Essays on Macroeconomics and Economic Policy in Emerging Economies

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Abstract

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A well-documented result in the literature is that more corruption is associated with more income inequality. However, the relationship is not necessarily this simple and can depend on the size of the informal sector in an economy. In the first chapter, I use panel data spanning from 2003-2018 on 15 ex-Eastern Bloc countries and utilize threshold regression techniques from Hansen (1999) to test that. The findings suggest that when the size of the informal economy exceeds a threshold point, there exist a tradeoff between corruption and inequality. However, when the size of the informal economy is below that threshold point, a positive association is found. I also show the existence of a statistically significant informal sector size threshold below/above which the relationship between tax evasion and income inequality is positive/negative, respectively. As a robustness check, I demonstrate similar findings for multiple measures of inequality, informality, and corruption.

In the second chapter, I develop a macroeconomic model to explain the intuition behind the empirical non-linearity between tax evasion and inequality found in the first chapter. The second chapter continues on to explore the welfare implications of the model.

The third chapter focuses on banking in the Gulf Cooperation Council (GCC) countries. Interest rates were rising in the US in 2015-2018. GCC countries have pegged exchange rate regimes and will have to raise policy rates in tandem. In aggregate data, it is challenging to

find interest rates effects on economic and financial variables in the GCC. In this chapter, co-authors from the IMF and I use a panel of bank level data, exploiting variation across banks within country, to isolate the impact of rising US interest rates on GCC banks funding costs and profitability. We find strong pass-through from US monetary policy to GCC policy rates and bank liabilities. However, US interest rates seem to have limited impact on asset rates and profitability. We explore two potential explanations to the findings by looking at what happens to the size of bank funding after a monetary tightening episode. We also explore the importance of looking at the degree of bank competition across the GCC countries to understand transmission of monetary policy into banks cost of funding and profitability.

The fourth chapter examines the effectiveness of fiscal policy in Egypt under different debt regimes. In so doing, Nurmukhametov and I evaluate the relationship between expansionary fiscal policy and real economic growth. Two elements of particular interest are the (non)linearity and the impact of domestic debt on macroeconomic variables. Specifically, we search for a threshold effect by applying the Hansen (2000) sample-splitting threshold regression model. We establish with statistical significance that fiscal expenditure leads to greater real GDP in a low-debt regime (81.5% domestic debt-to-GDP threshold) and lower real GDP in a high domestic debt above the threshold. We further explore and test possible theoretical explanation for the findings. The paper concludes with a discussion of policy implications of this research.

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I would also like to thank my beautiful wife, Rita, whose love and sacrifice know no bounds. Special thanks to my parents, Majd and Khalil, without whom I would not be half the man I am today.

Dedication

To my wife and our son who is in the womb. You are my joy and I hope to always make you proud.

Corruption, Inequality, and the Informal Sector: an Empirical Investigation

1 Chapter 1

1.1 Motivation and Literature

Previous literature and general common sense lead most policy makers to simply adopt the line of thinking that more corruption in an economy necessarily lead to more income inequality. While this statement has its merit, it does not reflect the full picture. In this paper, I empirically demonstrate how the corruption-inequality relationship can be affected by the size of the informal sector in the economy and how a tradeoff between corruption and inequality exists due to that. In so doing, I use panel data from 15 Eastern European countries for the years 2003-2018 and threshold regression techniques developed by Hansen in his 1999 seminal paper. To the best of my knowledge, this is the first piece of research to utilize threshold regressions to study this problem and to empirically quantify informal sector size thresholds. It is also the first paper to study the corruption-inequality-informality relationship for the Eastern Europe, Central Europe, and the South Caucasus regions.

There are three main strands of literature related to the question explored by this chapter. The first strand of literature is on the relationship between corruption (broadly defined) and inequality. The second one is on the relationship between corruption and informality and whether they are substitutes or complements. The third strand of literature explore the corruption-inequality-informality nexus and how we can view the interaction between these three variables. Each of these literature strands contain a collection of empirical and theoretical papers.

The first and richest strand of literature related to this paper is on the relationship between corruption and inequality. First let's consider the empirical literature that falls under this strand. Most of the empirical papers (Mauro, 1995, 1997; Gupta et al., 1998; Fisman and

Svensson, 2000; Gyimah-Brempong, 2002, Gyimah-Brempong and De Camancho, 2006) find a positive relationship between corruption and inequality. These papers argued for multiple avenues by which this might be the case and use define corruption differently. One avenue is that tax evasion and exemptions leading to having less funds for social programs (education and health) going hand in hand with the wealthy being more likely to evade (regressive-like tax system) lead to higher income inequality. Second avenue is through corruption changing the composition of public spending leading to the kind of expenditure that benefits the richer subset of the population (e.g: higher spending on higher education as opposite to primary education), which consequently causes a widening gap between the richer and poorer subsets of the population. A third avenue is through the inefficient allocation of public procurement in a corrupt system leading to inferior public infrastructure which subsequently effects on welfare and inequality. Chong and Calderón (2000) quantifies a quadratic relationship between corruption (measured by institutional quality) and inequality for a full panel containing both rich and poor countries. They also find a negative relationship between corruption and income inequality for the poor countries in the panel. They explain their result by hypothesizing that poor countries have large informal sectors. Anti-corruption measures (such as institutional reforms and formalization) can lead the informal sector workers to incur a cost (e.g: improvement in tax collection and/or bureaucratic requirements). Since the informal sector mainly employs the poorer individual, income inequality goes up. Their empirical findings lead them to conclude that having high inequality and high corruption at the same time would lead to an inequality trap since fighting anti-corruption polices might only lead to an even higher inequality.

There is also some theoretical work on the corruption-inequality relationship. For example, Gleaser et al. (2003) develop a model where the form of corruption modeled is judicial corruption. Institutions only allows legally protected agents to become rich leading to increase in inequality. Bunch of other theoretical papers produce a two-way causality. Sonin (2003) and Chong and Gradstein (2007) theorize that inequality leads to weaker institutions

which in return leas to even higher inequality. Bourguignon and Verdier (2000) develop a political economy growth model which produces a non-monotonic relationship between corruption (proxied by democracy) and inequality. In this model, at the beginning of time, the educated voting minority runs the country leading to increased inequality initially. To achieve higher economic growth, citizens education rises leading to an increased number of voters and redistribution from old elite to the newly educated (known as the political Kuznets curve).

Moreover, Alesina and Angeletos (2005) show that large public project aiming and reduced inequality lead to more opportunities for corruption (e.g: tax loopholes and allocation corruption). They also illustrate that a benevolent policy maker would still implement large public project incurring cost of corruption to reduce inequality (tradeoff exists). Finally, Mandal and Marjit (2010) develop a small open economy model with competitive markets which shows that lowering corruption has an ambiguous effect on wage and relative wages in equilibrium.

Second strand of literature related to my paper is the literature on the relationship between corruption and informality and whether they are substitutes or complements. According to the theoretical work on this question., both type of relationships may hold. Choi and Thum (2005) show how informality limits corruption (substitutes). Informality provides businesses the opportunity to go underground. Dreher, Kotsogiannis and McCorriston (2009) also find that corruption and informal sector size are substitutes. A larger informal sector reduces the likelihood of government crooks receiving bribes from firms. Meanwhile, Friedmann, Johnson, Kaufmann, and Zoido-Lobatan (2000) find that higher corruption leads to higher informality (complements). Corrupt official can behave in a predatorial fashion leading entrepreneur to go underground to avoid corruption premiums. Also, Hindriks, Mutho, and Keen (1999) theorize that corruption and informality are complements. Taxpayer and tax collector collude leading to higher tax evasion. According to the empirical papers, however, corruption and informality seem to be complements. Friedman et al. (2000) and

Kaufmann and Zoido-Lobaton (1998) find a complementary relationship between corruption and informality. Dreher and Schneider (2010) use a cross-section of 98 countries to show that the relationship depends on the level of income of a country. Dreher et al (2009) find that better institutional quality reduces both the size of corruption and size of the informal sector (under certain conditions). Overall, this second strand of literature seem to show that corruption and informality go hand in hand (complements) as weak institutions provide a base for corruption (help avoids institutional barriers and over regulated labor market).

A third strand of literature which this paper could be classified under is on the corruption-inequality-informality nexus. The empirical papers in this strand find that higher corruption (defined in several ways) leads to more informality. Schneider, Buehn, and Montenegro, (2010) show that in developing countries, the informal sector contains 40-50 percent of labor force and generates around 50 percent of GDP. Dabla-Norris, Gradstein, and Inchauste, (2010); Feige, (1996); Schneider, (2007); Tanzi, (1982) show that weak institutions (weak legal system, bureaucracy, heavy tax burden, and over regulation of labor) lead to a growing informal sector size. Meanwhile, Chong and Gradstein (2007b) find a negative relationship between institutional quality (proxy for corruption) and the size of the informal sector. In the sense that; lowering corruption by improving institutional quality leads to a decline in the size of the informal sector. Moreover, Dobson and Ramlogan-Dobson (2012) uses panel data from Latin American countries to show that the effect of corruption on income inequality is dampened when the presence of the informal sector in these countries is taken into consideration. The rationale given behind their findings is that countries with weaker institutions and larger informal sectors usually have looser employment regulations leading to more opportunities for the unskilled and semi-skilled workers, and hence, policies aimed at reducing corruption and strengthening institutions lead to reducing the size of the informal sector and consequently to higher income inequality. There are also some theoretical work that can be listed under this strand: Albrecht, Navaroo, and Vroman (2009) show that in an economy with a significant informal economy, reforming labor regulation (decrease in

corruption) lead to an increase in total unemployment. Ulyssea (2010) develops a two-sector matching model that shows that enforcement of labor market regulations leads to a smaller informal sector. Also, Maloney (2004) demonstrates how labor market regulations have minimal effect on informal sector size since informal sectors mostly include self-employed agents. Additionally, Okumu and Forgues Puccio (2014) shows that in equilibrium with corruption (defined as bureaucratic bribes), the informal economy mitigates the extent of income inequality.

This chapter contributes to the third strand of the literature as it explores the effect of informal sector size on the corruption-inequality relationship in a panel of ex-Eastern Bloc countries. To the best of my knowledge at the time of writing this chapter, this is the first piece of research to quantify informality size thresholds below/above which the effect of corruption on inequality might differ the association between corruption and income inequality is different. It is also the first empirical study on the corruption-informality-inequality nexus for the ex-Eastern Bloc countries.

The choice of ex-Eastern Bloc countries is motivated by the fact these countries have had centralized economies up until the collapse of the Soviet Union, and inherited corrupt political institutions and unequal distribution of income between the governing elites and non-elites. They also have a sizeable informal sector and suffer from tax evasion. All these factors combined make studying the relationship between corruption, inequality and informality in that region of particular interest.

1.2 Data and Variables

Panel data set was assembled using data from the World Bank development database, the World Bank informal economy database, and Transparency International. Data is annual for the years 2003-2018. The countries are Russia, Bulgaria, Czech Republic, Hungary, Poland, Ukraine, Romania, Belarus, Estonia, Latvia, Lithuania, Georgia, Armenia, Kazakhstan, and Slovenia. The variables collected are the Gini coefficient as a proxy for income inequality, self-employment as percentage of total employment as a proxy for size for the informal sector and level of tax evasion in the economy, Trade as percentage of GDP as a proxy for trade openness, PPP-adjsuted real GDP per capita in thousands of US dollars, FDI in billions of current US dollars, and inflation. In addition to that, data on the top 10 percent of income earners income share, bottom 40 percent income share, and the bottom 20 percent income share data were collected to calculate the Palma ratio and one more inequality measure that I refer to as the "Third ratio" in this chapter. Palma ratio is calculated by dividing the share of the top 10 percent of earners by the share of the bottom 40 percent. The Third ratio is calculated by dividing the share of the top 10 percent of earners by the share of the bottom 20 percent of income earners. This third ratio helps captures a wider income gap than the Palma ratio. The summary statistics for all these variables are found in Table 1.1

Other corruption, tax evasion, and informality related measures used in the the analysis are:

1. Transparency International's **Corruption Perception Index (CPI)**: the data on the CPI is available via the Transparency International website. The CPI is a number between 0 (highly corrupt) and 10 (very clean) reflecting the level of corruption in the public sector in each country.

2. **The Multiple Indicator Multiple Causes Model (MIMIC)**: which is a structural model used to estimate the size of the informal economy in each country. The standard model was developed by Schneider et al (2010) paper. Figure 1.4 shows the details of

what variables go into the structural estimation of the size of the informal economy and their sign.

3. **The C-Efficiency Ratio**: is an indicator used to measure the strength of tax compliance in an economy. The ratio's range is between 0% and 100% indicating the ratio of actual VAT collected by the government (actual revenues) to the potential VAT the could have been collected (theoretical revenues). A higher C-Efficiency ration indicates higher tax compliance (i.e: lower VAT evasion). The ratio is calculated using the following formula:

$$E^C \equiv \frac{V}{PV^\top} \tag{1.1}$$

where

$$PV^\top = \tau^S(FC - V). \tag{1.2}$$

The numerator V is actual VAT revenue, and the denominator $PV^\top$ is theoretical VAT revenue calculated as the product of the standard rate of VAT τ^S, and final consumption FC.

1.3 Methodology

In this section, the methodology is discussed at an abstract level. As my benchmark model, I will be using a fixed effect model with country and year fixed effects. For the threshold analysis, I resort to Hansen (1999) threshold regression model as a methodological base for this study. The Hansen (1999) methodology is as follows:

Consider a following simple regression equation:

$$y_{it} = \mu_i + \beta_1 x_{it} I[q_t \leq \gamma] + \beta_2 x_{it} I[q_{it} > \gamma] + e_{it} \tag{1.3}$$

where:

y_{it} is the dependent variable for country i at time t;

x_{it} is a vector of predictor variables for country i at time t;

q_{it} is a threshold variable for country i at time t;

γ is a threshold value;

$I[q_{it} \leq \gamma]$ is an indicator function that is equal to 1 when $q_{it} \leq \gamma$ and equals 0 otherwise;

$I[q_{it} > \gamma]$ is an indicator function that is equal to 1 when $q_{it} > \gamma$ and equals 0 otherwise.

The null hypothesis of the test is

$$H_0 : \beta_{1i} = \beta_{2i}$$

If the null hypothesis has been rejected, then the threshold effect has been established. The threshold value can be found by estimating equation (1.3) though finding the minimum one of the sums of squared errors in a threshold variable. Under the null hypothesis, the distribution of the p-value statistic is uniform, and this transformation can be calculated via bootstraping. One thing to keep in my that after testing for the existence of a first threshold, we test the existence of a double threshold model, and so on. The resulting estimates $\hat{\beta}_1$ and $\hat{\beta}_2$ represent the effect of the independent variable on the dependent variable below and above the established statistically significant thresholds.

For more information about the methodology, refer to the highly cited Hansen (1999) paper.

1.4 Empirical Analysis

In this section, I will empirically study the corruption and income inequality relationship and its dependency on the size of the informal economy. I will perform the analysis using measures for different types of corruption, firstly, corruption in the public sector, and secondly, tax evasion. For the case of tax evasion, I will consider the case of tax evasion at the bottom (by choosing to work in the informal economy), and tax evasion at the top where I consider

the case of VAT evasion which usually takes place either by suppressing sales or inflating purchases.

1.4.1 Public Sector Corruption and Income Inequality

In this subsection, I use the Corruption Perception Index (CPI) to measure public sector corruption and three different measures of income inequality that were discussed in more details in section 1.2. We can see that these measure of inequality are positively correlated as shown by Figure 1.1.

I start this empirical investigation by producing few simple plots. Figure 1.2 shows a scatter plot with the corruption perception index on the x-axis and the Gini coefficient at the y-axis. It is immediately noticeable that there is no clear pattern, in the sense it is hard to spot any positive or negative co-movement between the two variables in the panel. Producing similar plots using two other measure of income inequality in figure 1.3 shows similar clouds of data point with no clearly identifiable relationship.

Now lets consider Table 1.2. When I take the mean value for the self-employment share of total employment (proxy for informal sector size) in the panel (20.71%) and calculate the correlation coefficient between it and different measures of inequality; I find that when self-employment share is below 20.71% the correlation coefficients are positive in all the three cases while when the share is below 20.71% the correlation becomes negative. This simple exercises motivates the need to explore the corruption-inequality relationship in more details and motivates the potential need for threshold estimations.

Next, I will be consider two different regression models to explore the relationship between corruption on inequality in the panel. Also, for robustness, I will be using three different measures of inequality. The first model to serve as a benchmark model is the fixed effect model. The second model utilized will be the threshold regression model developed in Hansen (1999) which is outlined section 1.3 of this chapter. For both models I will be clustering standard errors by having 15 clusters for each of the countries in the panel. However, due

to having a low number of clusters (less than 40 clusters), potential bias might occur in the standard error (Angrist and Pischke, 2009). Hence, in the regression tables found the end of this chapter, I will be reporting results with both cluster-adjusted and regular standard errors.

I use control variables that are standard in the literature as in Andres and Ramlogan-Dobson (2011), and Dobson and Dobson(2012). The control variables are: Trade as percentage of GDP (proxy for openness), real GDP per capita, FDI, and inflation rate.

The two models look as follows:

1. **Fixed Effect Model (Year and Country):**

$$\begin{aligned}
&\text{Inequality}_{\ it} = \mu_i + \lambda_t + \delta_1 \text{ Corruption}_{\ i,t} + \delta_2 \text{ Corruption}_{\ i,t-1} + \delta_3 \text{ Corruption}_{\ i,t-2} + \delta_4 \text{ Corruption}_{\ i,t-3} \\
&+ \delta_5 \text{IS}_{\ i,t} + \delta_6 IS_{i,t-1} + \delta_7 \text{ IS}_{\ i,t-2} + \delta_8 IS_{i,t-3} \\
&+ \delta_9 \text{ Inflation}_{\ i,t} + \delta_{10} \text{ Inflation}_{\ i,t-1} + \delta_{11} \text{ Inflation}_{\ i,t-2} + \delta_{12} \text{ Inflation}_{\ i,t-3} \\
&+ \delta_{13} \text{ OPEN}_{\ i,t} + \delta_{14} \text{ OPEN}_{\ i,t-1} + \delta_{15} \text{ OPEN}_{\ i,t-2} + \delta_{16} \text{ OPEN}_{\ i,t-3} \\
&+ \delta_{17} RGDP_{i,t} + \delta_{18} RGDP_{i,t-1} + \delta_{19} RGDP_{i,t-2} + \delta_{20} RGDP_{i,t-3} \\
&+ \delta_{21} FDI_{i,t} + \delta_{22} FDI_{i,t-1} + \delta_{23} FDI_{i,t-2} + \delta_{24} FDI_{i,t-3} + e_{it}
\end{aligned} \tag{1.4}$$

μ_i captures country fixed effects, λ_t captures year fixed effect, and $IS_{i,t}$ refers to informal sector size of country i at time t. The results from estimating this fixed effects model with country and year fixed effects is shown in Table 1.3. Despite the lack of statistical significance, we can notice that corruption (measured by CPI $\times$ -1) and income inequality are positively associated. This positive relationship is in line with what was previously documented in the literature summarized in section 1.2. Moreover, we can see form Table 1.3 that trade openness has a positive and statistically significant association with two of the three inequality measures, real GDP per capita has negative and statistically significant association with all of the inequality measures, while lagged FDI seems to have a statistically significant association with the third ratio.

2. **Threshold Model:**

Given the different signs of correlations found in the exercises in Table 1.2, I will be investigating the existence of statistically significant informality threshold and if the the relationship between corruption and inequality differs below/above these threshold. The model I estimate in this case which I will refer to as the threshold model is shown by equation 1.5 below.

$$
\begin{aligned}
&Inequality_{it} = \mu_i + \lambda_t \\
&+ \beta_1 \,\text{Corruption}_{i,t}\, I\left[IS_{i,t} \leq \eta_1\right] + \beta_2 \,\text{Corruption}_{i,t}\, I\left[\eta_1 < IS_{it} < \eta_2\right] + \beta_3 \,\text{Corruption}_{i,t}\, I\left[IS_{it} > \eta_2\right] \\
&+ \delta_1 IS_{i,t} + \delta_2 IS_{i,t-1} + \delta_3 IS_{i,t-2} + \delta_4 IS_{i,t-3} \\
&+ \delta_5 \text{ Inflation }_{i,t} + \delta_6 \text{ Inflation }_{i,t-1} + \delta_7 \text{ Inflation }_{i,t-2} + \delta_8 \text{ Inflation }_{i,t-3} \\
&+ \delta_9 \text{ OPEN }_{i,t} + \delta_{10} \text{ OPEN }_{i,t-1} + \delta_{11} \text{ OPEN }_{i,t-2} + \delta_{12} \text{ OPEN }_{i,t-3} \\
&+ \delta_{13} RGDP_{i,t} + \delta_{14} RGDP_{i,t-1} + \delta_{15} RGDP_{i,t-2} + \delta_{16} RGDP_{i,t-3} \\
&+ \delta_{17} FDI_{i,t} + \delta_{18} FDI_{i,t-1} + \delta_{19} FDI_{i,t-2} + \delta_{20} FDI_{i,t-3} + e_{it}
\end{aligned}
\tag{1.5}
$$

η_1 and η_2 refer to the statistically significant thresholds. Again, as explained in section 1.3. The first step is to test the existence of statically significant thresholds for the size of the informal sector. The results are tabulated in Tables 1.4, 1.5 and 1.6. Each table represents the the findings for different measures of inequality.

When inequality is measured by the Gini coefficient, there exists two statistically significant informality thresholds (at 12.33% and 35.39% informality size). When inequality is measured by the Third Ratio, I find that there exists two statistically significant informality thresholds (at 12.33% and 35.17%). When inequality is measured by the Palma ratio, I find that there exists no statistically significant threshold which leads me to not include that case in the regression analysis.

The estimated coefficients for the threshold regression model are shown in Table 1.7. For

the case of Gini coefficient, we can clearly see the existence of statistically significant positive association between corruption and income inequality when informality size is below 35.39% and a statistically significant negative association when informality size is above 35.39%. We finds similar results for the case when the Third Ratio is used to measure income inequality with the threhsold being 35.17%.

Hence, unlike the fixed effects regression that yielded an unclear relationship, threshold regression analysis established the existence of a non-linear relationship between corruption and inequality and demonstrated that this relationship is indeed informality-size dependent.

1.4.2 Tax Evasion and Income Inequality

A question that comes to mind is: does the relationship still hold if we define corruption not as a corruption in the public sector but rather as tax evasion by workers and businesses?

To answer this, I utilize this subsection to explore the relationship between different measures of tax evasion and the three different measures of income inequality used in the previous section. The goal to explore whether this relationship also exhibits non-linearity and whether it depends the size of the informal sector in the economy. Two types of tax evasion will be considered. First type is what I will be referring to as tax evasion at the bottom (i.e, by agents evading tax payments through choosing to work in the informal economy), and a second type of evasion that I will be referring to as tax evasion at the top where I consider the case of VAT evasion which usually happens by agents suppressing sales or inflating purchases. The data used in this subsection is annual for the years 2006-2018 and exclude Armenia from the panel due to data availability issues.

- **Tax Evasion at the Bottom**

  As previously mentioned, I define tax evasion at the bottom as tax evasion by the workers working in the informal economy. By definition, informal activities are not registered activities and hence are not subject to taxation. Here, we can use similar

proxies that we use to capture the size of the informal sector size to capture the percentage of worker who evade paying taxes by being informal sector participants.

First, I start by choosing self employment as percentage of total employment as my proxy for both tax evasion at the bottom (independent variable) and the size of the informal sector (threshold variable), I do not find any statistically significant threshold when I utilize the Hansen (1999) methodology.

Therefore, I resort to using a different measure of informal size to use as a threshold variable in my estimation. In particular, I utilize the Multiple Indicators Multiple Causes model (MIMIC) that uses structural estimations to estimate the size of the informal economy (refer to section 1.2 and Figure 1.4 for more information on the MIMIC model).

In this case, I was able to find that there exists a statistically significant informality size threshold (measured using MIMIC) at 32.69% when Gini coefficient and the Third Ratio are used to measure inequality. When Palma ratio is used, the statistically significant informality size threshold is 32.35%.

