The shadow side of financial crises

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Abstract

Using the Modified Total Electricity approach we test the effect of financial crises on Total Economic Activity. TEA drops much less than the official economy following a crisis, most importantly the drop is never statistically significant. We also derive different estimates of the behaviour of the unofficial economy (both output and employment based) and show that they indeed grow in the aftermath of financial crises. Finally we find and explain the different behaviour of total (and unofficial) economy across different types of crises (banking, currency and debt).

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1 Introduction

Financial crises are costly. It is hard to disagree with this statement. During the last years a conspicuous literature has documented that the costs of financial crises are substantial and long lasting. But does everything go really lost? Is there some aspect of the economy that proliferates during the crisis?

The literature on the shadow economy suggests that the unofficial economy tends to display a countercyclical behaviour which is particularly strong during severe downturns (see for instance Loayza and Rigolini (2011) and Fiess et al. (2010)). Moreover the literature also stresses that the credit market plays a relevant role in this process. In fact it is well known (Amaral and Quintin, 2006) that in the informal sector production tends to be more capital-intensive than in the formal sector. The main reason is that informal firms have a more restricted access to external finance. Thomas (1992) documents that in the informal sector bank credit plays a residual role and it is mainly replaced by informal credit (loans from family and friends) and personal savings. Thus access to bank credit is both a barrier and a threshold that discriminates between official and unofficial sector. Given the critical role played by the credit market we expect it to be exacerbated during financial crises that worsening internal credit conditions should push more firms into the informal sector with respect to normal times.

There is an ample evidence[1] of the fact that financial crises have a negative impact on output. For the sake of precision what the literature finds is that crises impact negatively on *official output*. However if the arguments outlined above are true, following a crisis we should expect a decrease in official output but an increase in unofficial output. As a consequence any measure of Total Economic Activity (henceforth TEA) should be less responsive to economic crises that what is the official economy.

This is the first paper that puts these hypothesis to the test. Using the Modified Total Electricity approach we develop a consistent set of estimate of the growth rate of the total economy (i.e. official plus unofficial economy). We then test the effects of financial crisis on the total economy obtaining striking results: not only TEA drops much less than the official economy following a crisis, most importantly the drop is never statistically significant.

[1]The literature on the subject is large. See Cerra and Saxena (2008), Dell'Ariccia et al. (2008), Kroszner et al. (2007), Rajan and Zingales (1998), Reinhart and Rogoff (2009a), Reinhart and Rogoff (2009b) for the most recent contributions.

We subsequently derive different estimates of the behaviour of the unofficial economy (both output and employment based) and show that they indeed grow in the aftermath of financial crises. Finally we find and explain the different behaviour of total (and unofficial) economy across different types of crises (banking, currency and debt).

The remainder of the paper is structured as follows: section 2 illustrate how we measure Total Economic Activity and the unofficial economy, section 3 describes the data and methodology used, section 4 presents the empirical results, section 5 derives the implications of the finding for the behaviour of the shadow economy, finally section 6 concludes. All technical aspects are relegated to the Appendix.

2 Measuring Total Economic Activity and the unofficial economy

Any attempt to obtain a measure of the TEA is also an attempt to measure the unofficial economy. There are basically three approaches to accomplish this task. The first is the MIMIC approach to the estimation of the shadow economy; it has been presented in a series of papers by F. Schneider and coauthors[2] who develop a structural model for estimating a latent variable (the shadow economy) through a set of "causal variables" (such as taxation, regulatory burden, moral attitudes toward the state etc.) and "likely indicators" (such as changes in the demand for currency, in the labour force participation rate and in official GDP).

The second is the currency demand approach initially proposed by Cagan (1958) and subsequently developed by Tanzi (1983, 1980) and Feige (1989)[3] which assumes that currency is the exclusive medium of exchange in unobserved activities; the currency/deposit ratio si then used to derive a measure of the underground economy.

The third is the Total Electricity recently amended as the Modified Total Electricity approach (Eilat and Zinnes (2002) Lack (2000) Feige and Urban (2008)). This method obtains shadow economy estimates from electricity consumption data which are filtered to remove the influence of additional

[2]See for instance Schneider (2005) Schneider and Buehn (2007) and Schneider and Enste (2000).

