}$$

$$N_F = \frac{(T-N_I)\gamma(1-\rho\tau)\theta_I N_I^{\gamma-1} - \phi(1-\rho\tau)\theta_I N_I^{\gamma}}{\gamma(1-\rho\tau)\theta_I N_I^{\gamma-1} + \phi[(1-\tau)\theta_F(\frac{\alpha(1-\tau)\theta_F}{1/\beta-1+\delta})^{\frac{\alpha}{1-\alpha}} - \delta(\frac{\alpha(1-\tau)\theta_F}{1/\beta-1+\delta})^{\frac{1}{1-\alpha}}]}$$

5 Simulations

5.1 Income difference between Bolivia and Korea

According to the model based estimates of informal sector size as % of GDP, Korea and Bolivia had similar sizes of informal sector in 1960, around 70%. In 2012 while the size of informal economy in Korea has shrinked to 25%, Bolivia could only reach 61%. In the meantime the GDP per capita ratio of these countries rose from 1.7 to 25. For the period 1960-2012 this translates into an average of 8.92 GDP per capita ratio.

In order to simulate this income difference, following Restuccia (2004) we allow for total factor productivity differences across countries. We ask what is the exogenous TFP difference we need to impose in order to generate an income ratio of 8.9. Assuming in both Bolivia and Korea there is full tax enforcement, $\rho_B = \rho_K = 1$, we need TFP_K/TFP_B=3.13. Yet if we take $\rho_B = 0.4$, that is we raise the barriers, this time we need TFP_K/TFP_B=2.84, which corresponds to the TFP_K/TFP_B ratio that we observe in data (obtained using perpetual inventory method).(See Table 4)

Table 4: Income difference between Bolivia and Korea

$\frac{y_K}{y_B}$	ρ_B	TFP_K/TFP_B
8.9	1	3.13
8.9	0.9	3.08
8.9	0.8	3.03
8.9	0.7	2.99
8.9	0.6	2.93
8.9	0.5	2.88
8.9	0.4	2.84
8.9	0.3	2.80

For $\rho_B = 1$, $\tau_B = 0.35$, $\tau_K = 0.25$

We should also note that capital-output ratio's for Korea and Bolivia supports our empirical findings from the last section. Capital-output ratio for Bolivia is around 1.76 whereas for Korea the same ratio is 2.04. These results are very similar to those we observe in data, 1.71 and 2.45 respectively. So besides from generating the observed income difference; the model economy is also able produce a capital-output ratio that is close to what we observe in data.

5.2 Impulse Responses

This section will illustrate impulse responses of two economies; one with $\tau = 1, \rho = 1$ the other with $\tau = 0.25, \rho = 0$, otherwise identical. We will introduce a 5% TFP shock (to both sectors) in both environments. The results are given in Figure 4 and Figure 5.

For the economy with high tax-full tax enforcement we observe that formal output starts at a 0.025 higher level compared to low tax-no tax enforcement economy. When the TFP shock kicks in, the former elevates to 0.0909 whereas the latter can only reach 0.0707. The observation to be made is that in face of a TFP shock, the increase in formal output is more significant for the former environment with high tax- full tax enforcement.

The pattern of capital after the shock is introduced is another interesting part of this exercise. We observe that for the high tax-full tax enforcement environment capital elevates to higher levels whereas the movement in capital for the low tax-no tax enforcement is relatively smaller. This fact supports the evidence provided in Section 3.2.