Hence, the single threshold model could be written as:

$$
\begin{aligned}
&Inequality_{it} = \mu_i + \lambda_t \\
&+ \beta_1 \text{ TaxEvasion}_{i,t-1} I\left[IS_{i,t} \leq \eta\right] + \beta_2 \text{ TaxEvasion}_{i,t-1} I\left[IS_{it} > \eta\right] \\
&+ \delta_5 \text{ Inflation }_{i,t} + \delta_6 \text{ Inflation }_{i,t-1} + \delta_7 \text{ Inflation }_{i,t-2} + \delta_8 \text{ Inflation }_{i,t-3} \\
&+ \delta_9 \text{ OPEN }_{i,t} + \delta_{10} \text{ OPEN }_{i,t-1} + \delta_{11} \text{ OPEN }_{i,t-2} + \delta_{12} \text{ OPEN }_{i,t-3} \\
&+ \delta_{13} RGDP_{i,t} + \delta_{14} RGDP_{i,t-1} + \delta_{15} RGDP_{i,t-2} + \delta_{16} RGDP_{i,t-3} \\
&+ \delta_{17} FDI_{i,t} + \delta_{18} FDI_{i,t-1} + \delta_{19} FDI_{i,t-2} + \delta_{20} FDI_{i,t-3} + e_{it}
\end{aligned}
\tag{1.6}
$$

Table 1.8 shows the estimated coefficients when running this model for three different measures of inequality as the dependent variable. The results in Table 1.8 is similar

to what was found when CPI was used to measure corruption, i.e: a non-linear relationship between tax evasion and income inequality that depends on the size of the informal sector. When informal sector is below the threshold point, more tax evasion is associated with more income inequality, while when informality is large, there seems to be a trade-off between tax evasion and inequality.

This result could be due to the fact that if the informal sector is large (i.e: above the estimated threshold) and the government decided to reduce tax evasion, we expect these policies to have a larger negative effect on the income of informal sector workers than their formal counterparts leading to a widening income gap between top earners who usually work in the formal sectors and poorer individuals in the informal one. However, when informal sector size is small, the effect of widening inequality due stronger tax system could be offset from the benefits to formal sector firms that higher taxes bring in form of productivity-enhancing public investments that are more accessible for the formal agents in an economy (Chatterjee et al, 2021). I integrate this intuition in the theoretical model I develop in chapter 2 of this dissertation to explain the non-linearity in the evasion-inequality relationship.

When running the same model but utilizing Mimic informality estimates as both independent and threshold variable, I find one statistically significant threshold below which higher tax evasion is associated with higher income inequality, and above which the association seems to be unclear (no statistical significance). The results could be found in Table 1.9.

- **Tax Evasion at the Top**

  In this study, I define tax evasion at the top as tax evasion by agents who operate within the boundaries of the formal economy. I specifically use measurement of VAT evasion to capture the tax evasion by businesses who usually evade VAT payments by suppressing sales or inflating purchases. I use the C-Efficiency ratio that is explained

in details in section 1.2 to capture measure VAT evasion. A higher C-efficiency ratio means higher VAT compliance (lower VAT evasion) and vise versa.

When I use the self-employment as percentage of GDP as a proxy for inequality, I find that there exists no statistically significant threshold for informal sector size.

Hence, I will resort to using a different measure of informal sector size by utilizing the Multiple Indicators Multiple Causes model (MIMIC) that uses structural estimations to estimate the size of the informal economy (check section 1.2 and Figure 1.4 for more information).

When I use the MIMIC model to measure informality, I find that there exist a single statistically significant informality threshold of 32.69%. The single threshold model I estimate:

$$
\begin{aligned}
&Inequality_{it} = \mu_i + \lambda_t \\
&+ \beta_1 \,\text{CEFFICIENCY}_{i,t-1}\, I\left[IS_{i,t} \leq \eta\right] + \beta_2 \,\text{CEFFICIENCY}_{i,t-1}\, I\left[IS_{it} > \eta\right] \\
&+ \delta_5 \text{ Inflation }_{i,t} + \delta_6 \text{ Inflation }_{i,t-1} + \delta_7 \text{ Inflation }_{i,t-2} + \delta_8 \text{ Inflation }_{i,t-3} \\
&+ \delta_9 \text{ OPEN }_{i,t} + \delta_{10} \text{ OPEN }_{i,t-1} + \delta_{11} \text{ OPEN }_{i,t-2} + \delta_{12} \text{ OPEN }_{i,t-3} \\
&+ \delta_{13} RGDP_{i,t} + \delta_{14} RGDP_{i,t-1} + \delta_{15} RGDP_{i,t-2} + \delta_{16} RGDP_{i,t-3} \\
&+ \delta_{17} FDI_{i,t} + \delta_{18} FDI_{i,t-1} + \delta_{19} FDI_{i,t-2} + \delta_{20} FDI_{i,t-3} + e_{it}
\end{aligned}
\tag{1.7}
$$

The estimated regression coefficients are reported in Table 1.10. What I find is that higher VAT compliance (less VAT evasion) is associated with higher income inequality (using all three measures), particularly when informal sector size is below the threshold on 32.69% as the coefficient are positive statistically significant. This is opposite of the result found for the tax evasion at the bottom where evasion and inequality are positively associated at low informality size. This could be due to the fact that more evasion at the top means less tax revenues (and hence less government spending on

productivity-enhancing public investments), and since formal businesses who evade VAT are also the same businesses that benefit more from public investments, then they would reap the benefits of more compliance through utilizing public investment in their production more efficiently than their informal sector counterparts (Chatterjee et al,2021) shows similar intuition for the case of Indian firms where they find that increasing public investment spending enhances formal sector firms productivity while having no effect on informal sector firms. I integrate this intuition in one of the assumptions in the theoretical model I develop in chapter 2 of this dissertation.

1.5 Conclusion

In the first chapter of this dissertation, I examined using a panel data from 15 Eastern European countries the relationship between corruption and income inequality and its dependence on the size of the informal sector in the economy. The findings suggest the existence of a non-linear relationship whose sign depends on the size of the informal sector in the ecomomy. Using Hansen (1999) threshold regression methodology, statistically significant informality size thresholds were found below which the relationship between corruption and inequality is positive and above which there exists a corruption-inequality trade-off. The results are robust when one measure of corruption captures public sector corruption and when the measure of corruption captures tax evasion by the workers in the shadow economy. The results are also robust using three different measures income inequality. However, when corruption is measured by the magnitude of VAT evasion (evasion at the top by formal sectors), the relationship found is negative.To better understand the intuition behind some of these findings, I use chapter 2 of this dissertation to develop a novel theoretical macroeconomic model to explain the non-linearity in the tax evasion at the bottom and income inequality relationship and how it depends on the size of the informal sector.

Tables

Table 1.1: Summary Statistics (Panel Data)

	Annual Data	#Observations	Mean	Min.	Max.	S.D.
Gini index	$2003-2018$	240	32.33	23.7	45.9	5.12
Palma Ratio	$2003-2018$	240	0.85	0.60	1.30	0.15
Third Ratio	$2003-2018$	240	3.54	1.87	8.25	1.15
Corruption Perception Index (CPI)	$2003-2018$	240	4.26	1.8	7.3	1.39
Self-Employment (as % of GDP)	$2003-2018$	240	20.71	3.97	66.23	14.66
Inflation Rate	$2003-2018$	240	5.74	-1.54	59.21	7.22
Trade Openness	$2003-2018$	240	106.5	46.28	169.5	32.9
Real GDP	$2003-2018$	240	18.94	4.04	41.13	8.20
FDI	$2003-2018$	240	6.74	-64.70	75.1	13.9

Table 1.2: Simple Correlations

	Correlation Coefficient		
	Gini	Palma Ratio	Third Ratio
Self Employment $< 20.71\%$	0.14	0.17	0.12
Self Employment $> 20.71\%$	-0.23	-0.10	-0.18

Table 1.3: Regression Results

Fixed Effect Model

	Gini	**Palma**	**Third Ratio**	**Gini**	**Palma**	**Third Ratio**
$Corruption_t$	0.180	0.004	0.056	0.180	0.004	0.056
	(0.73)	(0.83)	(0.68)	(0.71)	(0.77)	(0.66)
$Corruption_{t-1}$	0.360	0.012	0.095	0.360	0.012	0.095
	(0.62)	(0.66)	(0.62)	(0.57)	(0.49)	(0.53)
$Corruption_{t-2}$	0.070	0.010	-0.088	0.070	0.010	-0.088
	(0.92)	(0.75)	(0.64)	(0.91)	(0.64)	(0.49)
$Corruption_{t-3}$	0.29	0.016	0.099	0.29	0.016	0.099
	(0.57)	(0.44)	(0.46)	(0.44)	(0.26)	(0.33)
$SelfEmployment_t$	-0.150	-.006	-.038	-0.150	-.006	-.038
	(0.28)	(0.31)	(0.32)	(0.17)	(0.25)	(0.26)
$SelfEmployment_{t-1}$	-.020	0.006	-0.008	-.020	0.006	-0.008
	(0.92)	(0.41)	(0.87)	(0.92)	(0.35)	(0.87)
$SelfEmployment_{t-2}$	0.014	0.006	0.028	0.014	0.006	0.028
	(0.44)	(0.40)	(0.56)	(0.10)	(0.064)	(0.35)
$SelfEmployment_{t-3}$	0.070	0.008	0.060*	0.070	0.008	0.063
	(0.58)	(0.11)	(0.08)	(0.73)	(0.315)	(0.33)
$Inflation_t$	-0.004	-0.001	-0.001	-0.004	-0.001	-0.001
	(0.86)	(0.63)	(0.85)	(0.81)	(0.49)	(0.75)
$Inflation_{t-1}$	0.007	0.001	0.003	0.007	0.001	0.003
	(0.83)	(0.69)	(0.70)	(0.56)	(0.26)	(0.31)
$Inflation_{t-2}$	-0.013	-0.0001	0.0005	-0.013	-0.0001	0.0005
	(0.65)	(0.90)	(0.95)	(0.64)	(0.91)	(0.95)
$Inflation_{t-3}$	0.003	0.0001	0.0005	0.003	0.0001	0.0005
	(0.79)	(0.79)	(0.90)	(0.73)	(0.70)	(0.85)
$TradeOpenness_t$	0.002	0.0003	-0.001**	0.002	0.0003	-0.001**
	(0.93)	(0.74)	(0.87)	(0.93)	(0.72)	(0.87)
$TradeOpenness_{t-1}$	0.0014	0.0003	0.002**	0.0014	0.0003	0.002**
	(0.65)	(0.77)	(0.85)	(0.47)	(0.65)	(0.78)
$TradeOpenness_{t-2}$	0.015	0.0002	0.001**	0.015	0.0002	0.001**
	(0.62)	(0.83)	(0.90)	(0.50)	(0.79)	(0.83)
$TradeOpenness_{t-3}$	0.047**	0.001*	0.009	0.047**	0.001**	0.009**
	(0.03)	(0.05)	(0.11)	(0.01)	(0.02)	(0.03)
$RealGDP_t$	-0.42*	-0.015*	-0.11*	-0.42**	-0.015**	-0.11**
	(0.06)	(0.08)	(0.05)	(0.01)	(0.02)	(0.00)
$RealGDP_{t-1}$	0.24	0.011	0.08	0.24**	0.011**	0.08**
	(0.50)	(0.44)	(0.41)	(0.01)	(0.03)	(0.01)
$RealGDP_{t-2}$	0.14	0.010	0.02	0.14	0.010	0.02
	(0.69)	(0.72)	(0.85)	(0.25)	(0.33)	(0.61)
$RealGDP_{t-3}$	-0.19	-0.011	-0.044	-0.19	-0.011	-0.044
	(0.40)	(0.25)	(0.47)	(0.25)	(0.12)	(0.30)
FDI_t	0.013	0.001	0.004	0.013	0.001	0.004
	(0.30)	(0.10)	(0.24)	(0.37)	(0.14)	(0.36)
FDI_{t-1}	0.007	0.0005	0.002	0.007	0.0005	0.002
	(0.62)	(0.43)	(0.61)	(0.68)	(0.53)	(0.57)
FDI_{t-2}	0.000	0.0005	-0.00003	0.000	0.0005	-0.00003
	(0.99)	(0.48)	(0.99)	(0.99)	(0.36)	(0.99)
FDI_{t-3}	-0.005	0.0001	-0.003**	-0.005	0.0001	-0.003**
	(0.71)	(0.97)	(0.41)	(0.44)	(0.94)	(0.12)
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Clustering	NO	NO	NO	Country	Country	Country
N	240	240	240	240	240	240
R^2	0.39	0.35	0.40	0.40	0.35	0.40

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 1.4: Threshold Estimation: Gini coefficient as dependent variable

	ν_1	ν_2	ν_3	p-value
Single Threshold Model	35.39%			0.007
Double Threshold Model	12.33%	35.39%		0.06
Triple Threshold Model	12.33%	20.72%	35.39%	0.71

Table 1.5: Threshold Estimation: Palma Ratio as dependent variable

	ν_1	ν_2	ν_3	p-value
Single Threshold Model	35.17%			0.42
Double Threshold Model				
Triple Threshold Model				

Table 1.6: Threshold Estimation: Third Threshold as dependent variable

	ν_1	ν_2	ν_3	p-value
Single Threshold Model	35.17%			0.05
Double Threshold Model	12.33%	35.17%		0.01
Triple Threshold Model	12.33%	29.49%	35.17%	0.73

Table 1.7: Regression Results

Threshold Model

	Gini	**Third Ratio**	**Gini**	**Third Ratio**
$Corruption_t, IS_{it} \leq \nu_1$	0.700**	0.079	0.700**	0.079
	(0.034)	(0.34)	(0.032)	(0.46)
$Corruption_t, \nu_1 < IS_{it} < \nu_2$	1.173***	0.211***	1.173***	0.211**
	(0.00)	(0.005)	(0.00)	(0.01)
$Corruption_t, IS_{it} \geq \nu_2$	-0.691**	-0.195**	-0.691*	-0.195*
	(0.027)	(0.01)	(0.05)	(0.06)
$SelfEmployment_t$	-0.051	-0.025	-0.051	-0.025
	(0.68)	(0.43)	(0.69)	(0.56)
$SelfEmployment_{t-1}$	0.187	0.072	0.187	0.072
	(0.27)	(0.11)	(0.28)	(0.14)
$SelfEmployment_{t-2}$	-0.051	-0.039	-0.051	-0.039
	(0.75)	(0.36)	(0.67)	(0.19)
$SelfEmployment_{t-3}$	0.042	0.059*	0.042	0.059
	(0.72)	(0.06)	(0.80)	(0.23)
$Inflation_t$	-1.249	-0.005	-1.249	-0.005
	(0.36)	(0.47)	(0.22)	(0.28)
$Inflation_{t-1}$	-1.249	-0.002	-1.249	-0.002
	(0.72)	(0.80)	(0.49)	(0.64)
$Inflation_{t-2}$	-1.249	-0.001	-1.249	-0.001
	(0.36)	(0.86)	(0.26)	(0.85)
$Inflation_{t-3}$	-1.249	0.001	-1.249	0.001
	(0.55)	(0.78)	(0.37)	(0.63)
$TradeOpenness_t$	-0.028	0.008	-0.028	0.008
	(0.16)	(0.14)	(0.25)	(0.24)
$TradeOpenness_{t-1}$	0.020	0.003	0.020	0.003
	(0.46)	(0.65)	(0.29)	(0.58)
$TradeOpenness_{t-2}$	0.023	0.002	0.023	0.002
	(0.39)	(0.82)	(0.32)	(0.76)
$TradeOpenness_{t-3}$	0.017	0.002	0.017	0.002
	(0.37)	(0.71)	(0.26)	(0.63)
$RealGDP_t$	-0.211	-0.052	-0.211	-0.052
	(0.28)	(0.30)	(0.17)	(0.12)
$RealGDP_{t-1}$	0.227*	0.058*	0.227*	0.058*
	(0.46)	(0.47)	(0.06)	(0.09)
$RealGDP_{t-2}$	-0.063	-0.009	-0.063	-0.009
	(0.84)	(0.91)	(0.52)	(0.77)
$RealGDP_{t-3}$	-0.043	-0.027	-0.043	-0.027
	(0.84)	(0.62)	(0.80)	(0.57)
FDI_t	0.019*	0.004*	0.019	0.004
	(0.09)	(0.09)	(0.17)	(0.23)
FDI_{t-1}	0.002	0.001	0.002	0.001
	(0.90)	(0.88)	(0.91)	(0.84)
FDI_{t-2}	0.003	0.001	0.003	0.001
	(0.81)	(0.76)	(0.77)	(0.62)
FDI_{t-3}	-0.015	-0.006**	-0.015**	-0.006**
	(0.28)	(0.11)	(0.02)	(0.01)
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Clustering	NO	NO	Country	Country
N	240	240	240	240
R^2	0.53	0.52	0.54	0.53

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 1.8: Threshold Regression Model

	Tax evasion at the Bottom					
	Gini	Palma	Third Ratio	Gini	Palma	Third Ratio
$TaxEvasion_{t-1}, IS_{it} \leq \nu$	0.204***	0.007**	0.049**	0.204	0.007	0.049
	(0.01)	(0.05)	(0.03)	(0.22)	(0.30)	(0.33)
$TaxEvasion_{t-1}, IS_{it} \geq \nu$	-0.178**	-0.009***	-0.040**	-0.178	-0.009	-0.040
	(0.04)	(0.01)	(0.1)	(0.33)	(0.23)	(0.47)
$Inflation_t$	0.005	-0.0006	-0.001	0.005	-0.0006	-0.001
	(0.81)	(0.52)	(0.84)	(0.78)	(0.51)	(0.83)
$Inflation_{t-1}$	-0.007	-0.00004	-0.0005	-0.007	-0.00004	-0.0005
	(0.72)	(0.96)	(0.93)	(0.66)	(0.95)	(0.89)
$Inflation_{t-2}$	-0.005	-0.0003	-0.002	-0.005	-0.0003	-0.002
	(0.82)	(0.78)	(0.74)	(0.71)	(0.35)	(0.45)
$Inflation_{t-3}$	-0.12	0.00006	-0.003	-0.12	0.00006	-0.003
	(0.56)	(0.95)	(0.60)	(0.58)	(0.94)	(0.57)
$TradeOpenness_t$	-0.104	0.0004	-0.0012	-0.104	0.0004	-0.0012
	(0.62)	(0.62)	(0.83)	(0.71)	(0.74)	(0.89)
$TradeOpenness_{t-1}$	0.008	0.0000	0.0016	0.008	0.000	0.0016
	(0.75)	(0.99)	(0.83)	(0.54)	(0.99)	(0.73)
$TradeOpenness_{t-2}$	0.007	0.00004	0.0007	0.007	0.00004	0.0007
	(0.76)	(0.96)	(0.92)	(0.57)	(0.92)	(0.85)
$TradeOpenness_{t-3}$	0.027	0.0006	0.0072	0.027	0.0006	0.0072
	(0.19)	(0.47)	(0.20)	(0.13)	(0.43)	(0.24)
$RealGDP_t$	-0.061	-.00008	-.0501	-0.061	-.00008	-.0501
	(0.74)	(0.99)	(0.32)	(0.63)	(0.98)	(0.18)
$RealGDP_{t-1}$	0.17	.0090	.0550	0.17*	.0090	.0550
	(0.53)	(0.45)	(0.46)	(0.30)	(0.08)	(0.23)
$RealGDP_{t-2}$	0.028	.0019	.0066	0.028	.0019	.0066
	(0.91)	(0.86)	(0.92)	(0.78)	(0.69)	(0.84)
$RealGDP_{t-3}$	-0.21	-.0134*	-.0392	-0.21*	-.0134	-.0392
	(0.23)	(0.09)	(0.43)	(0.14)	(0.05)	(0.34)
FDI_t	0.05	.00026	.0020	0.05	.00026	.0020
	(0.65)	(0.59)	(0.49)	(0.71)	(0.59)	(0.58)
FDI_{t-1}	-0.007	-.00022	-.0007	-0.007	-.00022	-.0007
	(0.51)	(0.63)	(0.79)	(0.54)	(0.65)	(0.78)
FDI_{t-2}	-0.011	-.0002	-.0016	-0.011	-.0002	-.0016
	(0.28)	(0.67)	(0.58)	(0.19)	(0.53)	(0.48)
FDI_{t-3}	-0.021*	-.0006	-.0048	-0.021*	-.0006	-.0048**
	(0.06)	(0.20)	(0.12)	(0.14)	(0.06)	(0.02)
constant	29.4	0.765	2.94	29.4	0.765	2.94
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Clustering	NO	NO	NO	Country	Country	Country
N	140	140	140	140	140	140

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 1.9: Regression Results

Tax Evasion at the Bottom

	Gini	Palma	Third Ratio	Gini	Palma	Third Ratio
$MIMIC_{t-1}, IS_{it} \leq \nu$	.474**	.014	.131**	.474*	.014	.131*
	(0.02)	(0.12)	(0.02)	(0.08)	(0.25)	(0.08)
$MIMIC_{t-1}, IS_{it} \geq \nu$	.322	.007	.091	.322	.007	.091
	(0.12)	(0.42)	(0.1)	(0.21)	(0.55)	(0.20)
$Inflation_t$	.013	-.0002	.0007	.013	-.0002	.0007
	(0.52)	(0.85)	(0.88)	(0.33)	(0.82)	(0.83)
$Inflation_{t-1}$	-.0014	.0003	.001	-.0014	.0003	.001
	(0.94)	(0.78)	(0.86)	(0.94)	(0.74)	(0.83)
$Inflation_{t-2}$	-.005	-.0002	-.0022	-.005	-.0002	-.0022
	(0.79)	(0.83)	(0.69)	(0.71)	(0.57)	(0.50)
$Inflation_{t-3}$	-.015	-.0001	-.0034	-.015	-.0001	-.0034
	(0.43)	(0.92)	(0.51)	(0.47)	(0.91)	(0.49)
$TradeOpenness_t$	-.016	.0002	-.0026	-.016	.0002	-.0026
	(0.44)	(0.79)	(0.63)	(0.56)	(0.86)	(0.76)
$TradeOpenness_{t-1}$	-.0002	-.0004	-.0004	-.0002	-.0004	-.0004
	(0.99)	(0.72)	(0.94)	(0.98)	(0.70)	(0.93)
$TradeOpenness_{t-2}$	.015	.0003	.0028	.015	.0003	.0028
	(0.56)	(0.78)	(0.68)	(0.36)	(0.60)	(0.55)
$TradeOpenness_{t-3}$	.021	.0003	.0055	.021	.0003	.0055
	(0.28)	(0.71)	(0.30)	(0.30)	(0.73)	(0.39)
$RealGDP_t$	-.108	-.0017	-.0594	-.108	-.0017	-.0594
	(0.55)	(0.82)	(0.21)	(0.41)	(0.76)	(0.14)
$RealGDP_{t-1}$	.203	.010*	.0645	.203	.010*	.0645
	(0.45)	(0.40)	(0.37)	(0.25)	(0.059)	(0.18)
$RealGDP_{t-2}$	-.0107	.0002	-.0037	-.0107	.0002	-.0037
	(0.96)	(0.98)	(0.95)	(0.92)	(0.96)	(0.92)
$RealGDP_{t-3}$	-.1946	-.0124	-.0315	-.1946	-.0124	-.0315
	(0.28)	(0.11)	(0.51)	(0.26)	(0.1)	(0.50)
FDI_t	.008	.0004	.0028	.008	.0004	.0028
	(0.46)	(0.38)	(0.33)	(0.58)	(0.46)	(0.49)
FDI_{t-1}	-.002	-.0001	.0003	-.002	-.0001	.0003
	(0.81)	(0.92)	(0.90)	(0.84)	(0.93)	(0.91)
FDI_{t-2}	-.0069	-.00003	-.0003	-.0069	-.00003	-.0003
	(0.53)	(0.94)	(0.90)	(0.48)	(0.93)	(0.88)
FDI_{t-3}	-.015	-.0004	-.0035**	-.015**	-.0004	-.0035**
	(0.16)	(0.40)	(0.23)	(0.043)	(0.13)	(0.03)
constant	17.09	.44	-.62	17.01	.44	-.62
	(0.03)	(0.19)	(0.76)	(0.1)	(0.30)	(0.81)
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Clustering	NO	NO	NO	Country	Country	Country
N	140	140	140	140	140	140