[3]See also Feige (1994) and Feige and Urban (2008).

factors such as variations in electricity prices and in the relative weight of energy-intensive industrial sectors.[4]

The first two methods have several shortcomings that constrain their use for the purpose of this study. The MIMIC approach lacks transparency and relies on assumptions that are often questioned by the literature (see the critique by Breusch (2005)). The method is also very demanding in terms of data limiting the with and the length of the available data set. The second approach runs into problems when applied to developing countries where, due to the inefficiency of local financial markets, there is a widespread use of dollarized assets as a store of value and not as a medium of exchange. This implies differences in velocity of circulation between the official and the unofficial sector which distort the estimates.

Probably for our purpose the major drawback of the two approaches mentioned above is the fact that they do not allow to estimate the size of the shadow economy on a wide set of countries for a long time span. The most recent estimates provide a good coverage of the cross sectional dimension but the time series remains restricted to few years.

The Modified Total Electricity approach on the other hand does not suffer from the drawbacks outlined above. It is a transparent method easily replicable and requires the availability of few data, the major being electricity consumption which is available for a large cross-section of countries over an extended period of time. This allows us to perform our analysis on a sample of 125 countries for 25 years.

In addition to the estimates of the shadow economy obtained from TEA, we also estimate the informal economy considering labour market measures. Following the literature (see in particular Loayza and Rigolini (2011), Fiess et al. (2010)) we therefore proxy informal employment with the share of self-employment in the labour force.

[4]This is based on the assumption that changes in the domestic real price of electricity capture the effects of energy supply shocks and of long term efficiency gains caused by technical change, whereas changes in the industry share of GDP affect the component of electricity consumption which is directly related to the country-specific evolution in the composition of domestic output.

3 Data and methodology

3.1 Data

Estimates of the growth rate of the total economy and of the shadow economy are obtained as in Onnis and Tirelli (2010), who apply a version of the MTE approach proposed by Eilat and Zinnes (2002). The Appendix describes the method with greater detail.

Data on electricity consumption, real price of electricity, share of industrial income and official GDP have been obtained from Energy Information Administration, International Energy Agency, World Bank and United Nations, respectively. Data on self-employment are obtained from ILO.

Banking, currency and debt crisis dates are obtained from Laeven and Valencia (2008), Laeven and Valencia (2010).[5] Since we treat these crises as the equivalent of a shock we consider only the starting year of the crisis and not their duration[6].

Overall we have a panel of 120 countries observed from 1980 to 2005.

3.2 Methodology

Our methodology follows Cerra and Saxena (2008) who in turn draw on the influential work by Romer and Romer (1989) that identifies the impact of monetary policy shocks on output.[7]

In detail we estimate the following autoregressive model.

$$TEAg_{it} = \alpha_i + \sum_{s=1}^{4} \beta TEAg_{i,t-s} + \sum_{s=0}^{3} \gamma DFC_{i,t-s} + \epsilon_{i,t} \qquad (1)$$

[5]While there is less disagreement on the definition of currency and debt crises, banking crises are more controversial. In particular Laeven and Valencia (2008) identify crises with either a) deposit runs, defined as a monthly percentage decline in deposits in excess of 5 percent, or with b) the introduction of deposit freezes or blanket guarantees, or with c) liquidity support or bank interventions, defined as the ratio of monetary authorities claims on banks as a fraction of total deposits of "at least 5% and at least double the ratio compared to the previous year".

[6]Indeed there is strong disagreement in the literature about the duration of financial crises.

[7]See also Romer and Romer (2010) for a more recent analysis on the impact of fiscal shocks.

Where $TEAg$ is the growth rate of the total economy and DFC is a dummy variable for the presence of a financial crisis. The number of lags of both the lagged variable and the crisis dummy have been chosen in order to maximise the informativeness of the model.[8]

The model above has been estimated using panel data that control for the presence of fixed effects and allow heteroskedasticity of the error term and autocorrelation within groups (countries).

The impact of the crisis has been estimated calculating impulse response function constructed using 1000 Monte Carlo simulations. The significance of the results is computed by calculating 95% confidence bands. The Appendix describes the procedure with greater details.

4 The effect of financial crises on TEA

Figure 1 shows the effect of financial crises on TEA and official GDP for the sample of countries considered. The first line displays impulse responses for TEA, the second line for official GDP. The figure distinguishes between banking, currency and debt crises.

The analysis of the impact of crises on GDP growth confirms the results of the literature and in particular the findings of Cerra and Saxena (2008). Crises have a long lasting and permanent effect on GDP; the loss in output is approximately 5% for banking crises, 3.5% for currency crises and 6% for debt crises. However when the analysis is replicated for the measure of TEA results are strikingly different. Not only TEA responds much less to financial crises but the impact of crises is not significant with the exception of currency crises.