Figure 4: Impulse Responses for $\tau = 1, \rho = 1$

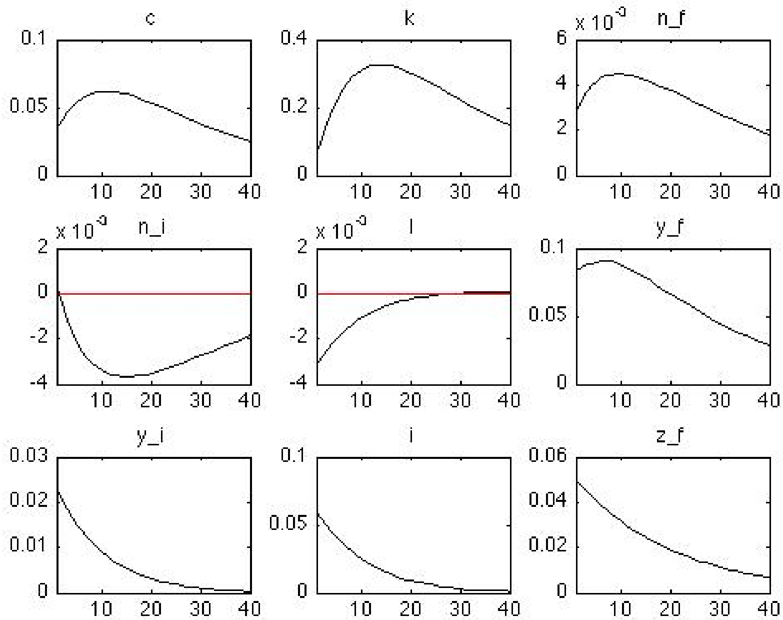
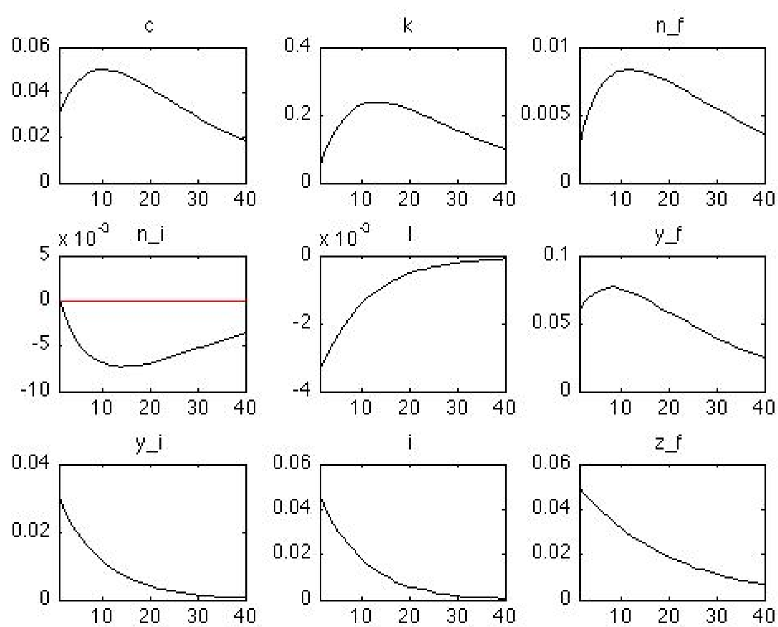


Figure 5: Impulse Responses for $\tau = 0.25, \rho = 0$



6 Conclusion

In this study we try to establish the negative relationship between informal sector size and relative gdp per capita, hence convergence. The empirical analysis we conducted establishes this analysis, more over we find that informality obstructs growth especially through the channel of capital-output ratio. Our quantitative analysis showed the two sector dynamic general equilibrium model that we employ is capable of producing the observed income differences as well as the capital-output ratio observed in data. Thus this study contributes to the barriers to growth literature by pointing out the prevalence of informality as a major determinant that obstructs growth of relative income per capita.

Future work in this area might consider different model economies. Employing an endogenous growth model would enable the growth rate to be determined endogenously. Although employing an endogenous growth model will, by construction, compromise transitional dynamics analysis, still it might lead to different results than what has been presented in this paper.

References

1. Benjamin, N. C., Mbaye, A. A. 2010. "Informality, productivity, and enforcement in West Africa: A firm level analysis", IPC Working Paper Series Number 100.

2. Elgin, Ceyhun & Oztunali, Oguz , 2012. "Shadow Economies around the World: Model Based Estimates," Working Papers 2012/05, Bogazici University, Department of Economics.

3. Eliat Y., Zinnes, C. 2000. The Evolution of the Shadow Economy in Transition Countries: Consequences for Economic Growth and Donor Assistance", CAER II Discussion Paper No. 65.

4. de la Fuente, Angel, 1998. "Convergence Equations and Income Dynamics: The Sources of OECD Convergence, 1970-95," CEPR Discussion Papers 1794, C.E.P.R. Discussion Papers.

5. De Soto, H. 1989. The other Path: The Invisible Revolution in the Third World, Harper Row, New York.

6. Ihrig, Jane & Moe, Karine S., 2004. "Lurking in the shadows: the informal sector and government policy," Journal of Development Economics, Elsevier, vol. 73(2), pages 541-557, April.

7. Loayza, N.V. 1997. The economics of the informal sector: A simple model and some empirical evidence from Latin America". World Bank Policy Research

Working Paper No. 1727.

8. Massenot, B., Straub, S. 2011. Informal Sector and Economic Growth: The Supply of Credit Channel". TSE Working Papers 11-254, Toulouse School of Economics (TSE).

9. Nabi, M. S., Drine, I. 2009. External Debt, Informal Economy and Growth", Economics Bulletin, 29 (3), 1695-1707.

10. Ngai, L. Rachel, 2004. "Barriers and the transition to modern growth," Journal of Monetary Economics, Elsevier, vol. 51(7), pages 1353-1383, October.

11. Parente, Stephen L. & Prescott, Edward C., 1994. "Barriers to Technology Adoption and. Development," Journal of Political Economy, University of Chicago Press, vol. 102(2), pages 298-321, April.

12. Restuccia, Diego, 2004. "Barriers to Capital Accumulation and Aggregate Total Factor Productivity," International Economic Review, Department of Economics, University of Pennsylvania and Osaka University Institute of Social and Economic Research Association, vol. 45(1), pages 225-238, 02.