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 1.10: Regression Results

Tax Evasion at the Top

	Gini	Palma	Third Ratio	Gini	Palma	Third Ratio
$CEFFICIENCY_{t-1}, IS_{it} \leq \nu$	4.68*	0.23**	1.49**	4.68*	0.23**	1.49***
	(0.06)	(0.03)	(0.02)	(0.05)	(0.03)	(0.006)
$CEFFICIENCY_{t-1}, IS_{it} \geq \nu$	-1.41	-0.05	-0.10	-1.41	-0.05	-0.10
	(0.54)	(0.60)	(0.87)	(0.51)	(0.58)	(0.81)
$Inflation_t$	.0151	-.0001	.0013	.0151	-.0001	.0013
	(0.45)	(0.93)	(0.80)	(0.29)	(0.91)	(0.73)
$Inflation_{t-1}$	-.0022	.0003	.0007	-.0022	.0003	.0007
	(0.92)	(0.78)	(0.90)	(0.91)	(0.75)	(0.88)
$Inflation_{t-2}$	-.0023	-.0001	-.0012	-.0023	-.0001	-.0012
	(0.91)	(0.89)	(0.82)	(0.88)	(0.74)	(0.70)
$Inflation_{t-3}$	-.0159	-.0001	-.0035	-.0159	-.0001	-.0035
	(0.43)	(0.93)	(0.51)	(0.50)	(0.92)	(0.52)
$TradeOpenness_t$	-.0190	.0001	-.0028	-.0190	.0001	-.0028
	(0.38)	(0.89)	(0.61)	(0.54)	(0.93)	(0.75)
$TradeOpenness_{t-1}$	-.0011	-.0005	-.0001	-.0011	-.0005	-.0001
	(0.96)	(0.67)	(0.98)	(0.94)	(0.67)	(0.98)
$TradeOpenness_{t-2}$	.0096	.0002	.0014	.0096	.0002	.0014
	(0.71)	(0.87)	(0.83)	(0.56)	(0.76)	(0.74)
$TradeOpenness_{t-3}$	.020	.0003	.0058	.020	.0003	.0058
	(0.32)	(0.77)	(0.28)	(0.23)	(0.77)	(0.30)
$RealGDP_t$	-.0855	-.0013	-.0560	-.0855	-.0013	-.0560
	(0.64)	(0.86)	(0.25)	(0.53)	(0.83)	(0.16)
$RealGDP_{t-1}$	.136	.0082	.0458	.136	.0082	.0458
	(0.61)	(0.48)	(0.52)	(0.41)	(0.13)	(0.26)
$RealGDP_{t-2}$	.0019	.0004	-.0020	.0019	.0004	-.0020
	(0.99)	(0.97)	(0.97)	(0.98)	(0.93)	(0.95)
$RealGDP_{t-3}$	-.1898	-.0123	-.0261	-.1898	-.0123*	-.0261
	(0.30)	(0.12)	(0.59)	(0.27)	(0.09)	(0.59)
FDI_t	.0081	.0004	.0028	.0081	.0004	.0028
	(0.46)	(0.37)	(0.34)	(0.57)	(0.44)	(0.49)
FDI_{t-1}	-.0034	-.0001	.00004	-.0034	-.0001	.00004
	(0.74)	(0.89)	(0.98)	(0.78)	(0.91)	(0.98)
FDI_{t-2}	-.0089	-.0001	-.0010	-.0089	-.0001	-.0010
	(0.42)	(0.87)	(0.73)	(0.38)	(0.85)	(0.70)
FDI_{t-3}	-.0160	-.0004	-.0037	-.0160**	-.0004	-.0037**
	(0.16)	(0.40)	(0.21)	(0.04)	(0.16)	(0.04)
constant	30.79	.78	2.85	30.79	.78	2.85
	(0.00)	(0.00)	(0.008)	(0.00)	(0.002)	(0.02)
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Clustering	NO	NO	NO	Country	Country	Country
N	140	140	140	140	140	140

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Figures

Figure 1.1: Positive correlation between different measures of inequality

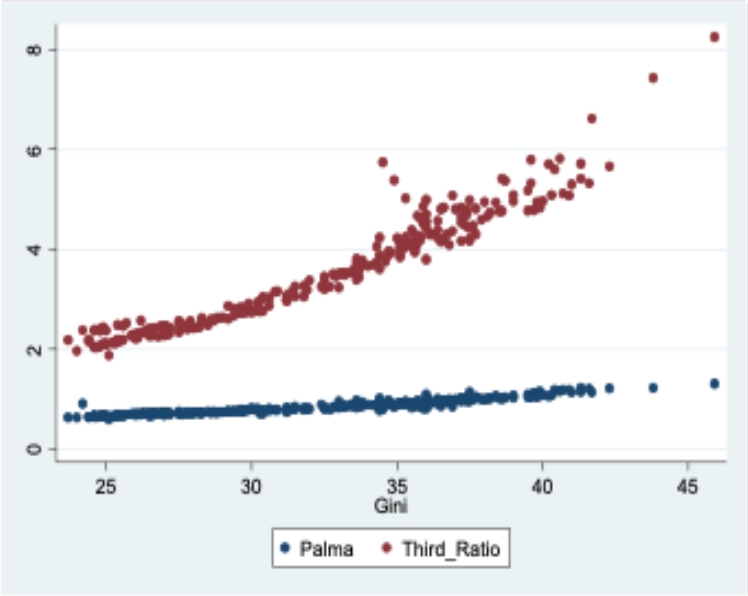


Figure 1.2: No clear relationship between Corruption Perception Index and Gini coefficient

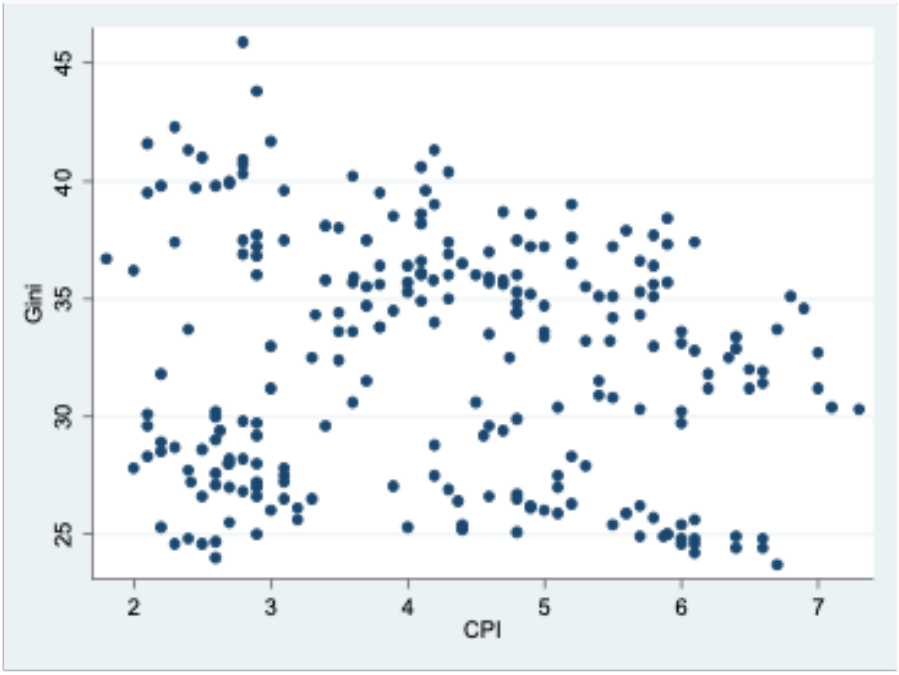


Figure 1.3: No clear relationship between Corruption Perception Index and other measures of income inequality

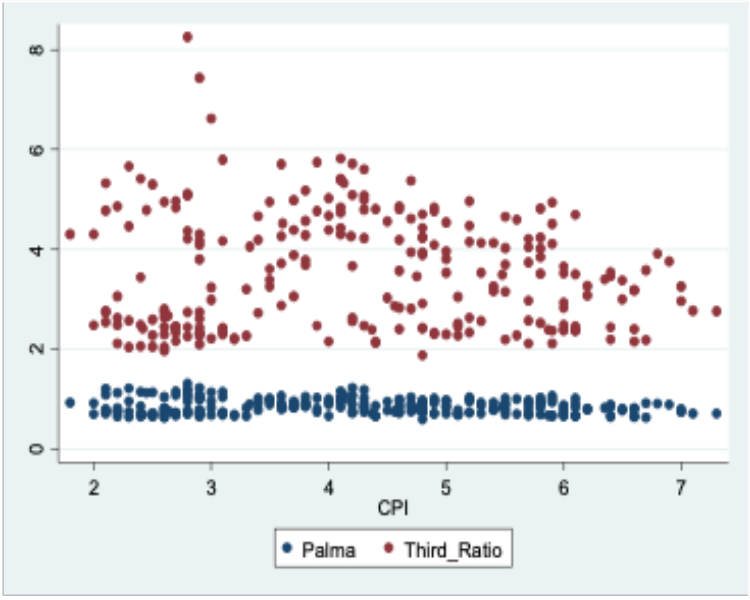
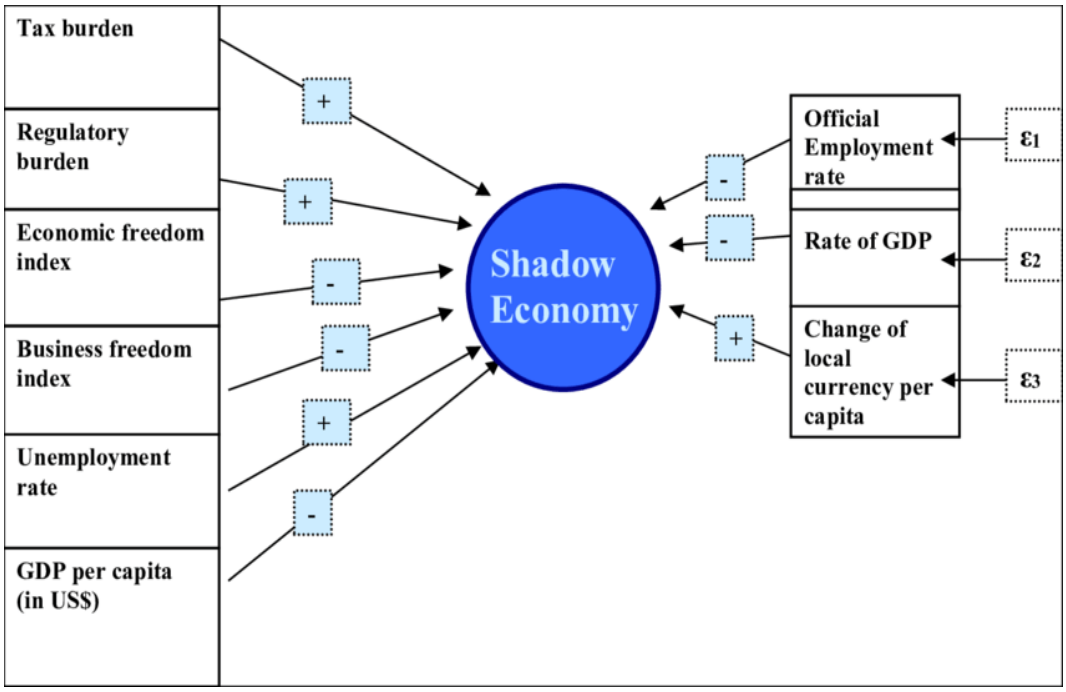


Figure 1.4: MIMIC: The Multiple Indicators Multiple Causes model



Source: Medina and Schneider (2018)

Tax Evasion, Inequality, and the Informal Sector: a Theoretical Exploration

2 Chapter 2

2.1 Motivation

In the first chapter of this dissertation, I empirically demonstrated the existence of a statistically significant informal sector size threshold below/above which the relationship between tax evasion and income inequality is positive/negative respectively for a panel of ex-Eastern Bloc countries.

In this chapter, I develop a one-period static macroeconomic model to explain the intuition behind the empirical non-linearity result. This model adopts few elements from Loayza (1996) and Loayza (2016) models and adapt them for the purposes of this research. To the best of my knowledge, at the time of writing this chapter, this is the first theoretical work that explores the non-linearity in the relationship between tax evasion and income inequality.

The intuition behind the model I am going to introduce in this chapter is as follows: the relationship between the level of tax evasion in the economy and income inequality can be positive or negative. The sign of the relationship depends on the size of the formal versus informal sector in the economy. There are multiple channels that produce either a positive or a negative relationship between evasion and inequality and they can be summarized as follows:

First, the positive channel: less tax evasion through an increased tax enforcement system strength is achieved through an increase in spending on the tax enforcement system by the government. This lead to less resources allocated towards public investment spending. In this model, I assume that formal firms utilize public investment spending more efficiently in their production process. Hence, a decrease in government public investment spending hurts the productivity of the producers in the formal sector relatively more. This results in

a more negative effect on the formal firm's disposable income relative to the informal firm's disposable income. In other words, this leads to lower income gap between workers in the formal and informal sectors.

Second, the negative channel: less tax evasion through an increased tax enforcement system strength leads to; firstly an increase in informality costs (i.e: hiding costs when evading taxes) incurred by the producers in the informal sector. A second effect of such a stronger enforcement system is the increase in formal sector size due to the existence of a stronger tax enforcement system. This leads to higher tax revenues in the government's coffers to spend on productivity enhancing public investments which has relatively higher positive effect on formal producer productivity. In other words, this leads to higher income gap between workers in the formal and informal sectors. The sign of the relationship between tax evasion and income inequality depends on which of these two channels is the more dominant channel. If the informal sector size exceeds a specific threshold point, we find that the negative channel dominates the positive one and vise versa. This theoretical construct helps explain the non-linear empirical relationship between tax evasion and inequality found in chapter 1 of this dissertation.

2.2 The Model Elements

The model's elements are as follows:

- There are two types of sectors: a formal sector and an informal sector.
- There are two types of household: households living in the formal sector and households living in the informal sector. I will be referring to the former as formal households and the latter as informal households throughout the rest of this chapter.
- There are two types of firms: firms producing in the formal sector and others producing in the informal sector. Formal firms pay taxes to the government and informal ones

incur informality penalty. The Informality penalty in this model represents the costs incurred by the informal firms to hide from the tax-collecting government.

- The government finances it's budget by collecting taxes from formal firms to finance: 1) public investment spending and 2) the tax enforcement system.
- As will be demonstrated in the welfare analysis part of this paper (section 2.4), the government conducts policy using two instruments: the strength of the tax enforcement system and the tax rate. A stronger tax enforcement system indicates the existence of a stronger anti-evasion policy.

2.2.1 Household Problem

There are two type of households: formal households existing in the formal sector and informal households existing in the informal economy. I am going to assume the existence of a population continuum between [0,1] where households [0,a] are formal and [a,1] are informal.

Formal households gain utility from consumption and disutility from labor supplied in the formal sectors. Formal households maximize:

$$\mathbb{U}\left(C_F, L_F\right) = \frac{C_F^{1-\theta}}{1-\theta} - \frac{L_F^{1+\mu}}{1+\mu} \tag{2.1}$$

subject to:

$$C_F \leq W_F L_F \tag{2.2}$$

Informal households gain utility from consumption and disutility from labor supplied in the informal sectors. Informal households maximize:

$$\mathbb{U}\left(C_I, L_I\right) = \frac{C_I^{1-\theta}}{1-\theta} - \frac{L_I^{1+\mu}}{1+\mu} \tag{2.3}$$

subject to:

$$C_I \leq W_I L_I \tag{2.4}$$

W_F and W_I refer to wages earned in the formal sector and informal sector respectively. Solving both H.Hs' utility maximization problem yields the following allocations:

$$L_F = W_F^{\frac{1-\theta}{\mu+\theta}} \tag{2.5}$$

$$C_F = W_F^{\frac{1+\mu}{\mu+\theta}} \tag{2.6}$$

$$L_I = W_I^{\frac{1-\theta}{\mu+\theta}} \tag{2.7}$$

$$C_I = W_I^{\frac{1+\mu}{\mu+\theta}} \tag{2.8}$$

2.2.2 Production

There exist two types of production in the economy: production in the formal sector by the formal sector firms and production in the informal sector by the informal sector firms. Formal firms pay taxes to the government and informal ones incur informality penalty. Informality penalty in this model represents the costs incurred by the informal sector firms to hide from the tax-collecting government.

The output of firms in both sectors is determined according the following production functions:

$$Y_F = (1-\tau) A_F G^{\beta} L_F \tag{2.9}$$

$$Y_I = \big(1 - \pi(\lambda)\big) A_I G^{\gamma} L_I \tag{2.10}$$

where L refers to labor supply, G refers to the government public investment spending, $0 \leq \tau \leq 1$ is the tax rate, $0 \leq \pi \leq 1$ is the informality penalty rate, $0 \leq \lambda \leq 1$ represents the strength of the tax enforcement system in the economy where 0 (no enforcement)

and 1 (perfect enforcement), β and γ refer to the public investment utilization rate by the formal/informal sector firms respectively, and assuming that the formal firms utilize public investment spending in a more efficient manner than their informal counterparts (i.e: $\beta > \gamma$). This assumption has merits in the empirical literature, for example Chatterjee et al (2021) show that public investment has a positive effect on the productivity of formal firms in India but no such effect on the productivity of informal ones. Another intuitive assumption is that the derivative of the penalty rate π with respect to the tax enforcement strength λ is positive, i.e: the stronger tax enforcement is; the more costly hiding from the tax-collecting government is.

Formal and informal agents' profit functions:

$$Profit_F = (1-\tau)A_F G^{\beta} L_F - W_F L_F \tag{2.11}$$

$$Profit_I = \big(1-\pi(\lambda)\big)A_I G^{\gamma} L_I - W_I L_I \tag{2.12}$$

Solving the profit maximization problems; we obtain the following conditions:

$$W_F = (1-\tau)A_F G^{\beta} \tag{2.13}$$

$$W_I = \big(1-\pi(\lambda)\big)A_I G^{\gamma} \tag{2.14}$$

Combining the allocations from the H.H problem (equations 2.5 and 2.7), the allocations from firms' problem (equations 2.13 and 2.14), and the binding H.H problem budget constraints (equations 2.2 and 2.4), we can write the output for both sectors as a function of model parameters, and government public investment spending:

$$Y_F = C_F = W_F L_F = \left[(1-\tau)A_F G^{\beta}\right]^{\frac{1+\mu}{\mu+\theta}} \tag{2.15}$$

$$Y_I = C_I = W_F L_F = \left[\big(1-\pi(\lambda)\big)A_I G^{\gamma}\right]^{\frac{1+\mu}{\mu+\theta}} \tag{2.16}$$

2.2.3 The Government

The government finances its budget by collecting taxes from formal firms to finance its public investment spending (G) and the tax enforcement system (E). Informality penalties are assumed to be hiding cost incurred by informal firms (not fines collected by the government). Hence, it is not modeled as part of the government revenues.

Recall that we assumed that there is a population continuum between [0,1] where households [0,a] are formal sector households and [a,1] are informal sector households. The size of the formal sector $a(\lambda, \tau)$ a bivariate function determined by the policy instruments λ and τ which levels are chosen to produce the revenue level the government is targeting to finance public investment spending (G) and the tax enforcement system (E). A stronger tax enforcement system would lead to an increase in the size of the formal sector while a higher tax rate incurred by formal firms would encourage a migration to the informal sector.

The government budget constraint can be written as follows:

$$G + E = a(\lambda, \tau)\, \tau Y_F \tag{2.17}$$

Another assumption is that the government collects taxes from formal firms and spends $\zeta(\lambda)$ fraction of it on public investment spending (G) and the rest $1 - \zeta(\lambda)$ fraction on the enforcement system (E).

$$G + E = \underbrace{\zeta(\lambda)\, a(\lambda, \tau)\, \tau Y_F}_{\text{G}} + \underbrace{\big(1 - \zeta(\lambda)\big) a(\lambda, \tau)\, \tau Y_F}_{\text{E}} \tag{2.18}$$

where $0 < \zeta(\lambda) < 1$ is the share of revenues allocated to public investment spending, and assuming $\frac{d\zeta}{d\lambda} < 0$ since it is intuitive that a stronger inspection system represented by λ leads to a larger share of budget revenues going towards tax enforcement as opposed to public investment spending.

Combining the equation for public spending, household allocations, and firm allocations,

we can write public investment spending (G) as function of model parameters and policy instruments:

$$G = \Big[\zeta(\lambda) \cdot a(\lambda, \tau) \cdot \tau\Big]^{\frac{(\mu+\theta)}{(\mu+\theta)-\beta(1+\mu)}} \Big[(1-\tau)A_F\Big]^{\frac{(1+\mu)}{(\mu+\theta)-\beta(1+\mu)}} \tag{2.19}$$

2.2.4 Income Inequality

In general, workers in the informal sector earn lower wages, are less educated, and have less access to social safety nets compared to workers in the formal sector. Several empirical paper demonstrate the existence of a wage differential between the sectors (e.g: Blunch (2015), Williams and Gashi (2021), Tansel and Kan (2012); among others). Therefore, I model income inequality in this chapter as the income gap between households living in the formal sector and households living in the informal sector. Combining optimality conditions and the government constraint, we can write income inequality as function of model parameters and policy instruments:

$$V = \frac{W_F L_F}{W_I L_I} = \Big[\frac{1-\tau}{1-\pi(\lambda)} \cdot \frac{A_F}{A_I}\Big]^{\frac{1+\mu}{\mu+\theta}} \Big[\zeta(\lambda) \cdot a(\lambda, \tau) \cdot \tau\Big]^{\frac{(\beta-\gamma)(\mu+\theta)}{(\mu+\theta)-\beta(1+\mu)}} \Big[(1-\tau)A_F\Big]^{\frac{(\beta-\gamma)(1+\mu)}{(\mu+\theta)-\beta(1+\mu)}} \tag{2.20}$$

Next, I will be taking the derivatives of the expression for V with respect to policy instruments τ and λ before substituting in specific functional forms and see if anything could be said about the determinants of the signs of those derivatives. The resulting derivatives (see Math Appendix) are very complex and hard to interpret. Hence, exploring the Inequality-Evasion-Informality nexus numerically is a more suitable option here.

Therefore, in the next section, I will use explicit functional forms and calibrate the model parameters to try to explore the evasion-inequality relationship in more depth.

2.3 Numerical Analysis

As mentioned previously, I take the derivatives of the expression for V with respect to policy instruments τ and λ before substituting in specific functional forms (Math Appendix); I find that the derivatives are too complex to derive any meaning about the determinants of the signs of those derivatives .

Exploring the Inequality-Evasion-Informality nexus numerically is a more suitable option. In this section, I will use explicit functional form and calibrate the model parameters.

First, I start by assuming functional forms for the size of the formal sector, penalty rate, and share of non-enforcement spending as follows:

$$a(\lambda, \tau) = \lambda^{x_1}(1-\tau)^{x_2} \tag{2.21}$$

$$\pi(\lambda) = x_3.\lambda \tag{2.22}$$

$$\zeta(\lambda) = 1 - \lambda^{x_4} \tag{2.23}$$

Those functional structures are chosen to reflect the definition of the variables and intuitive assumptions about them. For example, $a(\lambda, \tau)$ is a rate between zero and 1 reflecting the relative size of the formal sector where a rate of 1 means the economy consists of 100% formal activities. This formality rate $a(\lambda, \tau)$ depends positively on the strength of the enforcement system and negatively on the tax rate. The multiplicative functional forms chosen in equation (2.21) above is ensures having $a(\lambda, \tau)$ be between zero and 1 since it is the product of $0 < \lambda < 1$ raised to a power and $0 < (1-\tau) < 1$ raised to another power.

Functional form (2.22) captures the intuitive assumption that informality penalty rate is a positive function of the strength of the enforcement system and scaled by x_3. Lastly, the functional form in (2.23) captures the fact that the share of spending going to public investments $\zeta(\lambda)$ depends negatively on the strength of the enforcement system λ and ensures $\zeta(\lambda)$ is between zero and 1.