Figures 2, 3, 4 show in detail the effect of banking, currency and financial crises on TEA for different subgroups of countries. They confirm the results above showing that similar responses hold for every group of countries considered.

As stated above currency crises are somewhat an exception: following such crises the drop in TEA is indeed statistically significant and close to the drop displayed by official GDP. There is a clear explanation for this. If the difference between the behavior of TEA and official economy is due to the shadow economy then currency crises are expected to affect less unofficial

[8]The four year time lag is consistent also with the literature estimating the output responses at the same or at higher frequencies.

output for two reasons: on the one hand currency crises do not necessarily imply a disruption or collapse of the credit market which is one of the major cause of the relative growth of the shadow economy. On the other hand currency crises are often followed by an increase in inflation which erodes the tax advantage of operating in the informal sector. Thus we expect that currency crises have a higher impact on TEA with respect to banking and debt crises. The reasons underlying the different response to different crises will be investigated mote thoroughly in section 5.4.

4.1 Robustness

In addition to splitting the analysis in country groups we have applied to our estimates some other robustness checks. First we have checked whether crises reflect some other global shock common to all countries. The first row of Figure 5 shows impulse responses of equation1 adding time dummies. Results are unchanged. Secondly we have tested whether our results are driven by some extreme values. The second row shows impulse responses excluding some high and low values of growth rates of TEA. Also in this case our estimates are confirmed.

4.2 Endogeneity

Our analysis is based on the implicit assumption that financial crises are exogenous. However it is easy to build an endogeneity argument particularly when we consider the contemporaneous effect of crises on output. Is the crisis the cause of the drop in output or is it the deterioration of economic activity which then causes the financial crisis? In order to solve this problem we have implemented two tests. First we have estimated the model excluding the contemporaneous effect of the crisis on output. The third line of Figure 5 illustrate the result showing that nothing changes. Second we have estimated a probit model with the crisis variable as the dependent variable explained by current and lagged values of the growth rate. Table 1 shows that albeit crises are endogenous to the growth rate of the official economy (first column) they are exogenous for both TEA and the measure of the growth of the shadow economy.

5 The shadow effect of financial crises?

The previous section has shown that financial crises, have limited if no impact on total economic activity while maintaining a strong negative effect on official output. Since the difference between TEA and official output is necessarily the unofficial or shadow economy, this suggests that the latter acts as a "buffer" expanding following economic crises. So far the evidence that we have provided is only indirect. Can we provide a more direct evidence of the effect of financial crises on the shadow economy? This question does not have an easy answer. Ideally in order to estimate precisely the dynamic evolution of the shadow economy one would need a precise estimate of the dynamic evolution of TEA, official output and at least one base year to compute the value of the shadow economy as the difference between the value of TEA and official GDP. Unfortunately time series for a large group of countries for the share of the shadow economy are unavailable.

5.1 Shadow growth

However for a subset of countries (49) we can calculate a base year following the modified total electricity approach. This allows to calculate a direct measure of the shadow economy[9]. The first row of figure 6 shows the impulse responses of the growth rate of the shadow economy. The effect if positive for banking and currency crises, albeit in this case less strong, while non significant for debt crises. The non significance of the debt crises is probably due to the fact that in this subset advanced economies (where no debt crisis is recorded) are overrepresented making this effect difficult to be identified.

5.2 Proxies of the shadow growth

An enlargement of the sample of countries is possible provided we adopt the approximation generally used by the literature (Eilat and Zinnes (2002), Lack (2000) Feige and Urban (2008)) that attributes the difference between the growth rate in TEA and the growth rate of measured GDP as the growth rate in unrecorded economy.

The second row of Figure 6 reports the results. As supposed the response of the shadow economy is indeed positive and generally significant, also considering country groups (not reported in the figure).

[9]See Onnis and Tirelli (2010) for details.

Overall the findings suggest that the shadow economy acts countercicli-cally particularly following big negative shocks.

5.3 Informal employment growth

Another strand of the literature (Loayza and Rigolini (2011), Fiess et al. (2010)) analyses the behaviour of the informal sector from the employment side, using the share of self-employment in the labor force as the proxy for informal employment and showing that in the short run it behaves counter-cyclically. The underlying idea is that, when the economy is hit by a strong negative shock, often workers have no other option than accepting whichever working opportunity it becomes available.

In order to complement our analysis we have therefore calculated impulse responses of financial crises on self-employment. Data on self employment are obtained the ILO,[10] but are available for a limited number of countries and a restricted time serie span. Matched with our data we are left with 48 countries with the maximum time series going from 1984 to 2005.

The third row of figure 6 shows the results. The share of self employment over total employment rises, in particular following banking crises, suggesting that self employment acts counter-cyclically in the presence of financial shocks. Note that also with this analysis there is a clear difference in responses to banking and currency crises.

5.4 Explaining different responses to different crises

In the previous sections we have stressed that considering TEA, the growth rate of the shadow economy and even the time series behaviour of self-employment there is a clear difference between currency crises and banking and debt crises. In this section we provide an explanation for this which is in line with the interpretation of the role of the informal sector.

In fact if the difference in the behaviour of TEA and official GDP is given by the informal sector, an important role is provided by inflation response to financial crises. It is well known that inflation acts as a tax on money holding; as such it should affect relatively more the unofficial economy which is typically more "cash intensive" that the official economy. Thus we should

[10]See (`http://laborsta.ilo.org`. This is the same dataset used by Loayza and Rigolini (2011). We have excluded countries with incomplete series or series shorter that four years.

expect the growth of the shadow economy to be more constrained when inflation is higher. The fourth row of figure 6 shows that currency crises have a positive impact on inflation, much more than in debt crises and in banking crises. Thus a possible explanation of the negative response of TEA to currency crises is that the latter act as inflation shocks which constrain the growth of the shadow economy. The fact that the effect of banking crises on informal employment is stronger and more significant than currency and debt crises reinforces this argument. A final piece of evidence is provided by the velocity of money circulation which is displayed in the fifth row and which reinforces the argument above.

6 Conclusions

In this paper we contribute to the literature of the effects of financial crises showing that Total Economic Activity displays a strikingly different behaviour as compared to official GDP. Using the Modified Total Electricity approach we develop a consistent set of estimate of the growth rate of the total economy (i.e. official plus unofficial economy). Our results show that not only TEA drops much less than the official economy following a crisis, but most importantly the drop is never statistically significant. We subsequently derive different estimates of the behaviour of the unofficial economy (both output and employment based) and show that they indeed grow in the aftermath of financial crises. Finally we find different responses across financial crises (banking, currency and debt crises) and we explain this with the fact that the effect of currency crises on the informal economy employment is constrained by inflation which acts as a tax that affects strongly the informal economy typically more "cash intensive" that the official economy.

7 Appendix

7.1 Calculating Total Economic Activity

Any attempt to exploit electricity consumption to estimate TEA and the shadow economy should address the issue of the empirical stability of the energy-consumption-to-GDP ratio. Critics emphasize the potential downward bias caused by energy-saving technological change. The argument is straightforward and quite intuitive, but it neglects a long-standing debate

on the Jevons' Paradox: it cannot be taken for granted that energy-saving technological change will reduce the energy intensity of aggregate production (Iorgulescu Polimeni and Polimeni, 2007, Polimeni and Iorgulescu, 2007, Allan et al., 2007). In fact, computable general equilibrium models support the view that energy consumption might "rebound" because energy demand is at best weakly correlated with a more efficient energy use. The reason why this might happen is easily explained. Following an improvement in energy efficiency, market forces drive some countervailing effects: (i) the fall in energy prices triggers a substitution effect towards more energy-intensive goods and production techniques; (ii) the income effect raises household consumption of all commodities, including energy consumption. In addition, the downward bias might be offset by other forms of technological change, such as labor-saving innovations, which increase the energy intensity of the production function. For instance, early econometric work has shown that in the US manufacturing sector technical change has been energy intensive (Hogan and Jorgenson, 1991, Jorgenson and Faumeni, 1981). Finally, one should bear in mind that sectoral specialization might change as the economy develops, thereby affecting the energy intensity of production.

Our analysis is based on the assumption that changes in the domestic real price of electricity capture the effects of supply shocks and of long term efficiency gains caused by technical change, whereas changes in the industry share of GDP affect the component of electricity consumption which is directly related to the country-specific evolution in the composition of domestic output. The first stage of our application of the MTE procedure is therefore based on the following equation:

$$\Delta Elec_{i,t} = \alpha_i + \beta_1 \Delta Eprice_{i,t} + \beta_2 \Delta IndGdp_{i,t} + \varepsilon_{i,t} \tag{2}$$

where subscripts t, i are time and country indexes, $\Delta Elec$, $\Delta Eprice$ and $\Delta IndGdp$ respectively describe annual percentage changes in electricity consumption, in the real price of electricity and in the industry share of GDP.