Next, I calibrate the parameters x_1, x_2, x_3, and x_4 to match the data from the Russian economy for these rates as follows:

1. $a(\lambda, \tau) = \lambda^{0.45}(1-\tau)^{1.4}$ Estimated by running a regression of formal sector size on tax enforcement and taxes for Russia

2. $\pi(\lambda) = 0.18\lambda$ Calibrated to match evasion penalty rate in Russia in 2019

3. $\zeta(\lambda) = 1 - \lambda^{32}$ matching the spending on tax collection agency in Russia in 2019.

The values used for the other parameters and the sources are summarized in Table 2.1 . If we plug the calibrated explicit form into the inequality expression in equation (2.20), we get the following expression:

$$V = \left[\frac{1-\tau}{1-0.18\lambda} \cdot \frac{A_F}{A_I}\right]^{\frac{1+\mu}{\mu+\theta}} \left[(1-\lambda^{32}) \cdot \lambda^{0.45} \cdot (1-\tau)^{1.4} \cdot \tau\right]^{\frac{(\beta-\gamma)(\mu+\theta)}{(\mu+\theta)-\beta(1+\mu)}} \left[(1-\tau) \cdot A_F\right]^{\frac{(\beta-\gamma)(1+\mu)}{(\mu+\theta)-\beta(1+\mu)}} \quad (2.24)$$

Next, two numerical exercises are performed:

1. Plugging the Russia-calibrated and estimated parameter values from Table 2.1 into equation (2.24) except λ gives an expression of income inequality V as a univariate function of tax enforcement strength λ. Table 2.2 and Figure 2.1 show the effect of varying the enforcement strength rate on income inequality. We can clearly see the existence of an inverse-U relationship similar to the empirical relationship documented in the first chapter of this dissertation. The function is:

$$V(\lambda) = 1.97 \times \frac{\left[(1-\lambda^{32})\lambda^{0.45}\right]^{0.07}}{\left[1-0.18\lambda\right]^{1.13}} \quad (2.25)$$

We can notice from the table and the plot that the income gap is highest between the sectors (V=2.4) when the enforcement rate is equal 0.93 which is a high enforcement rate. This enforcement rate coupled with the exogenous tax rate of 13% which is the flat tax rate for Russia in 2019 produce an informal sector size of 22% below which an increase in enforcement strength increases inequality and above which an enforcement strength hike leads to a decrease in inequality. This non-linearity we observe here and which is demonstrated by Table 2.2 is similar to what I found empirically in the first chapter of this dissertation.

2. Plugging the Russia-calibrated and estimated parameter values from Table 2.1 into equation (2.24) except τ which is capturing the tax rate. Table 2.3 and Figure 2.2 show the effect of varying the tax rate on income inequality. We also find an inverse-U relationship:

$$V(\tau) = 2.70 \times (1-\tau)^{1.238} \times \tau^{0.056} \tag{2.26}$$

We can notice from the table and the plot that Inequality is highest (V=2.14) when the tax rate is equal 3% which is a very low tax rate. This tax rate coupled with the exogenous enforcement rate ($\lambda = 0.85$) assumed to match Russian data produce an informal sector size of 13% below which an increase in the tax rate increases inequality and above which an increase in tax leads to a decrease in inequality. The intuition is as following; when the tax rate is high enough (above the threshold), hiking the income tax further leads to formal sector income loss that is larger than the formal sector income gain stemming from higher public investment spending (which is a product of higher taxes and revenues). Meanwhile, when tax rate is low enough (below the threshold), the formal sector income gain from tax increase (due to higher public investment spending) dominates the formal sector income loss caused by formal workers paying a larger share of their income in taxes.

We can visualize both non-linearities found when modelling $V(\lambda)$ and $V(\tau)$ separately in Figures 2.1 and 2.2. We can also visualize them simultaneously by plotting a 3D plot of the

inequality function $V(\lambda, \tau)$ shown by equation (2.24). The 3D plot can be seen in Figure 2.9. We can clearly see the non-linear dependence of inequality on both tax rate and enforcement rate from the concavity of the produced 3D object.

Thus far, the numerical analysis was performed using values in Table 2.1 to match moments from the Russian economy. If we look at the value for the public investment spending utilization rate by informal sector firms (γ), we can notice that I set it to be equal to 0.06 which is lower than the value for the public investment spending utilization rate by the formal sector firms ($\beta = 0.12$). Due to lack of literature providing an estimate for γ for the case of Russia, I assumed a lower rate using the intuition from an empirical paper by Chatterjee et al (2021) which finds that public investment enhances the productivity of Indian formal sector firms while having low and not statistically significant effect on their informal sector counterparts.

Now, I will be considering two other scenarios. First scenario, I am going to assume that the informal sector firms in Russia do not utilize the government's public investment spending in their production ($\gamma = 0$). And in the second scenario, I am going to assume that the informal sector firms' public investment spending utilization rate is equal to that of the formal sector firms ($\gamma = \beta = 0.12$). For each of these scenarios, I am going to plot income inequality as a function of enforcement system strength $V(\lambda)$, income inequality as a function of the tax rate $V(\tau)$, and income inequality as a function of both enforcement strength and the tax rate $V(\lambda, \tau)$.

In the first scenario, setting $\gamma = 0$ means that the informal sector firms cannot utilize public investments in their production. This increases the wedge between the formal sector firms' and informal sector firms' public investment spending utilization rate from (β - γ = 0.06) to (β - γ = 0.12). This increased utilization gap leads to an increased income gap at every enforcement strength and tax rate levels. This can clearly be seen in Figures 2.5 and 2.6 that are simply a "shifted-upward" versions of Figures 2.1 and 2.2. Even when we plot a new 3D plot with the higher utilization gap taken into consideration (Figure 2.10), we can

clearly notice that the new figure produced is also a "shifted-upward" version of the initial 3D plot in Figure 2.9. In general, the intuition here is that the higher the gap between the two utilization rates the higher the income gap between firms in both sectors for a fixed tax rate and enforcement strength level. In other words, the income gap will be higher for a fixed public investment spending level.

The second scenario is when the utilization rates in both sectors are equalized ($\gamma = \beta = 0.12$). This means that the informal sector firm now utilizes public investment spending at a rate identical to its formal sector peers. By looking at Figures 2.7, and 2.8, we can clearly see that eliminating the utilization rate wedge leads to the elimination of the non-linearity in the inequality-enforcement and inequality-tax rate relationships established previously. Income inequality now only depends positively on the level of enforcement system strength and negatively on the tax rate. The intuition is that without the utilization wedge, the only effect of taxes on income inequality that is left is through the direct distortionary negative effect on formal household income. Also, without the public investment utilization wedge between the sectors, the only effect of enforcement system strength on the income gap left is through the direct distortionary negative effect on informal household income via the informality penalty rate. This can also be seen if we produce a 3D plot for the bivariate inequality function $V(\lambda, \tau)$ as shown in Figure 2.11 where the concavity clearly disappears.

These plots show how critical is the wedge in public investments spending utilization rates ($\beta > \gamma$) in producing the non-linearity in this model and in determining the size of the income gap between sectors. Again, the higher the gap between the two utilization rates the higher the income gap between firms in both sectors for the same tax rate,enforcement strength level, and consequently public investment spending level.

If we repeat the same numerical exercises using Romania-specific values (Table 2.4), we can notice that similar relationships are found for the case of Romania :

$$V(\lambda) = 1.35 \times \frac{\left[(1-\lambda^{32})\lambda^{0.65}\right]^{0.043}}{\left[1-0.22\lambda\right]^{1.098}} \tag{2.27}$$

$$V(\tau) = 2.62 \times (1-\tau)^{1.20} \times \tau^{0.043} \tag{2.28}$$

The relationships are captured in Figures 2.3 and 2.4 at the end of this chapter. It can be noticed that similar non-linearities are found for the case of Romania.

2.4 The Social Planner Problem

In this section, the welfare implications of the model are explored. This welfare analysis begins by considering the social planner problem. The social planner chooses consumption and labor allocations for formal sector and informal sector agents in the economy, and the relative size of each sector to maximize social welfare. In this problem, public investment spending (G) that goes into the firms' production is assumed to be financed via lump sum taxes (T) and not through distortionary income taxes.

The social planner problem is as follows:

$$\max_{a,C_F,L_F,C_I,L_I} [a.\mathbb{U}_F(C_F, L_F) + (1-a)\mathbb{U}_I(C_I, L_I)] \tag{2.29}$$

subject to the economy's resource constraint:

$$C_F \leq Y_F(L_F) \tag{2.30}$$

$$CI \leq Y_I(L_I) \tag{2.31}$$

$$G = T \tag{2.32}$$

Math Appendix.II shows the Lagrangian and the resulting first order conditions for this

problem in more details.

After solving the social planner problem, we find that the social planner chooses the following consumption and labor allocations:

$$C_F^{SP} = \left[A_F G^{\beta}\right]^{\frac{1+\mu}{\mu+\theta}} \tag{2.33}$$

$$L_F^{SP} = \left[A_F G^{\beta}\right]^{\frac{1-\theta}{\mu+\theta}} \tag{2.34}$$

$$C_I^{SP} = \left[A_I G^{\gamma}\right]^{\frac{1+\mu}{\mu+\theta}} \tag{2.35}$$

$$L_I^{SP} = \left[A_I G^{\gamma}\right]^{\frac{1-\theta}{\mu+\theta}} \tag{2.36}$$

We can observe by looking at equation (13.A) in the Math Appendix that one of the optimality conditions is to have U_F equals to U_I. If we assume first that the formal sector productivity A_F is higher than the informal sector productivity A_I, and second that the formal firms utilize government investment spending better than its informal counterpart in production (i.e: $\beta > \gamma$); then by construction the utility gained by the formal HH will always be higher than the informal one.

The only way where every household in the economy achieves the same level of utility, and hence a maximized level of welfare in the whole economy is by the social planner eliminating informality completely by setting (**a=1**).

If we solve a social planner problem where the social planner can only allocate consumption and labor but has no say over the relative size of the formal sector, then such a planner would set these allocations similar to equations (2.33), (2.34), (2.35), (2.36). However, such planner cannot achieve as high of a level of social welfare as the previous case because it cannot eliminate the distortions arising from the existence of an informal sector in the economy.

2.5 Three Government Problems

In this section, the welfare implications of this model are further explored by considering the problems of three different types of governments. These governments are similar in terms of the available policy tool they can utilize (tax enforcement system strength and the tax rate) but are different in terms of the policy goals they are trying to achieve. First, I start by exploring a social welfare-maximizing government (i.e: the Ramsey problem). Second, I explore the problem of a government interested in minimizing income inequality in the economy, and last, I explore the problem of a tax revenue-maximizing government. To make the policy problems more realistic, I add a similar constraint to all of the three optimization problems. The constraint is that the income gap between the sectors "**V**" is larger or equal to 1. In other words, none of these governments can make optimal policy choices that would lead to the income of the informal sector exceeding that of the formal one.

2.5.1 The Ramsey Problem

The Ramsey problem is a problem of a government that takes into account the competitive market allocations, its own budget constraint, and the economy wide resource constraint to choose optimal policy allocations λ^* and τ^* in order to maximize economy-wide social welfare.

The problem can be written as follows:

$$\max_{\lambda,\tau}[a\left(\lambda,\tau\right)\mathbb{U}_F\left(C_F\left(\lambda,\tau\right),L_F\left(\lambda,\tau\right)\right)+(1-a\left(\lambda,\tau\right))\mathbb{U}_I\left(C_I\left(\lambda,\tau\right),L_I\left(\lambda,\tau\right)\right)] \tag{2.37}$$

subject to:

$0<\lambda<1 \quad , \quad 0<\tau<1$, and $\mathbb{V}>1$

where $\mathbb{V}$ is the income gap between the formal and informal agents as defined by equation (2.20).

2.5.2 Inequality-Minimizing Government

The Inequality-Minimizing government problem is a problem of a government that takes into account the competitive market allocations, its own budget constraint, and the economy wide resource constraint to choose optimal policy allocations λ^* and τ^* in order to minimize the income gap between the formal and the informal agents.

The problem can be written as follows:

$$\min_{\lambda,\tau} \mathbb{V} \tag{2.38}$$

subject to

$$\mathbb{V} \geq 1 \tag{2.39}$$

where $\mathbb{V}$ is the income gap between the formal and informal agents as defined by equation (2.20).

2.5.3 Tax-Revenue Maximizing Government

The Revenue-Maximizing government problem is a problem of a government that takes into account the competitive market allocations, its own budget constraint, and the economy wide resource constraint to choose optimal policy allocations λ^* and τ^* in order to maximize its tax revenues collected from taxing the formal sector income.

The problem can be written as follows:

$$\max_{\lambda,\tau} a\left(\lambda,\tau\right)\tau\left[A_F G^{\beta}\right]^{\frac{1+\mu}{\mu+\theta}} \tag{2.40}$$

subject to

$$G = \left[\zeta(\lambda)\, a(\lambda, \tau)\, \tau(1-\tau)^{\frac{1+\mu}{\mu+\theta}} A_F^{\frac{1+\mu}{\mu+\theta}} \right]^{\frac{\mu+\theta}{(\mu+\theta)-\beta(1+\mu)}} \tag{2.41}$$

$$\mathbb{V} \geq 1 \tag{2.42}$$

where $\mathbb{V}$ is the income gap between the formal and informal agents as defined in equation (2.20)

2.5.4 Comparing the Results

In this section, I utilize the functional forms from equations (2.21), (2.22),(2.23), and the parameter values summarized in Table 2.1 for Russia and Table 2.4 for Romania to numerically solve the three government problems and compare the results. Table 2.5 summarizes the results arising from solving the three problems for Russia and Table 2.7 summarizes the results for the case of Romania.

One more way of exploring the welfare implications of the model is by quantifying how much consumption should be given to both formal and informal households to make them indifferent between the social planner allocations and the allocations of the Ramsey, Inequality-Minimizing, and the Revenue-Maximizing governments, respectively. This analysis is done while taking into account the labor supply level in each case. The results are summarized in Table 2.6 for Russia and Table 2.8 for Romania.

We see similar results for both countries that could be summarized as follows:

1. **The Ramsey Welfare Maximizer** chooses a low tax rate and a high tax enforcement strength rate. That combination maximizes welfare because it pushes more agents towards the formal sector and at the same time they get taxed at a very low income tax rate leading to increased utility for the households in that sector and hence in the economy as a whole.

From Tables 2.6 and 2.8, we can clearly notice that this Ramsey problem allocation clearly favors agents in the formal sector as only a very minimal amount of extra consumption is needed for them to have utility matching that of the social planner allocation. Despite it producing the highest overall welfare compared to other government problems, this allocation also leads to an income inequality level that is the highest out of all three problems and tax revenues that are the lowest due to the very low tax rate.

2. **The Inequality-Minimizing government**'s goal is to reduce the income gap between the formal and the informal sectors. The results in Table 2.5 and Table 2.6 show the this government achieves that by taxing the formal sector at a really high tax rate and by choosing a moderate enforcement strength level at the same time. The very high tax rate leads to having a very large informal sector that is only moderately inspected for evasion and to a closing of the income gap between the sectors completely (V=1).

   From Tables 2.5 and 2.7, we can clearly notice even if this inequality-minimization problem achieves perfect wage equality, it also leads to a significantly lower total welfare in the economy. From Table 2.6 and 2.8, we can see that it particularly leads to negative welfare implication for the agents who are in the formal sector compared to their informal sector peers as they get taxed at a very high tax rate. This is demonstrated by the amount of extra consumption that they would require to match welfare from the social planner allocations (115% both in the case of Russia and in the case of Romania) as opposed to household in the informal sector who only need 20.5% increase in consumption in the case of Russia and 9.6% increase in the case of Romania to achieve welfare levels equal to those from the social planner allocation.

   Eventhough tax rate is high, the tax revenue collected by such government is very low (only 35% of what the revenue maximizer government collects in case of Russia and

34% in case of Romania). That is mainly because of the small size of the formal sector and hence lower number of formal firms to tax.

3. **The Revenue-Maximizing government**'s main objective is to extract as much tax revenue as possible from the formal firms in the economy. The results are summarized in Table 2.5 and Table 2.7. To do so, this government chooses its policy instruments in a way where tax rate is high (28% in Russia and 27% in Romania) but not high enough to push too many agents out of the formal sector and into the informal one like in the case of the Ramsey government. It also chooses tax enforcement strength level that is very high (0.93 in Russia and 0.95 in Romania) that majority of agents still choose the formal sector despite tax rate being moderately high.

   While such a policy combination maximizes the revenue of the government, it only produces a fraction of how much economy wide welfare levels the Ramsey welfare maximizer achieves (64% in the case of Russia and 66% in the case of Romania). We can also see clearly in Tables 2.6 and 2.8 that agents in both formal and informal sector need a consumption boost of 32% and 19% respectively in Russia, and consumption boost of 37% and 26.5% respectively in Romania to match the welfare levels obtained from the social planner allocations. Both sectors welfare is affected by the distortions from the policy choice of the tax maximizing government because of the existence of a higher tax rate and a higher tax enforcement strength at the same time affecting the disposable income (and hence the welfare) of agents in both sectors.

4. **What if the social planner sets a=1?**

   An interesting case to consider is when the social planner can eliminate informality completely by setting (**a=1**). A question that comes to mind is what consumption boost is needed for Informal households to match the utility levels they would receive from the informality-eliminating social planner allocations. In other words: what is the consumption boost needed for informal agents' welfare to be equivalent to their

formal peers' social planner allocation welfare?

The answer to this question is in Table 2.9 which shows what the consumption boost needed is for agents existing under three different type of governments in both Russia and Romania. For Russia's informal sector agents, consumption boosts of 152%, 130%, and 94.5% are needed for the Ramsey, Inequality Minimizer, and Tax Revenue Maximizer cases, respectively. For Romania informal households, consumption boosts of 143%, 117%, and 161% are needed for the Ramsey, Inequality Minimizer, and Tax Revenue Maximizer cases, respectively. These numbers show the importance of eliminating the distortion of informality (coming from lower productivity and weaker utilization of public investment spending) on the improvement of agents' welfare levels in the informal economy as huge boosts in consumption are needed under the different types of government to match the welfare levels obtained by the informality-eliminating social planner.

2.6 Conclusion

In this second chapter of the dissertation, I developed a one-period static model to explain the empirical non-linearity in tax evasion and income inequality relationship quantified in the first chapter. The model illustrates the channels by which such non-linearity exists and how it relates to the relative size of the informal sector in the economy.

This chapter also explores the welfare implications of the model. It starts by considering the social planner problem in which a social planner chooses optimal consumption allocations, labor allocations, and relative size of the formal sector in order to achieve maximum welfare in the economy. After that, the welfare continues with a numerical exploration for three different government problems: a welfare-maximizing government, an inequality-minimizing government, and a revenue-maximizing one. Using moments from the Russian and Romanian economy, it is shown how different the allocations of each of the governments are and how they lead to different welfare outcomes for both sectors. Ramsey allocations favor the formal

sector agents, inequality-minimizing allocations favor their informal sector peers, while the results from the revenue maximizing government are more vague in terms of relative welfare as both sectors seem to be affected by the simultaneous choice of a high tax rate and a very strong tax enforcement system.

Math Appendix

(Appendix.I) Derivatives of Inequality $\mathbb{V}$ with respect to Tax Enforcement Strength (λ) and the Tax Rate (τ)

$$\begin{aligned}\frac{\partial V}{\partial \lambda} =& \Bigg[\frac{1-\tau}{1-\pi(\lambda)} \cdot \frac{A_f}{A_I} \cdot \frac{\mu+\theta}{(\mu+\theta)-\beta(1+\mu)} \cdot \Bigg[\zeta(\lambda) \cdot a(\lambda,\tau)\tau \cdot (1-\tau)^{\frac{1+\mu}{\mu+\theta}} \cdot A_F^{\frac{1+\mu}{\mu+\theta}} \Bigg]^{\frac{\beta(1+\mu)}{(\mu+\theta)-\beta(1+\mu)}} \\ & \cdot \left[\zeta(\lambda)\frac{\partial q}{\partial \lambda} + a(\lambda,\tau)\frac{\partial \zeta}{\partial \lambda} \right] \cdot \tau \cdot (1-\tau)^{\frac{1+\mu}{\mu+\theta}} A_F^{\frac{1+\mu}{\mu+\theta}} \Bigg] \\ & + \frac{(1-\tau)\cdot \frac{A_F}{A_I} \cdot \frac{\partial \pi}{\partial \tau}}{(1-\pi(\lambda))^2} \cdot \Big[\zeta(\lambda) a(\lambda,\tau)\tau(1-\tau)^{\frac{1+\pi}{\mu+\theta}} A_F{}^{\frac{1+\mu}{\mu+\theta}} \Big]^{\frac{\mu+\theta}{(\mu+\theta)-\beta(1+\mu)}} \end{aligned} \tag{1.A}$$

$$\begin{aligned}\frac{\partial V}{\partial \tau} =& \frac{1-\tau}{1-\pi(\lambda)} \cdot \frac{A_f}{A_I} \cdot \frac{\mu+\theta}{(\mu+\theta)-\beta(1+\mu)} \cdot \Bigg[\zeta(\lambda) \cdot a(\lambda,\tau)\tau \cdot (1-\tau)^{\frac{1+\mu}{\mu+\theta}} \cdot A_F^{\frac{1+\mu}{\mu+\theta}} \Bigg]^{\frac{\beta(1+\mu)}{(\mu+\theta)-\beta(1+\mu)}} \\ & \cdot \Bigg[\tau(1-\tau)^{\frac{1+\mu}{\mu+\theta}} A_F{}^{\frac{1+\mu}{\mu+\theta}} \cdot \zeta(\lambda)\frac{\partial a}{\partial \tau} \\ & + \zeta(\lambda)a(\lambda,\tau)\left((1-\tau)^{\frac{1+\mu}{\mu+\theta}} A_F^{\frac{1+\mu}{\mu+\theta}} - \tau\frac{1+\mu}{\mu+\theta}(1-\tau)^{\frac{1+\mu}{\mu+\theta}} A_F^{\frac{1+\mu}{\mu+\theta}} \right) \Bigg] \\ & - \Bigg[\Bigg[\zeta(\lambda)a(\lambda,\tau)\tau(1-\tau)^{\frac{1+\mu}{\mu+\theta}} A_F^{\frac{1+\mu}{\mu+\theta}} \Bigg]^{\frac{\mu+\theta}{(\mu+\theta)-\beta(1+\mu)}} \cdot \frac{A_F}{A_I} \cdot \frac{1}{1-\pi(\lambda)} \Bigg] \end{aligned} \tag{2.A}$$

(Appendix.II) The Social Planner Problem

The Lagrangian can be written as:

$$\mathscr{L} = a.\mathbb{U}_F\left(C_F, L_F\right) + (1-a)\mathbb{U}_I\left(C_I, L_I\right) + \Phi[A_F G^{\beta} L_F - C_F] + \Psi[A_I G^{\beta} L_I - CI] \quad (3.A)$$

Obtaining the FOCs and re-arranging them, we find similar conditions to the competitive equilibrium from the consumer and firm problems, i.e: the marginal productivity of labor is equal to the marginal rate of substitution between labor and consumption in both the formal and the informal sectors. Another condition is that to maximize social welfare, the utility of the formal household should be equal to the utility of the informal one.