Once the relative-price and demand-composition effects have been identified, the residual changes in electricity consumption, $\Delta Elec^{res}$, may be used as a proxy for the growth rate in Total Economic Activity:

$$\Delta Elec^{res}_{i,t} = \Delta Elec_{i,t} - [\beta_1 \Delta Eprice_{i,t} + \beta_2 \Delta IndGdp_{i,t}] \tag{3}$$

Then, the growth rate of the unrecorded economy, ΔSH, is obtained by subtracting the growth rate of the official economy to the growth rate of

total economic activity.

Since the time series dimension of the panel is relatively long, the econometric methodology is based on a preliminary stationarity and cointegration analysis of the relevant variables. Variables $\Delta Elec$, $\Delta Eprice$, $\Delta IndGdp$ exhibit non stationarity, tested using Im et al. (2003), Pesaran (2007), Hadri (2000), Kwiatkowski et al. (1992), ADF and Phillips-Perron unit root tests. A cointegrating relationships between $\Delta Elec$, $\Delta Eprice$ and $\Delta IndGdp$ has been, therefore, detected using the residual-based procedure developed by Pedroni (1999), Pedroni (2004).

Due to the presence of cointegrated time series, in our estimate of equation (2) we use the group-mean panel Fully Modified Ordinary Least Squares (FMOLS) method proposed by Pedroni (2000), Pedroni (2001). The group-FMOLS estimates reported in Onnis and Tirelli (2010) suggest that a positive and statistically significant relationship exists between the changes in electric consumption and those in the share of industry. On the contrary, a negative and statistically significant relationship exists between the changes in electric consumption and those in electricity price. [11]

7.2 Calculating impulse responses

Impulse responses have been calculated as follows. First we have estimated equation (1) by GLS with fixed effects and time dummies. Obtained the estimated coefficients we have assumed that they are drawn from a multivariate normal distribution with mean the estimated vector of coefficients and as variance the estimated variance covariance matrix.

We have drawn a sample of 1000 coefficients from the distribution and we have simulated the cumulative effect of a financial crises. Confidence intervals have been calculated from the 2.5 and 97.5 percentiles.

[11] To use changes in country-specific electricity price as an explanatory variable for changes in electricity consumption may generate problems of endogeneity. Firstly, we have re-estimated equation (2) adopting an alternative more exogenous real price of energy for 26 OECD countries and a global index of energy price for the remaining 23 countries. Second, we have used the global price of energy for the entire panel. In both situations we have obtained the same result. There is a positive and statistically significant relationship between changes in electricity consumption and changes in industry share of GDP. There is a negative and statistically significant relationship between changes in electricity usage and changes in the price of energy.

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Table 1:

	Banking	Banking	Currency	Debt
L0	-0.060***	-0.005	-0.004	-0.03
	-0.02	-0.01	-0.01	-0.02
L1	-0.01	-0.006	0.009	0.01
	-0.02	-0.01	-0.01	-0.02
L2	-0.015	-0.006	0.007	0.004
	-0.02	-0.01	-0.01	-0.02
L3	0.012	-0.007	-0.023**	-0.002
	-0.02	-0.01	-0.01	-0.02
L4	0.009	-0.004	0.012	0.018
	-0.02	-0.01	-0.01	-0.01
N. Obs.	2788	2541	2541	2541
N. Countries	120	121	121	121

Note: Dependent variable is banking crisis in cols 1 and 2, currency crises in col 3 and debt crises in col 4. L0-4 refer to different lags of the regressors which are official gdp in col 1 and TE in cols 2, 3, 4. Estimation is panel probit random effect. Robust standard errors reported in parentheses. ***,**,* denote significance at the 1, 5 and 10 percent levels respectively.

Figure 1: Impulse responses of financial crises: effects on the growth rate of TEA (first row) and on official GDP (second row)