FOCs:

$$[a] : U_F - U_I = 0 \quad (4.A)$$

$$[C_F] : a \cdot \frac{\partial U_F}{\partial C_F} - \Phi = 0 \quad (5.A)$$

$$[C_I] : (1-a) \cdot \frac{\partial U_I}{\partial C_I} - \Psi = 0 \quad (6.A)$$

$$[L_F] : a \cdot \frac{\partial U_F}{\partial L_F} + \Phi \cdot \frac{\partial Y_F}{\partial L_F} = 0 \quad (7.A)$$

$$[L_I] : (1-a) \cdot \frac{\partial U_I}{\partial L_I} + \Psi \cdot \frac{\partial Y_I}{\partial L_I} = 0 \quad (8.A)$$

$$[\Phi] : C_F = Y_F = A_F G^{\beta} L_F \quad (9.A)$$

$$[\Psi] : C_I = Y_I = A_I G^{\gamma} L_I \tag{10.A}$$

Re-arranging the FOCs after plugging the functional forms:

$$\begin{aligned} MPL_F &= MRS_{L_F, C_F} \\ A_F G^{\beta} &= \frac{L_F^{\mu}}{C_F^{-\theta}} \end{aligned} \tag{11.A}$$

$$\begin{aligned} MPL_I &= MRS_{L_I, C_I} \\ A_I G^{\gamma} &= \frac{L_I^{\mu}}{C_I^{-\theta}} \end{aligned} \tag{12.A}$$

$$U_F = U_I \tag{13.A}$$

Tables

Table 2.1: Model Parameters (Russian Economy in 2019)

Parameter	Value	Source
τ	0.13	Federal Tax Service of Russia (2019)
λ	0.85	matching Russia's C-efficiency ratio (2019)
μ	5.7	Klepikova (2016)
θ	0.24	Khvostova et al (2014)
β	0.12	Kortelainen and Leppänen (2013)
γ	0.06	Assumed following Chatterjee et al (2021)
A_F	761	matching productivity data in Russia (2019)
A_F/A_I	1.54	La Porta and Shleifer (2008)

Table 2.2: Numerical Exercise: Varying the Tax Enforcement Strength (Russia)

λ	τ	Informality	Inequality
0.7	0.13	30%	2.26
0.8	0.13	26%	2.33
0.93	0.13	22%	2.40
0.97	0.13	19%	2.36
0.99	0.13	18%	2.24

Table 2.3: Numerical Exercise: Varying the Tax Rate (Russia)

λ	τ	Informality	Inequality
0.85	0.01	9%	2.06
0.85	0.03	11%	2.13
0.85	0.043	13%	2.14
0.85	0.1	20%	2.08
0.85	0.2	32%	1.87

Table 2.4: Model Parameters: Romania in 2016

Parameter	Value	Source
x_1	0.65	estimated using Panel Data
x_2	1.5	to match moments from Romania (2016)
x_3	0.22	matching evasion penalty in Romania
x_4	32	assumed to equal the value from Russia
τ	0.16	ANAF (Romania, 2016)
μ	7.5	Copaciu et al (2015)
θ	0.24	Hudea (2019)
β	0.06	Roşoiu (2015)
γ	0.02	Chatterjee et al (2021)
A_F	2570	matching data from Romania(2016)
A_F/A_I	1.54	La Porta and Shleifer (2008)

Table 2.5: Comparing the Results (Russia)

	Ramsey	Inequality Minimizer	Revenue Maximizer
τ	0.05	0.53	0.28
λ	0.89	0.36	0.93
a	0.88	0.21	0.61
1-a	0.12	0.79	0.39
V	2.5	1	1.98
Tax Revenue (normalized)	29	35	100
Economy-Wide Welfare (normalized)	100	29	64

Table 2.6: Change in Consumption to Match Utility from the SPP Allocation (Russia)

% △ Consumption	Ramsey	Inequality Minimizer	Revenue Maximizer
Formal HH	% 4.4	% 115	% 32
Informal HH	% 20.3	% 20.6	% 19

Table 2.7: Comparing the Results (Romania)

	Ramsey	Inequality Minimizer	Revenue Maximizer
τ	0.03	0.50	0.27
λ	0.94	0.40	0.95
a	0.91	0.18	0.60
1-a	0.09	0.82	0.40
V	2.47	1	1.93
Tax Revenue (normalized)	21	34	100
Economy-Wide Welfare (normalized)	100	50	66

Table 2.8: Change in Consumption to Match Utility from the SPP Allocation (Romania)

% △ Consumption	Ramsey	Inequality Minimizer	Revenue Maximizer
Formal HH	% 3	% 115	% 37
Informal HH	% 26	% 9.6	% 26.5

Table 2.9: Change in Informal Agent's Consumption to Match Utility from the Allocations of a Social Planner who eliminates Informality (sets a=1)

% $\triangle$ Consumption	Ramsey	Inequality Minimizer	Revenue Maximizer
Informal HH (Russia)	% 152	% 130	% 94.5
Informal HH (Romania)	% 143	% 117	% 161

Figures

Figure 2.1: Inequality-Enforcement Relationship (Russia)

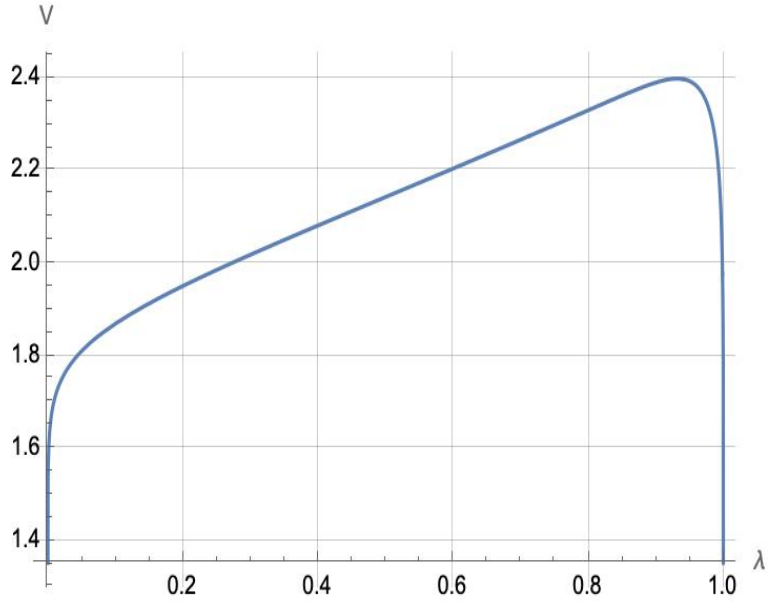
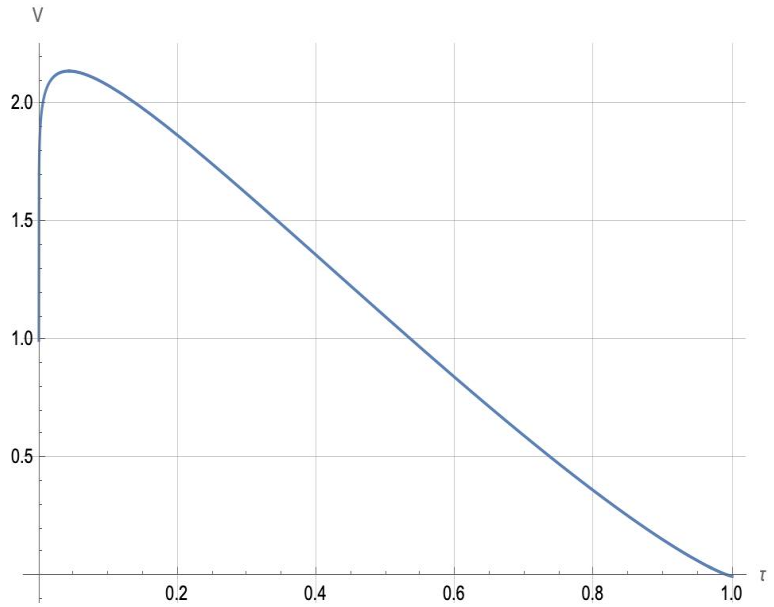


Figure 2.2: Tax Rate-Inequality relationship (Russia)



Figures

Figure 2.3: Inequality-Enforcement Relationship (Romania)

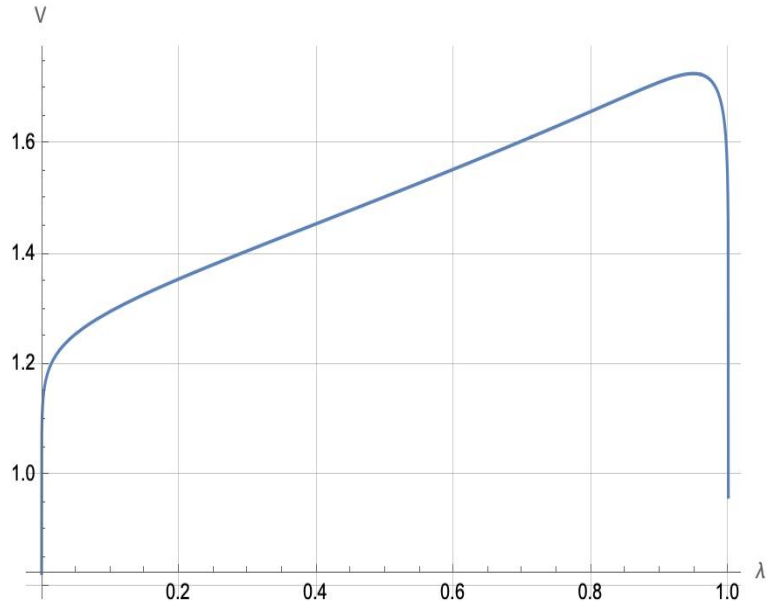


Figure 2.4: Tax Rate-Inequality Relationship (Romania)

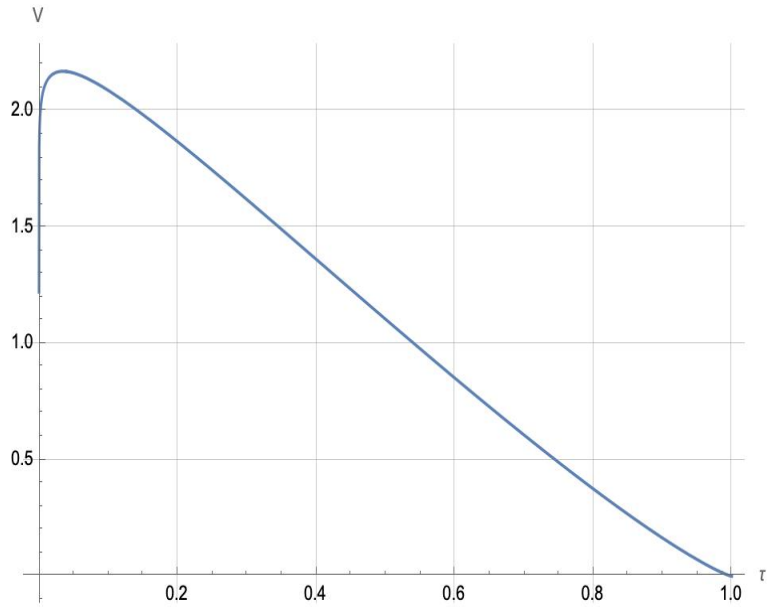


Figure 2.5: Inequality-Enforcement Relationship when $\gamma = 0$ (Russia)

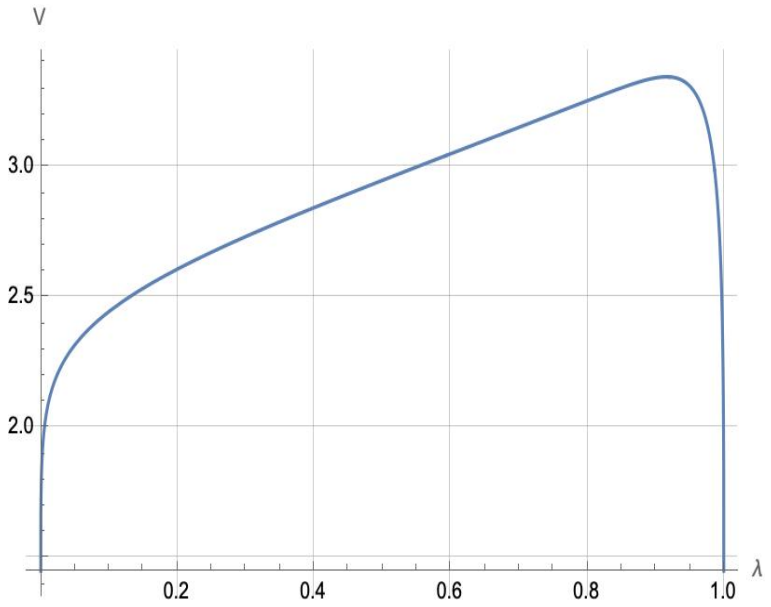


Figure 2.6: Inequality-Tax Rate Relationship when $\gamma = 0$ (Russia)

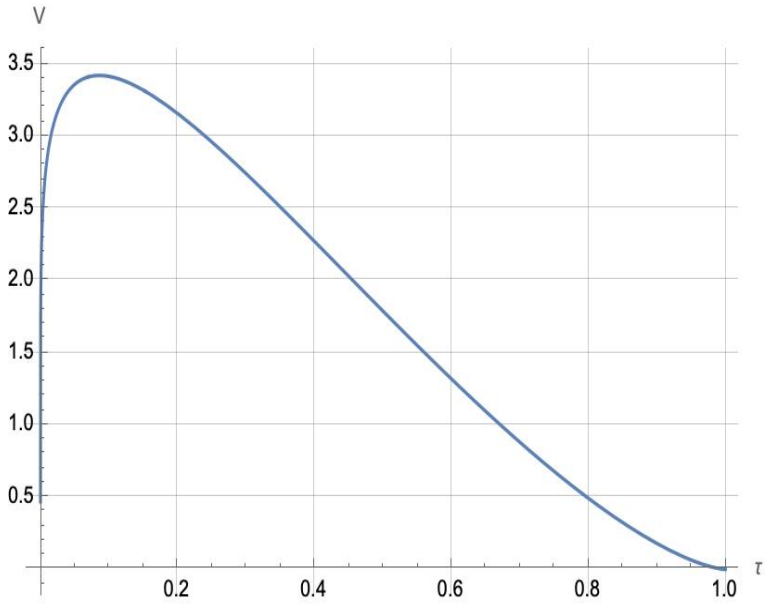


Figure 2.7: Inequality-Enforcement Relationship when $\gamma = \beta = 0.12$ (Russia)

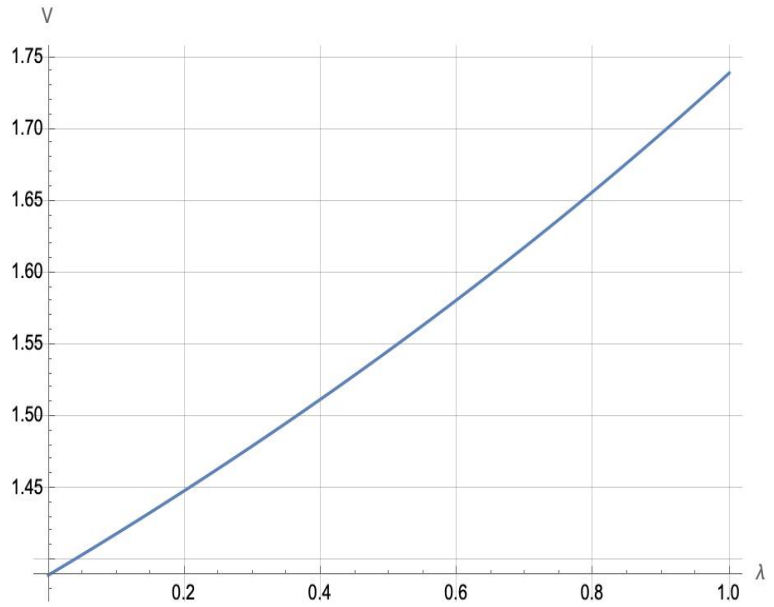


Figure 2.8: Inequality-Tax Rate Relationship when $\gamma = \beta = 0.12$ (Russia)

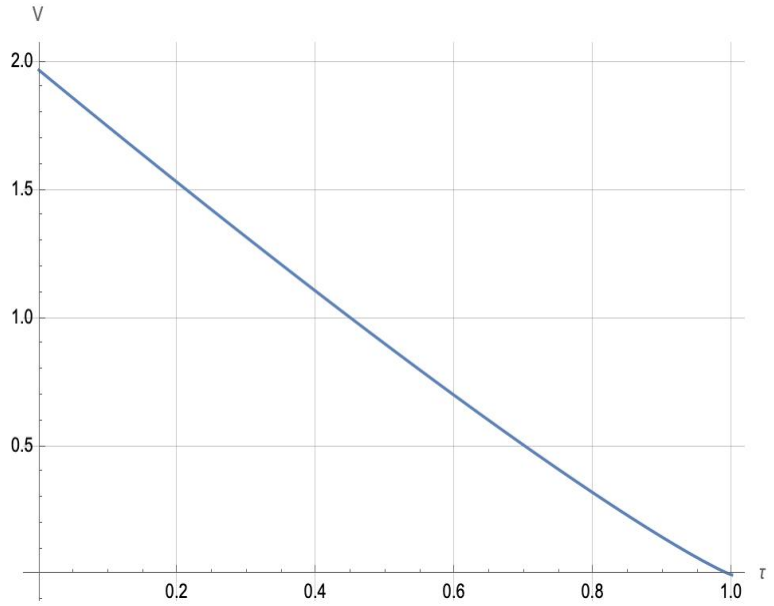


Figure 2.9: Inequality as a Function of λ and τ using the Calibrated Value $\gamma = 0.06$ (Russia)

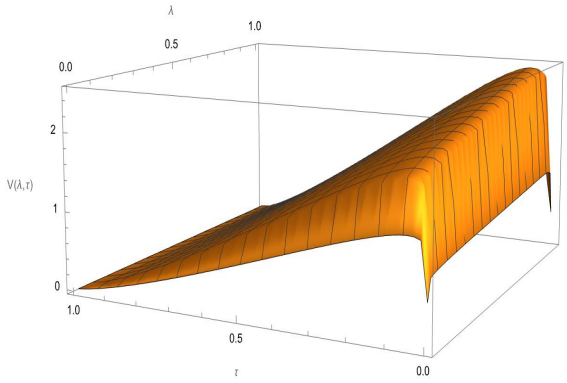


Figure 2.10: $V(\lambda, \tau)$ when $\gamma = 0$ (Russia)

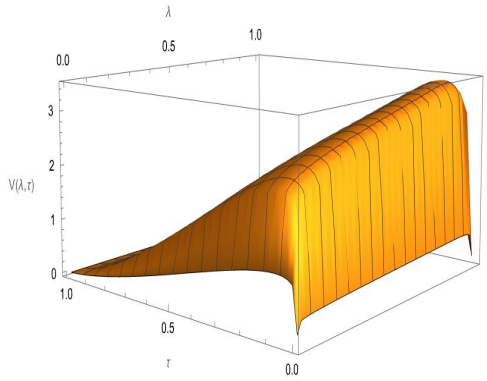
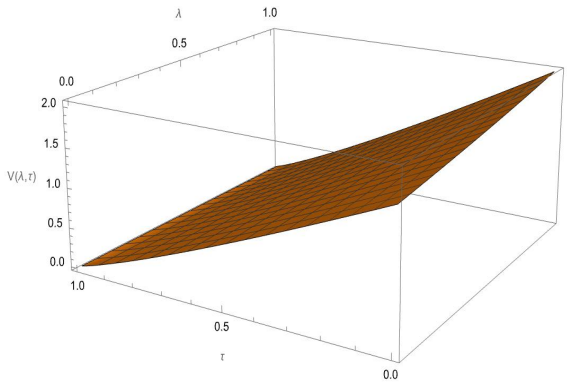


Figure 2.11: $V(\lambda, \tau)$ when $\gamma = \beta = 0.12$ (Russia)



How Do Changing U.S. Interest Rates Affect Banks in the Gulf Cooperation Council (GCC) Countries?[1]

Authors: Olumuyiwa S Adedeji, Yacoub Alatrash, and Divya Kirti

3 Chapter 3

3.1 Introduction

Monetary policy in the Gulf Cooperation Council (GCC) countries is conducted in the context of fixed exchange rate regimes and the open capital accounts.[2] National currencies are pegged to the U.S. dollar—or in the case of Kuwait, to an undisclosed basket of currencies tilted towards the U.S. dollar. The pegs are maintained by managing the magnitude of short-term interest rate differentials with U.S interest rates. Policy rates in GCC countries have generally mirrored recent shifts in U.S. monetary policy. This raises the important question of how changing policy interest rates impact the GCC banking sector. Previous work on the impact of U.S. interest rates on GCC economies largely focuses on aggregate data (Sheehan and Russer (1995), Espinoza and Prasad (2012), Alghaith and others (2014), and Adedeji and others (2019)). To address the challenges the literature faces in isolating the impact of interest rates from coincident macroeconomic shocks, this paper offers two methodological contributions. First, we construct asset and liability rates for GCC countries, given that interest rate series are not available for some of these countries. Implied deposit and lending rates are constructed at the GCC, country, and bank levels. Second, we use bank-level panel data to explore variation across banks within countries to isolate the impact of changing U.S. interest rates on GCC banks' funding costs and profitability and

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[1]This study represents the authors' view and not the views of the International Monetary Fund

[2]See IMF (2019) for a discussion of the benefits and costs of pegged exchange rates given the current structures of these economies.

derive monetary policy implications. We study the effect of changes in U.S. monetary policy on the cost of funding, lending rates, and profitability of GCC banks. We are not aware of prior work on GCC countries that studies these links by looking at variation across banks within country. Our approach aims to isolate the impact of interest rates in a manner that is difficult to do with aggregate data. We build on Drechsler and others (2017) and Kirti (2017), who study cross-sectional differences in U.S. banks' interest rate exposure. This literature finds considerable variation across banks in the U.S. in their interest rate exposure. We find similar heterogeneity across banks in the GCC and exploit this variation in the cross-section. These authors also find that U.S. banks adjust the interest rate exposure of their assets to match that of their liabilities. In this paper, we explore if this is the case for banks in the GCC. We also examine the role of competition in determining interest rate pass-through, with implications for the transmission of monetary policy. With stronger competition, margins are compressed, implying that loan and deposit rates move closely with market and policy interest rates. Indeed, van Leuvensteijn and others (2013) find that competition is an important determinant of interest rate pass-through across Euro area countries. GCC policy rates and bank liability rates largely follow U.S. policy rates, both in aggregate and at the country level. There are, however, substantial differences across individual GCC banks in the extent to which their liability interest rates are sensitive to shifting monetary policy in the U.S. We suggest that this is an important dimension of cross-sectional variation that may help study the impact of U.S. monetary policy on GCC banks. We find liability rates to be more sensitive to changes in U.S. monetary policy than asset rates and profitability. Following tighter U.S. monetary policy, more liability-sensitive GCC banks see their liability interest rates rise. These rate increases attract larger quantities of funding, limiting scope for these banks to raise asset rates. Competition is relevant as well: large banks can have an outsized effect on markets in concentrated banking systems. The presence of large banks with more stable funding costs also constrains liability sensitive banks' ability to raise asset rates. This places pressure on profitability for liability sensitive banks (our regressions show

a negative, but statistically insignificant, impact on profitability). Stronger pass-through to liabilities than to assets is consistent with stronger competition in deposit and funding markets than in loan markets. On the liability side, open capital accounts in GCC countries lead to some competition. When the U.S. monetary policy tightens, and GCC central banks raise policy rates, domestic banks that do not follow by raising their own liability rates face increased competition from banks abroad. On the asset side, our results suggest that larger margins allow banks scope to absorb the impact of changes in monetary policy. This also implies that the effectiveness of monetary policy in terms of driving interest rates on loans is limited. From a policy perspective, measures to enhance competition focused on loan markets may assist with enhancing the transmission of monetary policy. The remainder of this paper is structured as follows. Section 3.2 presents stylized facts based on the interest rate series we construct. Section 3.3 lays out our conceptual framework and discusses our empirical findings. Section 3.4 concludes.

3.2 Stylized Facts

We expect that monetary policy rates in GCC countries would tend to move in line with the federal funds rate given the pegged exchange rate regimes. In addition, in order for the monetary policy to be effective in terms of achieving desired objectives, the liability and asset rates would tend to be correlated with the GCC policy rates. In line with our expectation, GCC policy rates largely follow U.S. policy rates (Figure 3.1).[3] Also, GCC bank assets rates have broadly followed the policy rates in their home countries (Figure 3.1).[4]. Figure 3.8

[3]The policy rate refers to the one-week central bank deposit rate in Bahrain, the central bank discount rate in Kuwait, the average repo rate in Oman, the central bank deposit rate in Qatar, the reverse repo rate in Saudi Arabia (the reason for not using repo rate is that repo rate has been flat during the most recent U.S. tightening cycle), and central bank CD rate in the UAE. See section 3.5 for more detail on definitions of key variables and a summary of data sources. We obtain these rates starting in 2003 for Kuwait, Qatar, and Saudi Arabia, 2004 for Bahrain and Oman, and 2007 for the UAE.

[4]The liability rate is defined as total interest expense divided by interest-bearing liabilities. A subset of this is the deposit rate, which is calculated as the interest expense on customer deposits divided by total customer deposits. The asset rate is gross interest and dividend income divided by interest-earning assets. The loan rate is a component of the asset rate and is calculated as interest income on loans divided by net loans. As section 3.5 explains, Islamic compensation is included in the calculations of these interest rates.

shows the evolution of these interest rates at the country level.

GCC banks' liability rates only partially responded to the increase in the U.S. Federal Funds rate during 2004-06 due to several factors. First, during this period, oil prices were relatively higher, with positive implications for banks' liquidity (see IMF (2017) and Adedeji and others (2019)).[5] Second, banks may effectively have more market power when policy rates are high (Drechsler and others 2017). When policy rates are low, there is little room for banks to lower deposit rates – further reductions might lead depositors to switch to cash. In contrast, when policy rates are high, even at deposit rates well below policy rates, depositors are unlikely to switch to cash. Banks may therefore be able to set deposit rates well below policy rates at times when policy rates are high.

At the country level, policy rates are strongly positively correlated with the U.S. Federal Funds Rate (Table 3.1). Liability and asset rates also move with U.S. policy rates, although this co-movement is stronger on the liability side (other than in Saudi Arabia).

3.3 Empirical Analysis

3.3.1 Panel Analysis Based on Time Series Variation

We begin with bank level regressions where the dependent variables are changes in liability and asset rates and the independent variable is the change in the U.S. Federal Funds Rate (Table 3.2). All variables are expressed in percentage points. Specifications including either country or bank fixed effects are shown. In these and subsequent panel regressions, t-statistics are shown in parentheses, and are based on standard errors clustered by both country and year.[6] Taken at face value, Table 3.2 suggests pass through from U.S. interest rates to GCC banks' liability and asset rates. The regressions suggest that when U.S. rates rise by 100 basis points, GCC banks' liability rates rise by 35 basis points and their asset rates by close

[5] "Liquidity" is defined as the subset of central bank domestic currency liabilities vis-à-vis commercial banks that is readily avilable for payments purposes, essentially commercial bank excess reserves at the central bank (see Gray (2008) for a more-detailed discussion).

[6] By double clustering standard errors, we adjust for correlation in errors both across years within country and across countries within year: these are the dimensions across which errors are most likely to be correlated.

to 20 basis points. We also find similar results using changes in country-specific policy rates as the independent variable instead. However, as with any analysis based on country level data, it is difficult in these regressions to isolate the effect of changes in policy rates from other changes to the macroeconomic environment. Although they are based on bank level data, these regressions do not allow us to account for other important factors such as shocks to oil prices, changes in liquidity conditions, or global financial market developments.

Our approach to address this issue is to shift our attention to cross-sectional variation and include year fixed effects in our regressions. Year fixed effects absorb all changes common to the region and provide a robust way to account for developments other than changes in interest rates. However, these cannot be included in the regressions presented in Table 3.2 as these only use variation in the time series – variation fully absorbed by year fixed effects. To use this approach, we focus on differences across banks in sensitivity to changes in U.S. monetary policy.

3.3.2 Liability Pass-Through as Measure of Cross-Sectional Variation in Liability Interest-Sensitivity

One important source of differential sensitivity to monetary policy across GCC banks is the deposit mix and the sensitivity of deposit interest rates. Figure 3.2 shows that the deposit mix can vary substantially across banks and seems to be associated with differences in net interest margins. Figure 3.2 shows that there is wide variation in the fraction of deposits that are interest bearing (as Appendix I notes, our data accounts for Islamic banking activity). Some banks have almost no deposits on which any form of compensation is paid, while others almost exclusively rely on compensated deposits. In Saudi Arabia, many of the most profitable banks (i.e. those with large Net Interest Margins) are able to fund themselves largely with deposits that are not compensated. However, restricting attention to variation in the deposit mix may not be sufficient as non-deposit liabilities also play an important role in some GCC countries. Figure 3.3 shows that, although deposits dominate Saudi banks'

liability structures, non-deposit liabilities such as wholesale funding are important for banks in Kuwait and Bahrain. This makes it important to capture the sensitivity of all bank liabilities, not just deposits, to changing interest rates. We therefore construct a measure of the overall sensitivity of bank liabilities to changes in U.S. monetary policy at the bank level: liability pass-through (LPT). We estimate LPT using bank level regressions in which the dependent variable is the change in the bank's liability rate, and the independent variable is the change in the U.S. Federal Funds Rate:

$$\Delta LiabilityRate_{i,t} = \alpha_0 + \alpha_0 \Delta FederalFundsRate_t + \epsilon_{i,t} \tag{3.1}$$

The estimated coefficient $\hat{\alpha}_1$ is a measure of how sensitive a bank is to U.S. monetary shocks. For banks with $\hat{\alpha}_1$ close to 1, liability rates respond almost one to one with U.S. monetary policy (sensitive banks), while for banks with $\hat{\alpha}_1$ close to 0, liability rates do not respond strongly to U.S. monetary policy (insensitive banks). We use LPT as our main measure of cross-sectional variation across banks.

LPT is likely to link closely with the interest-bearing fraction of deposits in countries where deposits dominate, but may differ from the interest-bearing fraction of deposits in other countries. As discussed above, in some countries such as Kuwait and Bahrain, sources of funding other than deposits are important. Figure 3.4 shows that for the case of Saudi Arabia, where deposits dominate banks' liability structures, LPT is closely related to the interest-bearing fraction of deposits. Across GCC countries, while LPT is broadly in line with the interestbearing fraction of deposits for many banks, there are banks for which these two measures are very different (Figure 3.5).

Figure 3.5 shows that while interest-bearing deposits are important for most GCC banks, some banks have essentially no interest-bearing deposits. Within banks that do have a substantial fraction of interest-bearing deposits, banks with similar fractions of interest-bearing deposits can have different LPTs for several reasons. Deposits may account for different fractions of liabilities. The strength of deposit franchises or market power may vary

too. Within banks that have essentially no interest-bearing deposits, there are several distinct types of banks. Some have high LPT: these are primarily banks that rely on wholesale funding that must be obtained at market rates.[7] Others have low LPT: these are banks that are able to fund themselves with uncompensated deposits, as is the case for some Saudi banks.

Overall, considering the sensitivity of all liabilities, and not just the sensitivity of deposits, is important. Our LPT approach better captures the overall sensitivity of bank liabilities to interest rates than measures based on the shares of different types of liabilities, as interest-bearing deposits and wholesale liabilities can have different sensitivities to policy rates across banks and countries.

3.3.3 Panel Analysis Based on Cross-Sectional Variation

We now use differences in liability pass-through (LPT) as a source of differential sensitivity to changes in U.S. monetary policy. This allows us to present panel regressions similar to those presented in Table 3.2 that exploit cross-sectional variation and can include year fixed effects to control for macroeconomic developments other than changes in U.S. monetary policy. We ask whether banks with more sensitive liabilities also exhibit more sensitivity of assets and profitability.[8] Kirti (2017) argues that the liability structure of U.S. banks is an important determinant of their asset structure in aggregate and presents evidence that banks with more interest-sensitive liabilities also choose to hold more interest-sensitive assets. Table 3.4 presents panel regressions using this cross-sectional variation. The specification is:

[7] There are also some banks for which the interest-bearing fraction of deposits is low, deposits are a significant share of liabilities, and LPT is high. These may be banks for which the interest-bearing fraction of deposits is not reported correctly.

[8] Our focus is on the effect of U.S. monetary policy shocks on GCC banks. While GCC policy rates are highly correlated with U.S. monetary policy, it is also possible that changes in U.S. monetary policy directly affect GCC banks, for example by changing the ease with which dollar funding can be accessed. Our measure of liability sensitivity captures both channels.

$$\Delta InterestRate_{i,t} = \alpha_t + \alpha_i + \alpha_1 \Delta FederalFundsRate_t \times LiabilityPassthrough_t + \epsilon_{i,t} \quad (3.2)$$

The dependent variables are changes in interest rates or profitability at the bank level. These regressions include both year fixed effects (α_t) and bank fixed effects (α_i). The coefficient of interest is α_1: the interaction between changes in the U.S. Federal Funds Rate and LPT. This coefficient looks at the differential impact of changes in U.S. monetary policy on banks with more sensitive liabilities. Year and bank fixed effects absorb the individual variables. As in Table 3.2, t-statistics are shown in parentheses, with standard errors double clustered by country and year. As U.S. monetary policy is not set to target financial conditions in GCC countries, this approach captures differences in GCC banks' exposures to exogenous shocks.

The results in Table 3.3 show that while there is substantial variation in the impact of U.S. monetary policy on GCC banks' liability rates, there seems to be little systematic differential impact on asset rates or profitability. On the liability side, as expected, liability rates respond substantially more to shifting U.S. monetary policy for banks with higher LPT. Relative to a bank with no liability pass-through, if the U.S. Federal Funds Rate rises by 100 basis points, liability rates rise by an additional 74 basis points for a bank with one-to-one liability pass-through. Focusing on the estimated sign and magnitude of the coefficient for asset rates, banks with higher LPT do seem to raise asset rates more when U.S. rates rise, although not as much as they raise their liability rates. Correspondingly, the estimated differential impact on profitability is negative. However, the latter two coefficients cannot be statistically distinguished from zero. In the cross section of GCC countries, therefore, some GCC banks are more sensitive on the liability side, but we are unable to detect a robust differential effect on asset rates or on profitability at the GCC level.

3.3.4 Availability of Funding and Bank Competition

We explore two potential factors that may help explain why we do not find a systematic effect of U.S. monetary policy on asset rates and profitability in the cross section. First, we consider changes in the quantity and structure of banks' funding. Shifting quantities may explain why prices do not respond as much as expected. We find some evidence to support this interpretation. Second, we examine the role of differences in bank competition across countries. We begin by studying whether shifting U.S. monetary policy differentially affects the quantity and structure of banks' liabilities for sensitive banks. Banks with high LPT raise liability rates more for a given increase in U.S. policy rates. Our analysis so far has abstracted from how the quantity of liabilities responds to this change in prices. Perhaps more sensitive banks attract relatively more funding when U.S. rates rise, given that they offer more attractive deposit rates. Regressions where dependent variables are changes in the overall size of liabilities and assets, presented in Table 3.4, suggest that more sensitive banks may attract more funding when U.S. rates rise. The dependent variables here are log-changes, multiplied by 100, so that coefficients can be interpreted as changes in quantities in percentage points. Relative to a bank with no liability sensitivity, a bank with one-to-one liability pass-through sees an additional 7.5 percentage points of overall liability growth for a 100 basis point increase in U.S. rates. Its assets correspondingly grow by close to an additional 7 percentage points as well, although the coefficient is not statistically significantly different from zero. It seems plausible that this additional inflow of funding can help explain why the differential impact of U.S. monetary policy on sensitive banks' asset rates is limited. As sensitive banks need to substantially grow their assets when U.S. rates rise, they may find it difficult to simultaneously increase asset rates by as much.

If more sensitive banks' higher liability rates attract more funding when U.S. rates rise, this new funding should arrive in the form of compensated deposits. Non-deposit funding is likely obtained at market rates in any case, while uncompensated deposits are relatively less attractive when interest rates are high. Table 3.5 shows that sensitive banks' new

liabilities are indeed in the form of compensated deposits. Relative to a bank with no liability sensitivity, compensated deposits grow by close to 7 percentage points for a bank with one-to-one liability pass-through for a 100 basis point increase in U.S. rates, while uncompensated deposits actually shrink. We find little effect on liabilities other than deposits. In the absence of the ability to effectively price discriminate, this approach allows sensitive banks to retain their existing base of funding, even if it does reduce profitability per unit of assets held.

Our findings suggest that GCC banks' depositors respond to price incentives. When U.S. interest rates rise, liability sensitive banks raise their liability rates substantially more than banks that are not sensitive (Table 3.3). Our results in Tables 3.4 and 3.5 show that depositors at sensitive banks respond by increasing holdings of compensated deposits and reducing their holdings of uncompensated deposits. Again, our methodology compares sensitive banks to less sensitive banks. Our findings suggest that even in GCC countries, where Islamic banking plays an important role, and some banks are able to fund themselves almost entirely with uncompensated deposits (Figure 3.2), depositors do respond to relative prices. Banks that follow rising U.S. rates by offering higher deposit rates attract relatively more compensated deposits.

Next, we examine the role of bank concentration. Figure 3.6 shows concentration of the banking systems in GCC countries based on the market share of the largest two and the largest four banks. GCC banking systems are concentrated: the top four banks account for more than 40 percent of assets in the UAE and Bahrain, about 60 percent of assets in Saudi Arabia, and about 70 percent of assets in Kuwait, Qatar, and Oman. Larger banks are more likely to be banks with market power: indeed, in four of the six countries we find a negative correlation between bank size and interest-rate pass-through to deposits.

We find suggestive evidence that differences in bank concentration can help explain our finding that U.S. rates have a limited impact on profitability in the cross section. Figure 3.7 shows how the impact of U.S. rates on profitability varies with bank concentration. The vertical axis is the coefficient from country level versions of the third specification shown

in Table 3.3. More negative coefficients imply a greater negative impact on profitability of rising U.S. rates for more sensitive banks. The horizontal axis of this figure is the Herfindahl-Hirschman Index (HHI), a continuous measure of concentration that ranges from 0-10000.[9] A larger HHI indicates more concentration. Rising U.S. rates seem to matter more for sensitive banks' profitability in GCC countries with more concentrated banking systems. For three countries we find a statistically significant negative impact of rising U.S. rates on sensitive banks' profitability (Bahrain, Oman, and Qatar, shown in Figure 3.7 in bold). Of these, Oman and Qatar have relatively concentrated banking systems by all three measures of concentration (the market share of the largest two and largest four banks, and the HHI).

Rising U.S. rates may impair profitability for sensitive banks in more concentrated banking systems if sensitive banks in these systems have to raise liability rates more for a given increase in U.S. rates. Particularly if more liability sensitive banks are not themselves the dominant banks (as we find is the case in four of the six GCC countries), they may find it necessary to raise deposit rates to retain their deposit base when U.S. rates rise, but may not be able to increase their asset rates to match this increase in their cost of funding. Table 3.6 examines whether this is the case, but statistical power is limited here, as our sample only covers six countries, and the results are not statistically significant.

3.4 Conclusion

In this paper, we use bank-level data to explore the effect of changes in the U.S. federal funds rate on banks in the GCC countries. We find stronger pass-through from U.S. to GCC policy rates and bank liability rates than to asset rates and bank profitability. The joint evolution of prices and quantities may help explain the limited sensitivity of asset rates: banks that must raise liability rates to match a tightening of U.S. monetary policy tend to attract additional funding which they then need to lend out, leaving little scope for raising asset rates. The presence of large banks with relatively insensitive liabilities also constrains

[9]The HHI is calculated as the sum of individual market participants' market shares squared. For example, a monopolist has a 100 percent market share, and the HHI is therefore a maximal 10000.

more sensitive banks' ability to raise rates.

From a policy perspective, there may be room to improve monetary policy transmission to loan rates. Measures to enhance competition with emphasis on the loan market could help enhance the transmission of monetary policy.

3.5 Data Appendix

We use annual bank-level data from Fitch Connect. Our sample period is 2004-2017. For consistency, we exclude banks for which coverage begins after 2004. Table 3.1 shows the number of banks included in the sample for each country.

We obtain data on policy rates for Bahrain (one-week deposit rate), Kuwait (central bank discount rate), Oman (repo rate), Qatar (deposit rate), Saudi Arabia (reverse repo rate), United Arab Emirates (central bank CD rate) and the United States (Federal Funds rate) from Haver. Bank-level implied interest rates are calculated as follows:

- **Liability side**: The liability rate is interest expense scaled by interest-bearing liabilities. The deposit rate is interest expense on customer deposits scaled by customer deposits.

- **Asset side**: The asset rate is gross interest and dividend income scaled by interest-earning assets. The loan rate is calculated as interest income on loans divided by net loans.

- **Profitability**: We focus on the net interest margin (NIM)–net interest income scaled by total interest-earning assets.

We also calculate these rates at the country and GCC levels as bank size-weighted averages (we calculate implied interest rates treating the relevant group of banks as a single bank).

The data covers Islamic banking. Taking the example of Saudi Arabia, banks' financial statements report all sources of income, including 'special commission' compensation on assets and liabilities associated with Islamic banking operations. Fitch classifies these receipts and payments as interest income and interest expense.

Tables

Table 3.1: Sample Size

Country	No. of Banks
Bahrain	20
Kuwait	16
Oman	8
Qatar	8
Saudi Arabia	11
United Arab Emirates (UAE)	20

Table 3.2: Correlation of Policy and Bank Rates with U.S. Monetary Policy (2004-2017)

Country	Δ Policy Rate	Δ Liability Rate	Δ Deposit Rate	Δ Asset Rate	Δ Loan Rate
Bahrain	0.995	0.920	0.846	0.554	0.471
Kuwait	0.829	0.885	0.774	0.624	0.527
Oman	0.954	0.784	0.656	0.295	0.617
Qatar	0.922	0.678	0.042	0.501	0.246
Saudi	0.991	0.844	0.611	0.851	0.824
UAE	0.988	0.736	0.623	0.506	0.277

Sources: Fitch Connect; Haver; and IMF staff calculations

Table 3.3: Regressions Using Time Series Variation

	Δ Liability Rate	Δ Liability Rate	Δ Asset Rate	Δ Asset Rate
Δ Federal Funds Rate	0.35	0.35	0.19	0.18
	(7.51)	(7.33)	(2.41)	(2.41)
Country FE	Y	N	Y	N
Bank FE	N	Y	N	Y
Clustering	Country, Year	Country, Year	Country, Year	Country, Year
R2	0.45	0.49	0.11	0.16
N	604	603	604	603

Sources: Fitch Connect; and IMF staff calculations.

Table 3.4: Regressions Using Cross-Sectional Variation

	Δ Liability Rate	Δ Asset Rate	Δ Net Interest Margin
Δ Federal Funds Rate x Liability Passthrough	0.74	0.47	-0.11
	(3.34)	(1.3)	(−1.02)
Country FE	N	N	N
Year FE	Y	Y	
Bank FE	Y	Y	
Clustering	Country, Year	Y	Country, Year
R2	0.66	Country, Year	0.18
N	603	0.31	603

Sources: Fitch Connect; and IMF staff calculations.

Table 3.5: Response of Quantities to Changes in U.S. Monetary Policy

	Δ ln (Liabilities) ×**100**	Δ ln (Assets) ×**100**
Δ Federal Funds Rate × Liability Passthrough	7.52	6.6
	(1.91)	(1.64)
Country FE	N	N
Year FE	Y	Y
Bank FE	Y	Y
Clustering	Country, Year	Country, Year
R2	0.57	0.59
N	603	603

Sources: Fitch Connect; and IMF staff calculations.

Table 3.6: Response of Liabilities to Changes in U.S. Monetary Policy

	Δ ln(Interest Bearing Deposits)	Δ ln(Non Interest Bearing Deposits)	Δ ln(Other Liabilities)
Δ Federal Funds Rate × Liability Passthrough	6.78	-8.47	2.1
	(3.55)	(−2.31)	(0.19)
Country FE	N	N	N
Year FE	Y	Y	Y
Bank FE	Y	Y	Y
Clustering	Country, Year	Country, Year	Country, Year
R2	0.2	0.16	0.24
N	484	595	603

Sources: Fitch Connect; and IMF staff calculations.

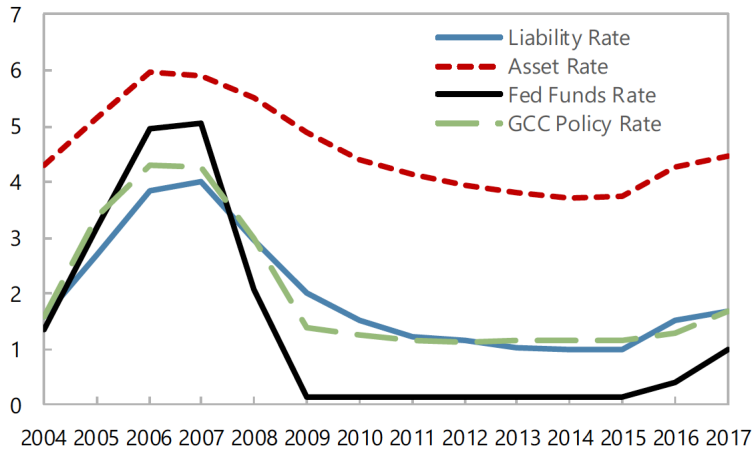
Table 3.7: Regressions Using Variation in Competition

	Δ Liability Rate	Δ Liability Rate
Liability Passthrough	-0.54	
	(−1.65)	
$\triangle FFR\times$ Liability Passthrough	0.29	0.34
	(0.85)	(0.95)
△FFR × HHI	-0.75	-0.55
	(−1.14)	(−0.81)
Liability Passthrough ×HHI	3.13	
	(1.70)	
△FFR× Liability Passthrough ×HHI	2.84	2.39
	(1.61)	(1.3)
Country FE	Y	N
Year FE	Y	Y
Bank FE	N	Y
Clustering	Country, Year	Country, Year
R2	0.64	0.67
N	604	603

Sources: Fitch Connect; and IMF staff calculations.

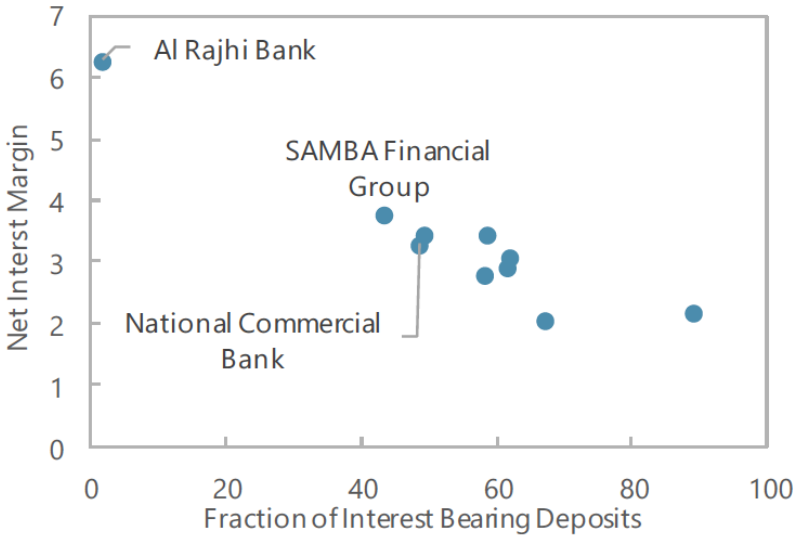
Figures

Figure 3.1: GCC-Wide Bank and Policy Rates and U.S. Federal Funds Rate (Percent)



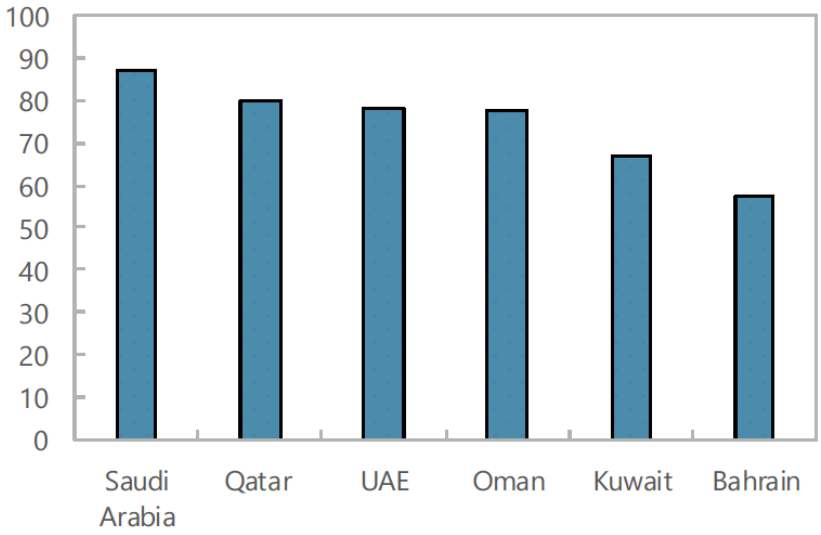
Source: Fitch Connect; and IMF staff calculations.