Figure 2: Impulse responses of banking crises on TEA, country groups

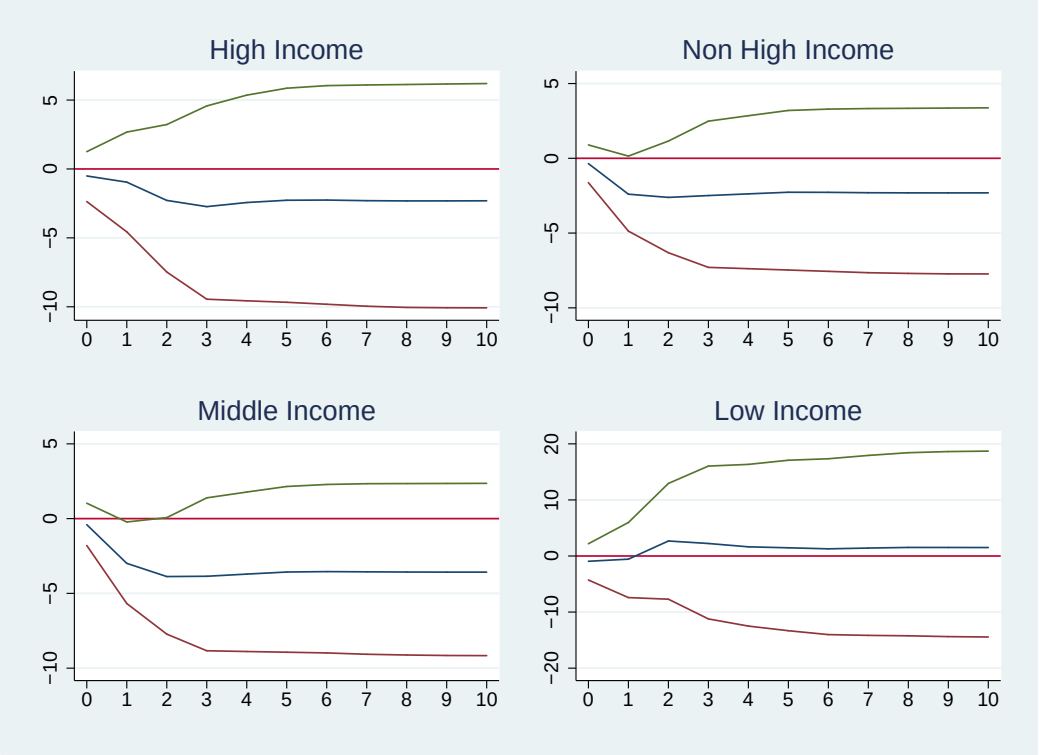

Figure 3: Impulse responses of currency crises TEA, country groups

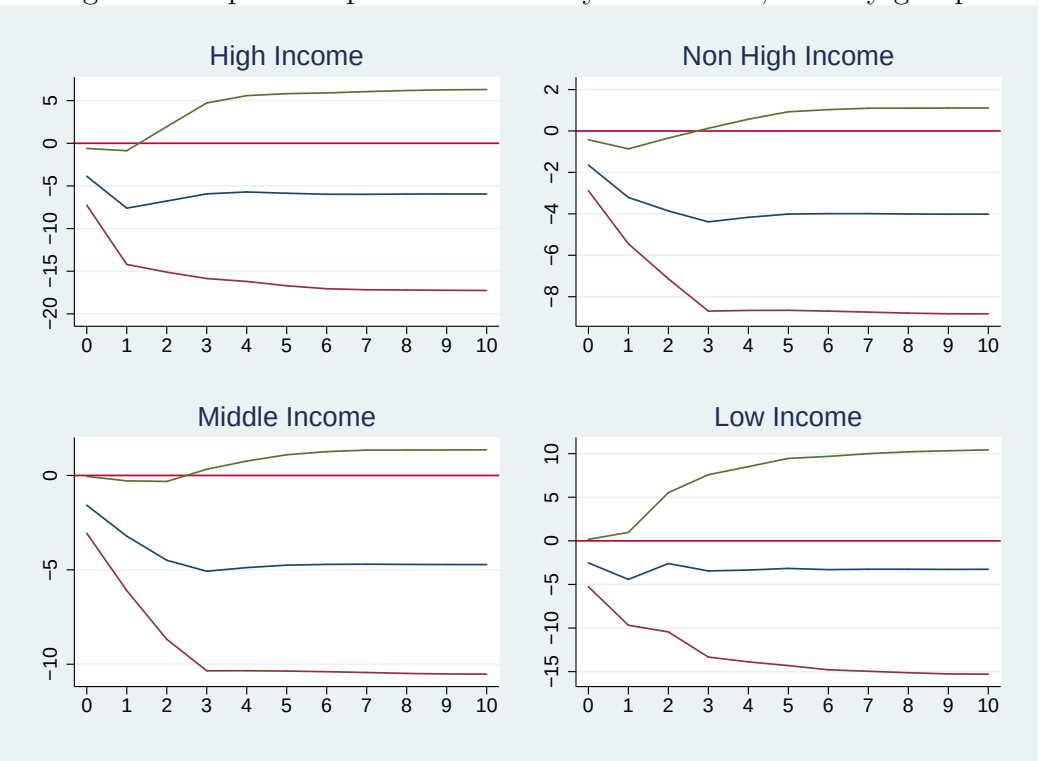

Figure 4: Impulse responses of debt crises on TEA, country groups

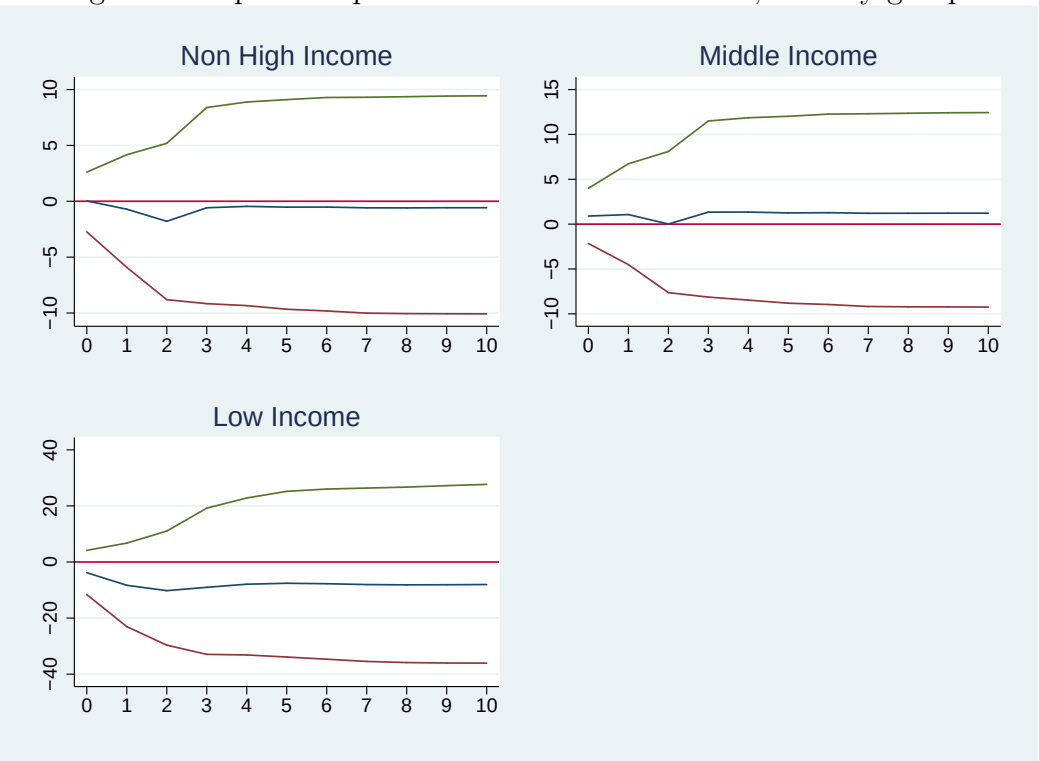

Figure 5: Impulse responses of financial crises. Robustness checks

Figure 6: Impulse responses of financial crises: effects on the shadow economy growth, small set of countries (first row), proxy shadow economy growth, full set of countries (second row), informal employment (third row), inflation (fourth row), and money velocity (fifth row).