Figure 3.2: Net Interest Margin of Saudi Banks (Percent)



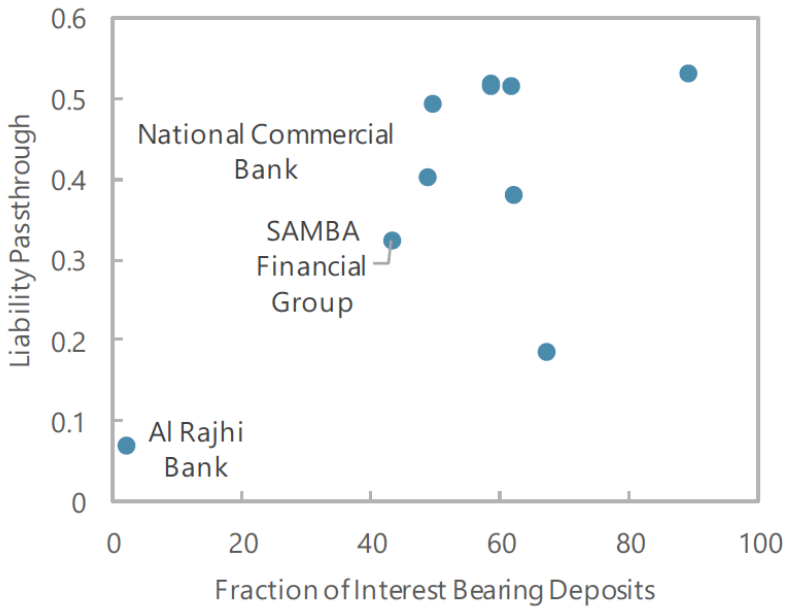
Sources: Fitch Connect and IMF staff calculations.

Figure 3.3: Deposit Fraction of Total Liabilities



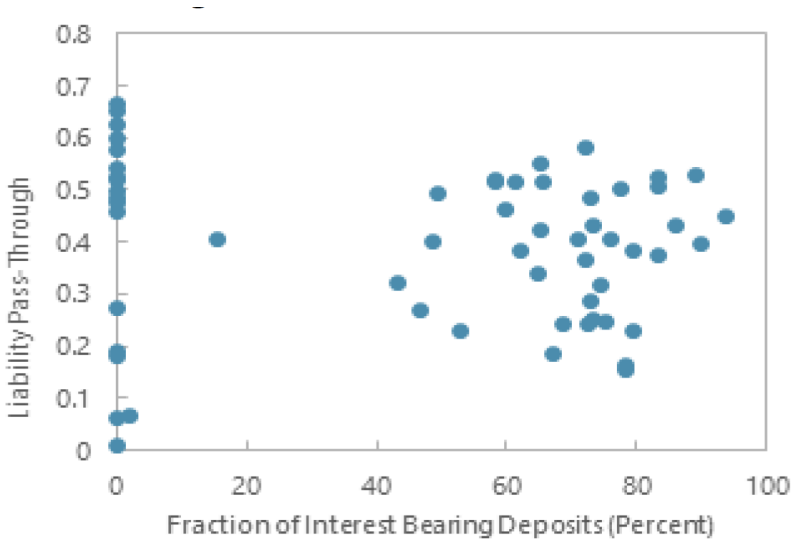
Sources: Fitch Connect; and IMF staff calculations.

Figure 3.4: Variation within Saudi Arabia



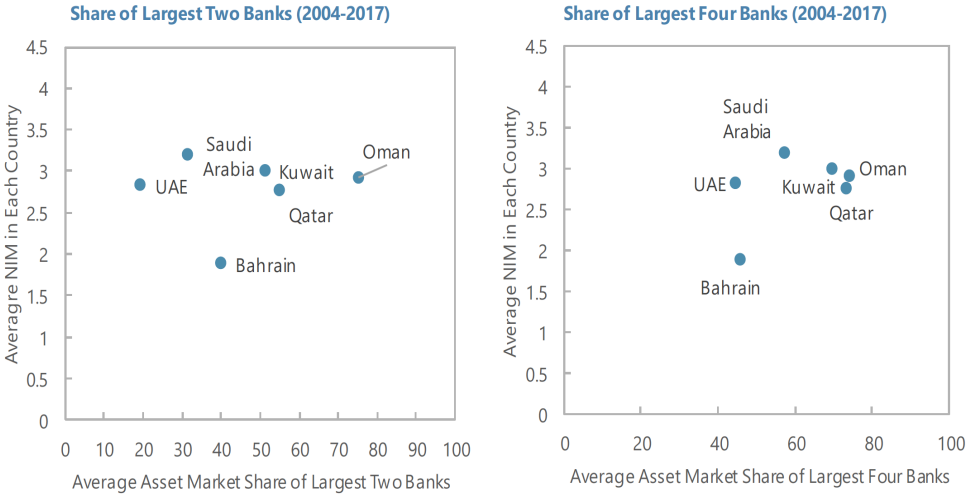
Sources: Fitch Connect; and IMF staff calculations.

Figure 3.5: GCC-Wide Variation



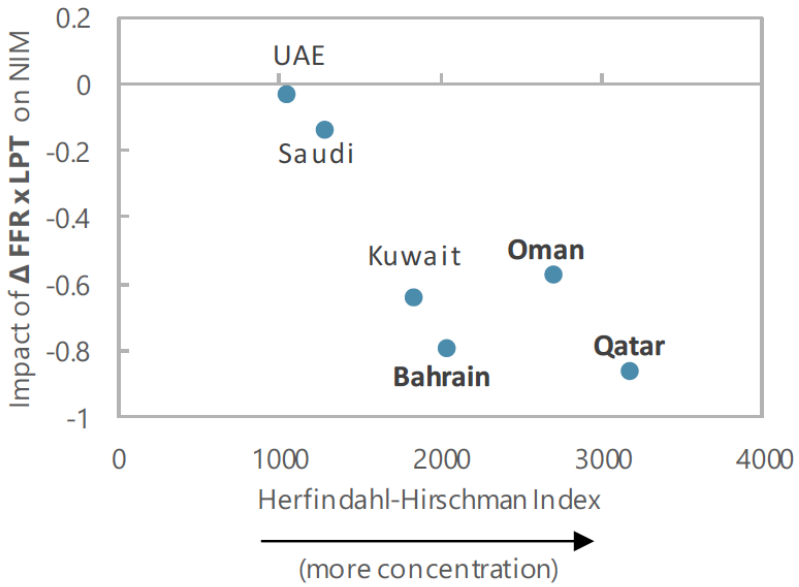
Sources: Fitch Connect; and IMF staff calculations

Figure 3.6: Market Concentration and Net Interest Margin



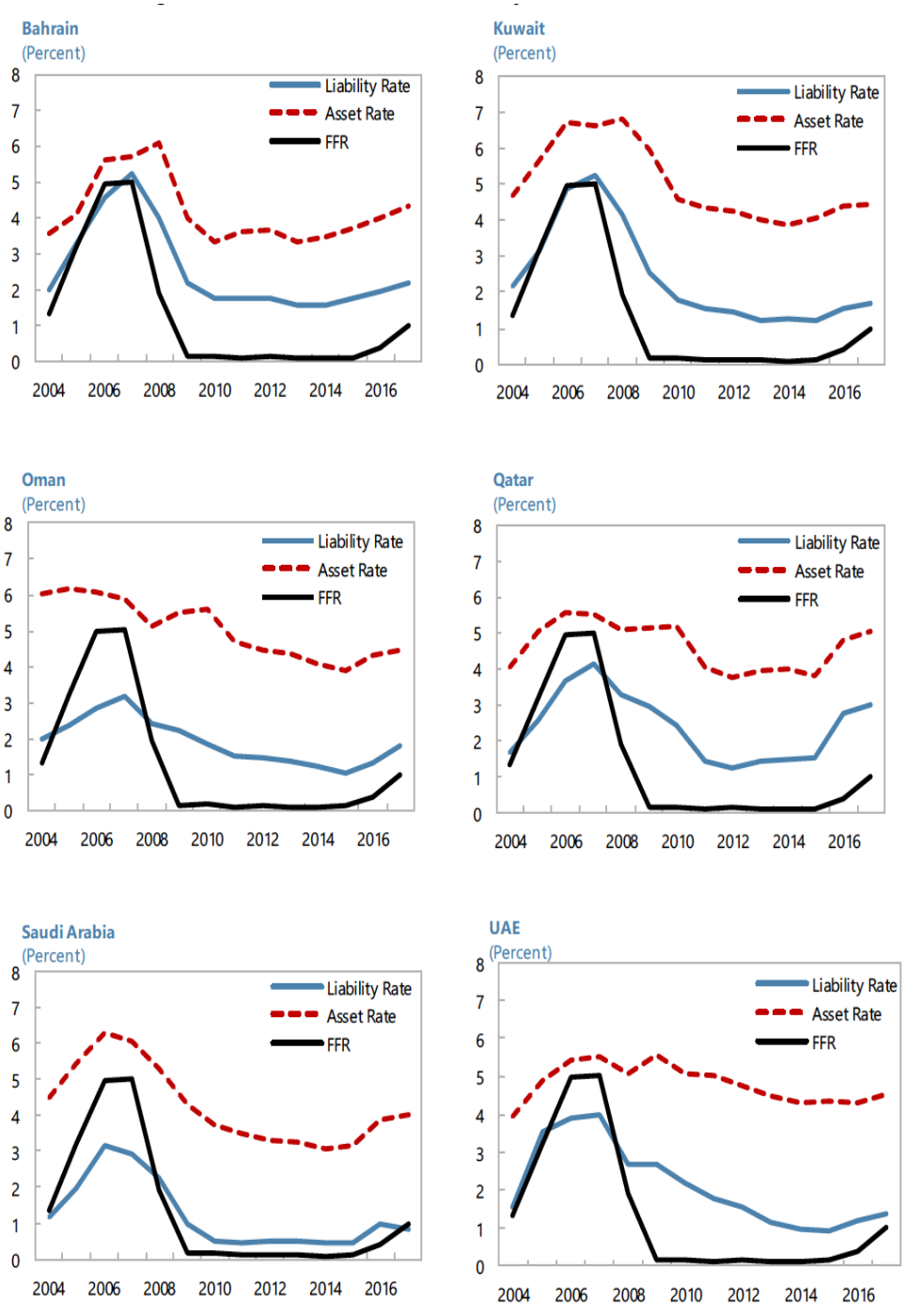
Sources: Fitch Connect; and IMF staff calculations.

Figure 3.7: Country-Level Impact of U.S. Monetary Policy on Profitability



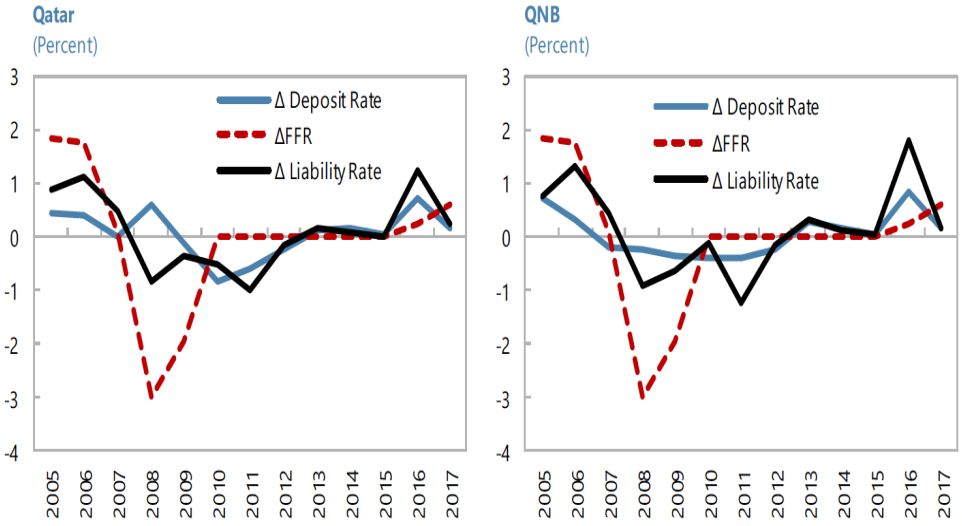
Sources: Fitch Connect; and IMF staff calculations
Note: coefficients are statistically significant for countries labeled in bold.

Figure 3.8: Time Series of Asset, Liability, and Federal Funds Rate



Source: Fitch Connect; and IMF staff calculations

Figure 3.9: Qatar's Banking System and U.S. Federal Funds Rate



Source: Fitch Connect; and IMF staff calculations.

Fiscal Policy Effectiveness Under Different Debt Regimes: The Case of Egypt[1]

Authors: Yacoub Alatrash, and Gani Nurmukhametov

4 Chapter 4

4.1 Introduction

Egypt has been undergoing a major IMF-supported reform program to solve its fiscal structural problems and move towards fiscal consolidation over the past five years. Those efforts led to notable fiscal development and overall improvement of the economic climate in Egypt. However, the COVID-19 pandemic put tremendous pressure on many sectors of the Egyptian economy (e.g., tourism and manufacturing), decreasing Egypt's economic growth rate by two percentage points compared to the pre-pandemic forecast.

This pandemic led policymakers to adopt an expansionary policy and enact a COVID-19 emergency budget increase of 100 billion Egyptian pounds. In addition, the government passed tax relief such as halving the dividends tax and the exchange tax relief. The rise in fiscal spending coupled with reduced revenue constitutes a threat to the Egyptian government's fiscal consolidation efforts.

We empirically investigate the impact of fiscal stimulus on real economic growth and shed light on the relationship between these variables. We particularly explore whether fiscal stimulus has a different effect on real economic activity when a country has low domestic debt versus when it has high domestic debt as a percentage of GDP. We then empirically quantify a particular threshold (i.e., a tipping point) at which the effectiveness of fiscal policy changes. First, we establish the existence of a threshold that splits the data into a low domestic debt regime

[1]This work has benefited from a financial grant from the Economic Research Forum. The contents and recommendations do not necessarily reflect the views of the Economic Research Forum.

and a high domestic debt regime at 81.5% domestic debt-to-GDP ratio. We also test for the existence of more than one threshold in the data, but we do not find any other threshold. Second, we establish with statistical significance that fiscal expansion increases real economic growth in the low-debt regime ($\leq$ 81.5%) and a decrease in real economic growth in the high-debt regime ($>$ 81.5%).

Third, we explore some of the possible theoretical explanations for the existence of the threshold effect. The first is the "Ricardian equivalence argument" – private investors internalize the government's budget constraint and reduce investment spending when debt levels are high, which leads to lower real economic growth. The second one is that higher fiscal spending increases interest rates, leading to a crowding out effect on investment. The last potential explanation is the "precautionary saving hypothesis" (Barro, 1974) – current excessive spending coupled with existing high levels of accumulated debt causes households to consume less and save more in the present because of anticipated tax hikes in the future (which has contractionary effects on real GDP). In the fourth section of this paper, we test empirically whether any of these arguments could explain why government spending has an adverse effect on growth in the high-debt regime.

To the best of our knowledge, no other empirical papers quantify debt-to-GDP thresholds for Egypt or provide policy implications of debt accumulation under different debt regimes. The paper is divided into five sections. The first section is an introduction that presents the research statement and the objective of this paper. The second section is a literature review. The third section describes the data used in the analysis and shows the sources, followed by the empirical methodology used to test our hypothesis. The fourth section shows the results of the empirical analysis and explores the theoretical arguments. The fifth section discusses the policy implications of the result. The last section concludes.

4.2 Literature Review

Optimal fiscal policy has been extensively studied in the economic literature. For example, authors have examined fiscal consolidation (Alesina and Ardagna, 2010; von Hagen and Strauch, 2001), fiscal reaction functions (Bohn, 1995 and 2007), and the optimal level of government expenditures (Forte and Maggazino, 2016). Several studies have also investigated these topics in developing economies (Baldacci et al., 2006; Gupta et al., 2005). Others evaluated government expenditures numerically and tax multipliers (Blanchard and Perotti, 2002; Coenen et al., 2012; Ilzetzki et al.,2013; Ramey, 2019; Romer and Romer, 2010; Woodford, 2011), including in MENA countries (Al Moneef and Hasanov, 2020; Alnashar, 2017; Cerisola et al., 2015; Espinoza and Senhadji, 2011).

Following the COVID-19 pandemic, fiscal stimulus, and other macroeconomic measures in the OECD and the US received extensive attention. Yet, as Alon et al. (2020) observes, it quickly became clear that developing countries could not replicate policies implemented in the advanced economies. Similarly, the analysis and the policy recommendations in the emerging markets should naturally follow the patterns intrinsic to developing economies and be based on the local data. Therefore, in our research, we reference recent work on the pandemic impact in emerging markets[2] and we pay particularly close attention to the papers that examined the fiscal measures under different debt regimes in developing countries (Burger and Calitz, 2020; Benmelech and Tzur-Ilan, 2020).

Several aspects of the optimal fiscal policy in Egypt (in particular, the effect of government spending and tax relief on GDP growth over different time horizons) have not been examined sufficiently in the recent economic literature. However, two notable works that are exceptions to this premise exist; both studies provide valuable insights but have some limitations. Alnashar (2017) evaluates the determinants of the government spending multiplier but does not analyze the tax change multiplier, and the research covers the pre-pandemic time frame. On the other hand, El-Khishin (2020) focuses on the economic measures taken

[2]Addison et al., 2020; Arellano et al., 2020; Loayza and Pennings, 2020

by Egypt's government to alleviate the impact of the pandemic. However, as a brief policy report, this study provides only the descriptive summary of the policy response and lacks the depth of the economic analysis.

The strand of literature that relates closely to our paper examines the empirical relationship between the level of debt and economic growth. For example, Reinhart and Rogoff (2010) employs a data set covering 44 countries over 200 years to show that a government debt-to-GDP ratio exceeding 90% is associated with lower GDP growth. Cecchetti et al. (2011) uses data on government, corporate, and household debt from 18 OECD countries and find that high debt levels ($> 80-90\%$ for government, $> 90\%$ for corporate, and $> 85\%$ for household debt) are associated with lower economic growth while a moderate level of debt can improve welfare. Checherita-Westphal and Rother (2012) utilizes data from 12 EU countries to show a negative effect of debt-to-GDP at the high levels of 90-100%. Several papers use threshold regression to study the impact of government spending on GDP under different debt regimes. Nickel and Vansteenkiste (2008) employs a panel of 21 developed countries and quantifies a threshold of 85% as the point after which spending and debt have adverse effects on growth, while Baharumshah et al. (2017) uses time series data on Malaysia and finds a threshold of 54.71% for domestic debt.

4.3 Data and Methodology

We use the publicly available quarterly data for Egypt ranging from March 2001 to March 2021. The data source for all the variables except economic policy uncertainty is the Central Bank of Egypt (CBE); we use monthly statistical bulletins, quarterly economic reviews, annual reports, and quarterly time-series data – all retrieved from the official CBE webpage. Data for economic policy uncertainty (EPU) index has been retrieved from Federal Reserve Bank of St. Louis Economic Data (FRED), World Economic Uncertainty Index for Egypt. The summary of the variables used in the research is given in the Table 4.1 below.

As can be seen from the Table 4.1, the overlapping period for all the variables is September

2003 – July 2020, 68 quarters in total. Since Egypt uses a fiscal year (FY) that starts in July and ends in June, the time frame of our research matches FY 2003/04:Q1 – FY 2019/20:Q4.

The raw quarterly data for real GDP exhibits a clear pattern of seasonality: there is a significant increase in real GDP between the last quarter of a previous fiscal year and the first quarter of a current fiscal year; we observe this pattern for the entire span of the data series. We apply a simple deseasonalizing method based on the centered moving average and used the deseasonalized data to calculate the change in real GDP between quarterly periods.

We consider two debt variables as a potential threshold variable in our paper: domestic debt and total debt, the latter refers to the sum of domestic debt and external debt. Both variables are normalized to a GDP level (expressed as debt-to-GDP ratios) and are measured in percentage points of Egypt's nominal GDP. It should be noted that the public debt reported by CBE includes the government's debt as well as the debt by public economic authorities and the debt accrued to National Investment Bank of Egypt; however, the share of the government's debt in public debt is estimated to fluctuate around 80-90% for the period analyzed in the current research.

The fiscal balance is calculated as the difference between total government revenues and total government expenditures over nominal GDP, the positive (negative) value for the fiscal balance implies that the government is running a fiscal surplus (deficit) in the current period. As it can be seen in the Figure 4.1, the government of Egypt was running a fiscal deficit in all but three time periods during the time span analyzed in the paper, and the median value for the fiscal balance to nominal GDP is negative 2.2 percentage points.

We chose the standard control variables used in the economic literature: change in money supply (M1), consumption, investment, export, inflation rate, unemployment rate, and EP uncertainty. The inflation rate has been calculated as the change in consumer price index (CPI) relative to corresponding month of previous year, the weights from January 2010 CPI were used for the entire data span to preserve the consistency for the calculation exercise. Consumption, investment, and export are normalized to a GDP level and are measured in

GDP percentage points.

We resort to Hansen (2000) sample splitting threshold regression model as a methodological base of our exercise. Consider a following simple regression equation:

$$y_t = (\beta_{10} + \beta_{11}x_t + \beta_{12}x_{t-1} + +\beta_{13}x_{t-2})\, I\,[q_t \leq \gamma] + (\beta_{20} + \beta_{21}x_t + \beta_{22}x_{t-1} + +\beta_{23}x_{t-2})\, I\,[q_t > \gamma] + \varepsilon_t \tag{4.1}$$

where:

- x_{t-j} is a vector of predictor variables, lagged j period(s);
- q_t is a threshold variable;
- γ is a threshold value;
- $I\,[q_t \leq \gamma]$ is an indicator function that is equal to 1 when $q_t \leq \gamma$ and equals 0 otherwise;
- $I\,[q_t > \gamma]$ is an indicator function that is equal to 1 when $q_t > \gamma$ and equals 0 otherwise;

We are testing the null hypothesis $H_0 : \beta_{1i} = \beta_{2i}$ for $i = 0, 1, 2, 3$. If the null hypothesis has been rejected, then the threshold effect has been established. The threshold value γ can be found by estimating equation (1) though finding the minimum one of the sums of squared errors in a threshold variable. Under the null hypothesis, the distribution of the p-value statistic is uniform, and this transformation can be calculated through bootstrap.

4.4 Results

As we mentioned previously, we consider two potential candidates for a threshold variable: domestic debt and total debt. Running different versions of empirical models, we find that regressions with domestic debt as a threshold variable yield robust result, but we are not able to reach significant results for models with total debt as a threshold variable. One of the drawbacks to using total debt as a threshold is that the total debt incorporates the external

debt component,which was subject to major exchange rate shocks in the past two decades, as the external debt being issued in world trade currencies, mainly in U.S. dollars. Being unable to collect the quarterly data on exchange rate for Egyptian pound, we cannot add the control variable for the exchange rate in the vector of regressors. Therefore, we resort to domestic debt as a threshold variable in the regression equations.

We consider contemporaneous variables as well as their first and second lags for fiscal balance and change in money supply to examine potential delayed responses to fiscal and monetary policy changes. We include only contemporaneous variables for the remaining explanatory (control) variables. The primary setup of an empirical model we estimate is as follows:

$$\begin{aligned}\Delta Y_t = (&\alpha_{10}+\beta_{11}FB_t + \beta_{12}FB_{t-1} + +\beta_{13}FB_{t-2} + \lambda_{11}\Delta M_t + \lambda_{12}\Delta M_{t-1} + \lambda_{13}\Delta M_{t-2} \\ &+\sigma_{1k}x_{k,t})\, I\left[DD_t \leq \gamma\right] \\ &+ (\alpha_{20} + \beta_{21}FB_t + \beta_{22}FB_{t-1} + \beta_{23}FB_{t-2} + \lambda_{21}\Delta M_t + \lambda_{22}\Delta M_{t-1} + \lambda_{23}\Delta M_{t-2} \\ &+\sigma_{2k}x_k)\, I\left[DD_t > \gamma\right] + \varepsilon_t\end{aligned} \tag{4.2}$$

where:

- ΔY_t is the change in Real GDP, relative to the previous time period;
- FB_{t-j} is the fiscal balance at time period t-j;
- ΔM_{t-j} is the change in money supply (M1), relative to the previous time period;
- $x_{k,t}$ is the vector of control variables at time period t;
- DD_t is the domestic debt (threshold variable) at time period t.