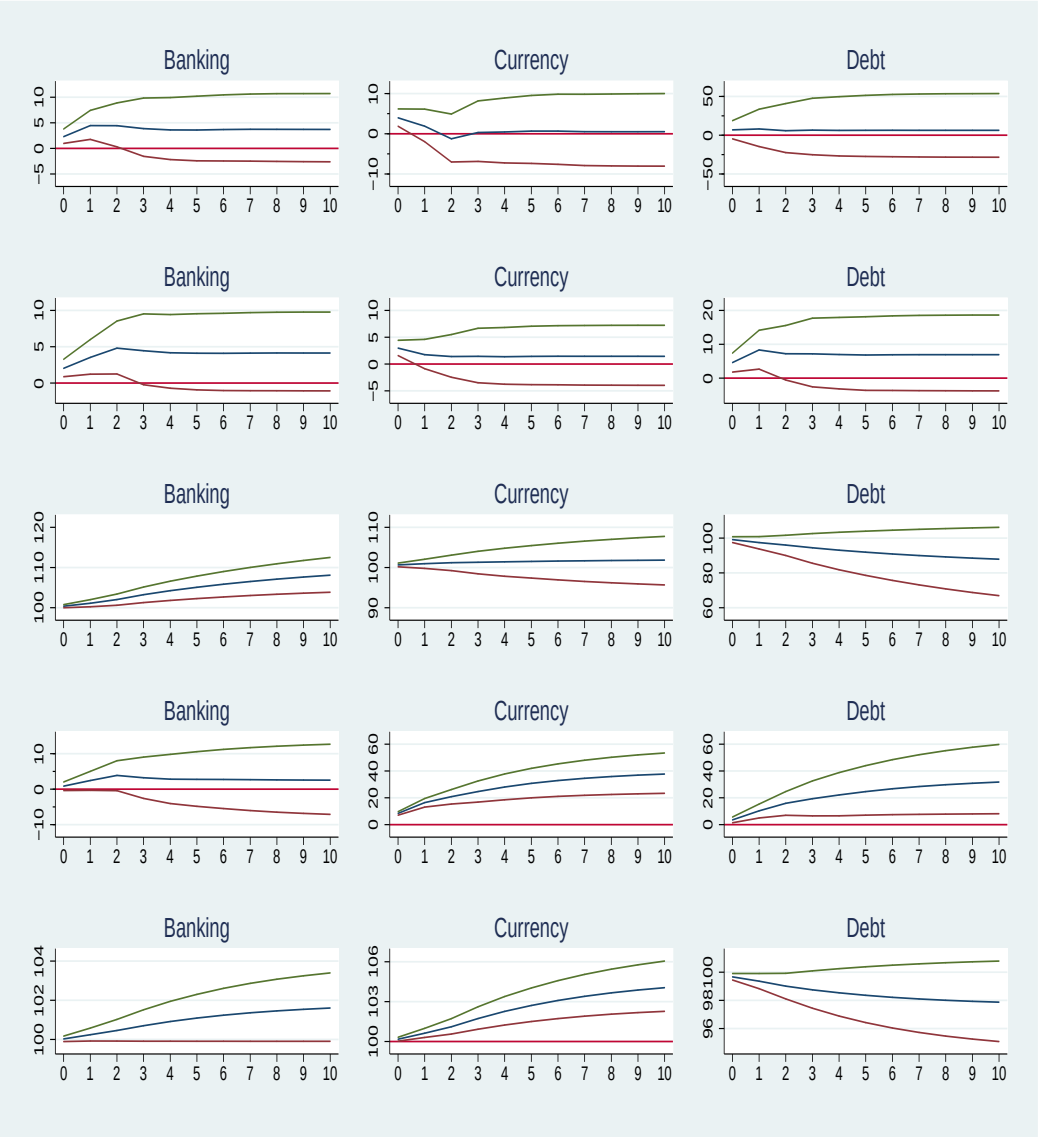

Table 2: List of Countries

Afghanistan	Cyprus	Japan*	Poland*
Albania	Czech Republic*	Jordan	Portugal*
Algeria	Denmark*	Kenya	Romania*
Angola	Dominican Republic	Kuwait	Rwanda
Argentina	Ecuador	Lebanon	SaudiArabia
Australia*	Egypt*	Liberia	Senegal
Austria*	El Salvador	Libya	Singapore*
Bahamas	Fiji	Luxembourg	Slovakia*
Bahrain	Finland*	Madagascar	South Africa
Bangladesh	France*	Malawi	South Korea*
Barbados	Gabon	Malaysia*	Spain*
Belgium*	Germany*	Maldives	Sri Lanka*
Belize	Ghana	Malta	Sudan
Benin	Greece*	Mauritius	Suriname
Bhutan	Grenada	Mexico*	Sweden*
Bolivia	Guatemala*	Mongolia	Switzerland*
Botswana*	Guinea	Morocco*	Syria
Brazil*	Guyana	Mozambique	Tanzania*
Brunei	Honduras	Nepal	Thailand*
Bulgaria*	Hong Kong*	Netherlands*	Tunisia*
Burkina Faso	Hungary*	New Zealand	Turkey
Burundi	Iceland	Nicaragua	UA Emirates
Cambodia	India	Niger	United Kingdom*
Cameroon	Indonesia	Nigeria	United States*
Canada*	Iran	Norway*	Uganda
Chile*	Iraq	Pakistan	Uruguay
China	Ireland*	Panama*	Venezuela*
Colombia*	Israel*	Paraguay*	Viet Nam
Costa Rica*	Italy*	Peru*	Zambia
Cote Ivoire	Jamaica	Philippines*	Zimbabwe

Note: * denote countries of the restricted sample.