The summary of the estimated regressions is provided in Table 4.2. We include a wide list of potential explanatory variables, namely investment, inflation rate, export, unemployment rate, and EPU in a vector of control variables in Model 1. The model exhibits the threshold

effect: we establish the existence of the first threshold with the estimated value 81.5% at a 10% level of significance (bootstrap p-value of the threshold estimate is 0.09). We go a step further after that and test for the existence of a second threshold (either above or below the estimated value of the first threshold). However, we cannot establish a statistically significant second threshold effect as the bootstrap p-value of the second threshold exceeds 0.10. Note also that while most of fiscal balance and change in money supply variables are significant (at different level of significance), only investment, and EPU for the low-debt regime are significant.

We include only investment as a control variable in Model 2 and obtain stronger results. Firstly, the model still exhibits the threshold effect, and the value of a threshold remains at 81.5% being estimated at a much higher significance (at 1% level of significance, since bootstrap p-value of the threshold estimate is 0.004); like in the previous model, the existence of the second threshold has not been detected. Secondly, while the signs of the regressors slope coefficients tend to remain the same, we observe the major improvement in their significance.

We observe that coefficients of both lagged fiscal balance variables are significant and have a negative sign under the low-debt regime, and a coefficient of the first lagged fiscal balance variable has a positive sign and is significant under the high-debt regime We can interpret these signs as follows: expansionary fiscal policy is associated with positive (negative) real GDP growth under the low-debt (high-debt) regime.

We have previously mentioned three potential reasons for the fiscal policy inefficiency under the high-debt regime: the precautionary savings motive for consumers, and the Ricardian equivalence and crowding out effect for private investors. To test the empirical validity of these theoretical claims we use modified empirical models with consumption or investment as a dependent variable as shown in Table 4.3. We include only fiscal balance and change in money supply variables as regressors. Different from the first two models, we do not check for the existence of threshold(s) for the case of consumption and investment regressions. In-

stead, taking the estimated threshold value of domestic debt (81.5%) as given, we run three separate regressions for both consumption and investment models: for the full sample, for the low-debt regime subsample, and for the high-debt regime subsample.

The obtained results do not support the Ricardian equivalence and precautionary saving hypotheses because the slope coefficients of fiscal balance variables albeit being highly significant, do not exhibit different signs under different debt regimes indicating no threshold effect. For these two hypotheses to hold we would have needed to see a negative sign for fiscal balance coefficients under the low-debt regime and positive coefficients under the high-debt regime.

However, the crowding out hypothesis (that higher government spending increases interest rates leading to reduced investment) might be valid in this case as we see a statistically significant positive association between fiscal balance and investment (which indicates that running larger fiscal deficits leads to lower private investment) under both low and high-debt regimes. In general, we could not establish in this paper with confidence what is causing the contractionary effects of higher government spending under the high-debt regime. This is a topic we are planning to explore in future iterations of this research.

4.5 Policy Implications

Some of the policy implications of this model are as follows:

1. The Egyptian government should increase prudence at high domestic debt-to-GDP ratios. In other words, it should constantly monitor debt levels before considering fiscal stimuli. When debt is high relative to GDP, any expansionary effects of additional spending disappear (or even become contractionary at worst). Thus, while the economy may expand in the short run, it is likely to contract in the medium to long run. This reversal means that the government should get its debt situation under control if its fiscal policy is to be effective.

2. Our empirical results suggest that the Egyptian policy makers should target a domestic debt level below or at the threshold value (81.5% domestic debt-to-GDP ratio). Historically, 47 out of 77 quarters of available data for Egypt's domestic debt fall in the low-debt regime while only 30 quarters fall in the high-debt regime as seen in Figure 4.2.

3. The Egyptian government should coordinate with the Central Bank of Egypt. Fiscal-Monetary Coordination in times of high debt could help stimulate growth despite the contractionary effects of fiscal spending that we found. As shown in Table 4.2, we can see that lagged growth in money supply (M1) is positively associated with real GDP growth in the high domestic debt regime for the second lag (with statistical significance) and in the first lag (weakly). Thus, expansionary monetary policy can lead to positive real GDP growth under high domestic debt regime without the need for more debt accumulation through fiscal expansion.

4. Our data shows a negative effect of economic policy uncertainty (EPU) on real GDP growth (with statistical significance in low debt regime and weakly in high debt regime). This indicates that risk management practices and innovative efforts to mitigate the negative consequences of EPU could be of great benefit for the Egyptian economy in the time of crisis.

4.6 Conclusion

growth under different debt regimes. First, we test if the relationship between fiscal expansion and economic growth is nonlinear and depends on the amount of domestic debt accumulated. To do this, we search for a threshold effect employing Hansen's (2000) sample-splitting threshold regression model. As a result, we establish that lagged fiscal expenditure leads to an increase in real GDP in the low-debt regime (below 81.5% domestic debt-to-GDP ratio threshold) and that fiscal expansion leads to adverse effects on real GDP under the high-debt

regime (above 81.5%). We further explore and test possible theoretical explanation for the findings such as Ricardian equivalence hypothesis, the precautionary saving hypothesis, and the crowding out of investment hypothesis. We conclude by discussing the policy implications of our results.

Tables

Table 4.1: Descriptive statistics of the variables

	Available Data	Qtrs.	Mean	Median	Min.	Max.	S.D.
Δ Real GDP	2003:Q3-2021:Q1	71	1.272	1.210	-7.580	9.330	3.751
Domestic Debt	2001:Q2-2020:Q2	77	78.813	79.800	66.300	96.700	6.808
Total Debt	2001:Q2-2020:Q2	77	103.840	105.100	81.400	131.200	13.260
Fiscal Balance	2003:Q3-2020:Q3	69	-2.194	-2.200	-4.900	0.4000	0.964
Δ Money Supply	2003:Q3-2021:Q1	71	4.169	4.030	-1.790	13.330	2.900
Consumption	2001:Q3-2021:Q1	79	78.529	78.080	62.870	91.080	6.848
Investment	2001:Q3-2021:Q1	79	16.874	16.420	8.200	27.780	3.941
Export	2001:Q3-2021:Q1	79	20.401	19.680	9.440	35.760	7.094
Inflation Rate	2003:Q3-2021:Q1	71	11.134	10.470	3.200	32.150	5.993
Unemployment Rate	2003:Q1-2021:Q1	73	10.656	10.600	7.200	13.400	1.853
EPU	2001:Q1-2021:Q1	81	0.1446	0.100	0.000	1.010	0.180

Table 4.2: Empirical Models Estimation

	Change in Real GDP (Model 1)			Change in Real GDP (Model 2)		
	Full sample	Low debt regime	High debt regime	Full sample	Low debt regime	High deb regime
Fiscal Balance	0.158 (0.641)	−0.430 (0.865)	0.428 (0.854)	−0.389 (0.489)	−0.593 (0.820)	−0.001 (0.522)
Fiscal Balance, lagged 1 period	0.525 (0.565)	−1.249 (0.783)	1.660** (0.732)	0.184 (0.488)	−1.577** (0.669)	1.513** (0.575)
Fiscal Balance, lagged 2 periods	−0.190 (0.616)	−1.749∗ (1.028)	0.089 (0.823)	−0.533 (0.524)	−2.432 ∗ ** (0.832)	−0.160 (0.602)
Δ Money Supply	−0.248 (0.198)	−0.548* (0.283)	0.314 (0.297)	−0.286∗ (0.169)	−0.600** (0.243)	0.213 (0.229)
Δ Money Supply, lagged 1 period	0.291∗ (0.173)	0.591*** (0.211)	0.421 (0.315)	0.228 (0.157)	0.446** (0.185)	0.395 (0.232)
Δ Money Supply, lagged 2 periods	0.014 (0.179)	−0.497** (0.217)	0.567* (0.295)	0.001 (0.168)	−0.468** (0.203)	0.536* (0.271)
Investment	0.437** (0.168)	0.856 ∗ ** (0.218)	0.421 (0.267)	0.319** (0.135)	0.580*** (0.161)	0.394* (0.199)
Inflation Rate	−0.091 (0.079)	−0.104 (0.109)	−0.128 (0.112)			
Export	−0.066 (0.114)	−0.218 (0.151)	−0.126 (0.187)			
Unemployment Rate	0.625* (0.370)	0.727 (0.503)	−0.047 (0.938)			
Economic Policy Uncertainty	−1.135 (2.935)	−6.238* (3.175)	−1.655 (8.922)			
# of observations	66	41	25	66	41	25
R^2	0.2287	0.5169	0.5967	0.1709	0.4220	0.5445

Standard errors are given in parentheses. Significance levels: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Table 4.3: Consumption and Investment as dependent variables

	Private Consumption			Investment		
	Full sample	Low debt regime	High debt regime	Full sample	Low debt regime	High deb regime
Fiscal Balance	−1.154 (0.746)	−1.471 (1.236)	(1.094)	0.466 (0.469)	1.409 (0.838)	−0.157 (0.617)
Fiscal Balance, lagged 1 period	−1.478** (0.734)	−1.313 (0.996)	−1.827 (1.194)	0.757 (0.462)	1.314* (0.675)	0.425 (0.674)
Fiscal Balance, lagged 2 periods	−3.230*** (0.736)	−2.874** (1.217)	−3.807*** (1.131)	1.583*** (0.463)	1.879** (0.825)	1.351** (0.638)
Δ Money Supply	−0.402 (0.259)	−0.474 (0.381)	−0.198 (0.476)	0.062 (0.163)	0.062 (0.259)	−0.163 (0.269)
Δ Money Supply, lagged 1 period	0.001 (0.236)	0.254 (0.280)	−0.354 (0.480)	−0.225 (0.149)	−0.294 (0.190)	−0.203 (0.271)
Δ Money Supply, lagged 2 periods	−0.056 (0.256)	−0.336 (0.305)	0.715 (0.558)	0.172 (0.161)	0.359* (0.207)	−0.254 (0.315)
# of observations	66	41	25	66	41	25
R^2	0.3701	0.3316	0.5206	0.3090	0.4272	0.3463

Standard errors are given in parentheses. Significance levels: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Figures

Figure 4.1: Egypt's Fiscal Balance in 2003 September - 2020 September

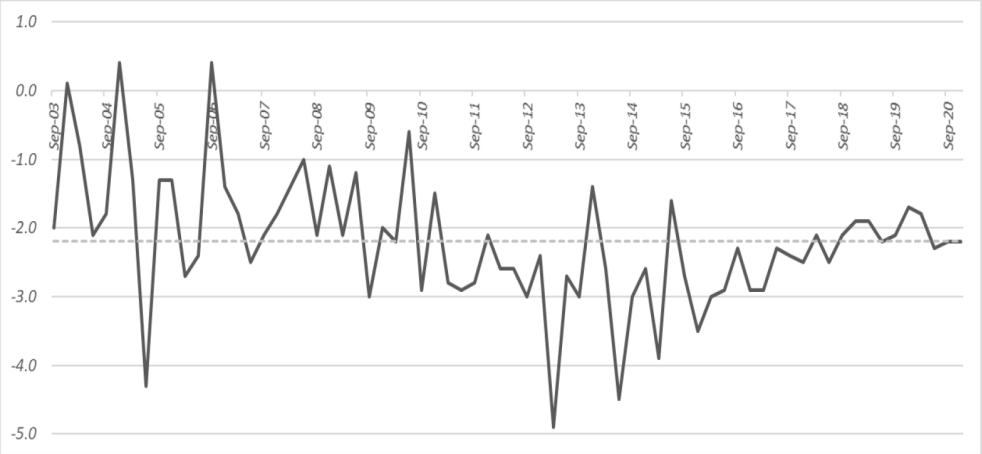
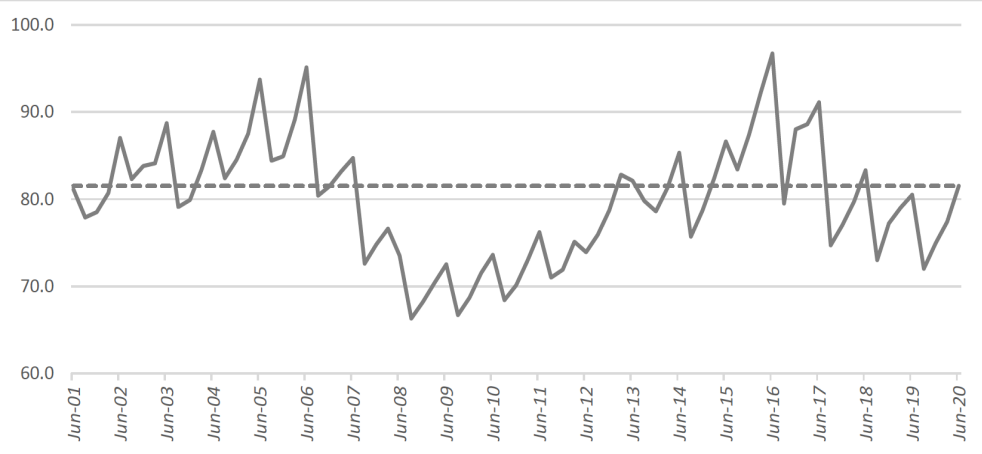


Figure 4.2: Egypt's Domestic Debt in 2001 June - 2020 June



References

[1] Tony Addison, Kunal Sen, and Finn Tarp. *COVID-19: Macroeconomic dimensions in the developing world*. Number 2020/74. WIDER Working Paper, 2020.

[2] Olumuyiwa S Adedeji, Sohaib Shahid, and Ling Zhu. *Saudi's Growth and Financial Spillovers to Other GCC Countries: An Empirical Analysis*. International Monetary Fund, 2018.

[3] Majed Al Moneef, Fakhri Hasanov, et al. Fiscal multipliers for saudi arabia revisited. *King Abdullah Petroleum Studies and Research Center: Riyadh, Saudi Arabia*, 2020.

[4] James Albrecht, Lucas Navarro, and Susan Vroman. The effects of labour market policies in an economy with an informal sector. *The Economic Journal*, 119(539):1105–1129, 2009.

[5] Alberto Alesina and George-Marios Angeletos. Corruption, inequality, and fairness. *Journal of Monetary Economics*, 52(7):1227–1244, 2005.

[6] Alberto Alesina and Silvia Ardagna. Large changes in fiscal policy: taxes versus spending. *Tax policy and the economy*, 24(1):35–68, 2010.

[7] Alberto Alesina and Roberto Perotti. Income distribution, political instability, and investment. *European economic review*, 40(6):1203–1228, 1996.

[8] Alberto Alesina and Dani Rodrik. Distributive politics and economic growth. *The quarterly journal of economics*, 109(2):465–490, 1994.

[9] Piergiorgio Alessandri and Benjamin D Nelson. Simple banking: profitability and the yield curve. *Journal of Money, Credit and Banking*, 47(1):143–175, 2015.

[10] Naif Alghaith, Ahmed Al-Darwish, Pragyan Deb, and Padamja Khandelwal. Monetary and macroprudential policies in saudi arabia. *Saudi Arabia: Tackling Emerging Economic Challenges to Sustain Growth*, page 37, 2014.

[11] Sara B Alnashar et al. Egypt's government spending multiplier: its size and determinants. In *Economic Research Forum (ERF) Working Paper Series*, number 1165, 2017.

[12] Titan Alon, Minki Kim, David Lagakos, and Mitchell VanVuren. How should policy responses to the covid-19 pandemic differ in the developing world? Technical report, National Bureau of Economic Research, 2020.

[13] Cristina Arellano, Yan Bai, and Gabriel P Mihalache. Deadly debt crises: Covid-19 in emerging markets. Technical report, National Bureau of Economic Research, 2020.

[14] Stefan Avdjiev, Leonardo Gambacorta, Linda S Goldberg, and Stefano Schiaffi. The shifting drivers of global liquidity. *Journal of International Economics*, 125:103324, 2020.

[15] Ahmad Zubaidi Baharumshah, Siew-Voon Soon, and Evan Lau. Fiscal sustainability in an emerging market economy: When does public debt turn bad? *Journal of Policy Modeling*, 39(1):99–113, 2017.

[16] Alexey Balaev. The structure of public spending and economic growth in russia. *Russian Journal of Economics*, 5(2):154–176, 2019.

[17] Emanuele Baldacci, Benedict Clements, Sanjeev Gupta, and Carlos Mulas-Granados. The phasing of fiscal adjustments: what works in emerging market economies? *Review of Development Economics*, 10(4):612–631, 2006.

[18] Abhijit V Banerjee and Andrew F Newman. Occupational choice and the process of development. *Journal of political economy*, 101(2):274–298, 1993.

[19] Robert J Barro. Are government bonds net wealth? *Journal of political economy*, 82(6):1095–1117, 1974.

[20] Efraim Benmelech and Nitzan Tzur-Ilan. The determinants of fiscal and monetary policies during the covid-19 crisis. Technical report, National Bureau of Economic Research, 2020.

[21] Keith Blackburn and Gonzalo F Forgues-Puccio. Distribution and development in a model of misgovernance. *European Economic Review*, 51(6):1534–1563, 2007.

[22] Olivier Blanchard and Roberto Perotti. An empirical characterization of the dynamic effects of changes in government spending and taxes on output. *the Quarterly Journal of economics*, 117(4):1329–1368, 2002.

[23] Niels-Hugo Blunch. Bound to lose, bound to win? the financial crisis and the informal-formal sector earnings gap in serbia. *IZA Journal of Labor & Development*, 4:1–34, 2015.

[24] Richard Blundell, Avinash K Dixit, John JF Sherrerd, et al. *Lawlessness and economics: Alternative modes of governance*, volume 1. Princeton University Press, 2004.

[25] Henning Bohn. The sustainability of budget deficits in a stochastic economy. *Journal of Money, Credit and Banking*, 27(1):257–271, 1995.

[26] Henning Bohn. Are stationarity and cointegration restrictions really necessary for the intertemporal budget constraint? *Journal of monetary Economics*, 54(7):1837–1847, 2007.

[27] François Bourguignon and Thierry Verdier. Oligarchy, democracy, inequality and growth. *Journal of development Economics*, 62(2):285–313, 2000.

[28] Falk Bräuning and Victoria Ivashina. Monetary policy and global banking. *The Journal of Finance*, 75(6):3055–3095, 2020.

[29] Philippe Burger and Estian Calitz. Covid-19, economic growth and south african fiscal policy. *South African Journal of Economics*, 89(1):3–24, 2021.

[30] Stephen G Cecchetti, Madhusudan S Mohanty, and Fabrizio Zampolli. The real effects of debt. 2011.

[31] Mr Martin D Cerisola, Mr Chadi Abdallah, Mr Victor A Davies, and Mr Mark Fischer. *Assessing the impact of fiscal shocks on output in MENAP countries*. International Monetary Fund, 2015.

[32] Nicola Cetorelli and Linda S Goldberg. Banking globalization and monetary transmission. *The Journal of Finance*, 67(5):1811–1843, 2012.

[33] Kung-Sik Chan. Consistency and limiting distribution of the least squares estimator of a threshold autoregressive model. *The annals of statistics*, pages 520–533, 1993.

[34] Anusha Chari, Karlye Dilts Stedman, and Christian Lundblad. Taper tantrums: Qe, its aftermath and emerging market capital flows. Technical report, National Bureau of Economic Research, 2017.

[35] Santanu Chatterjee, Thomas Lebesmuehlbacher, and Abhinav Narayanan. How productive is public investment? evidence from formal and informal production in india. *Journal of Development Economics*, 151:102625, 2021.

[36] Cristina Checherita-Westphal and Philipp Rother. The impact of high government debt on economic growth and its channels: An empirical investigation for the euro area. *European economic review*, 56(7):1392–1405, 2012.

[37] Jay Pil Choi and Marcel Thum. Corruption and the shadow economy. *International Economic Review*, 46(3):817–836, 2005.

[38] Alberto Chong and Cesar Calderon. Institutional quality and income distribution. *Economic Development and Cultural Change*, 48(4):761–786, 2000.

[39] Alberto Chong and Mark Gradstein. Inequality and institutions. *The review of Economics and Statistics*, 89(3):454–465, 2007.

[40] Günter Coenen, Christopher J Erceg, Charles Freedman, Davide Furceri, Michael Kumhof, René Lalonde, Douglas Laxton, Jesper Lindé, Annabelle Mourougane, Dirk Muir, et al. Effects of fiscal stimulus in structural models. *American Economic Journal: Macroeconomics*, 4(1):22–68, 2012.

[41] Mihai Copaciu, Valeriu Nalban, Cristian Bulete, et al. Rem 2.0, an estimated dsge model for romania. In *11th Dynare Conference, Brussels, National Bank of Belgium*, 2015.

[42] Era Dabla-Norris, Mark Gradstein, and Gabriela Inchauste. What causes firms to hide output? the determinants of informality. *Journal of development economics*, 85(1-2):1–27, 2008.

[43] Hernando De Soto. *The mystery of capital: Why capitalism triumphs in the West and fails everywhere else*. Basic books, 2000.

[44] Stephen Dobson and Carlyn Ramlogan-Dobson. Is there a trade-off between income inequality and corruption? evidence from latin america. *Economics letters*, 107(2):102–104, 2010.

[45] Stephen Dobson and Carlyn Ramlogan-Dobson. Inequality, corruption and the informal sector. *Economics letters*, 115(1):104–107, 2012.

[46] Stephen Dobson and Carlyn Ramlogan-Dobson. Why is corruption less harmful to income inequality in latin america? *World Development*, 40(8):1534–1545, 2012.

[47] Itamar Drechsler, Alexi Savov, and Philipp Schnabl. The deposits channel of monetary policy. *The Quarterly Journal of Economics*, 132(4):1819–1876, 2017.

[48] Axel Dreher, Christos Kotsogiannis, and Steve McCorriston. How do institutions affect corruption and the shadow economy? *International Tax and Public Finance*, 16:773–796, 2009.

[49] Axel Dreher and Friedrich Schneider. Corruption and the shadow economy: an empirical analysis. *Public Choice*, 144:215–238, 2010.

[50] Sarah El-Khishin. Countermeasures for the covid-19 outbreak in egypt: This time is really different. 2020.

[51] William B English et al. Interest rate risk and bank net interest margins. *BIS Quarterly Review*, 10(1):67–82, 2002.

[52] Mr Raphael A Espinoza and Mr Abdelhak S Senhadji. *How strong are fiscal multipliers in the GCC?* International Monetary Fund, 2011.

[53] Raymond Fisman and Roberta Gatti. Decentralization and corruption: evidence across countries. *Journal of public economics*, 83(3):325–345, 2002.

[54] Francesco Forte and Cosimo Magazzino. Government size and economic growth in italy: a time-series analysis. *European Scientific Journal*, 12(7), 2016.

[55] Eric Friedman, Simon Johnson, Daniel Kaufmann, and Pablo Zoido-Lobaton. Dodging the grabbing hand: the determinants of unofficial activity in 69 countries. *Journal of public economics*, 76(3):459–493, 2000.

[56] Oded Galor and Omer Moav. Das human-kapital: A theory of the demise of the class structure. *The Review of Economic Studies*, 73(1):85–117, 2006.

[57] Oded Galor, Omer Moav, and Dietrich Vollrath. Land inequality and the emergence of human capital promoting institutions. Technical report, Working Paper, 2005.

[58] Oded Galor and Joseph Zeira. Income distribution and macroeconomics. *The review of economic studies*, 60(1):35–52, 1993.

[59] Ardiana Gashi and Colin C Williams. Evaluating the prevalence and distribution of unregistered employment in kosovo: lessons from a 2017 survey. *South East European Journal of Economics and Business*, 14(1):7–20, 2019.

[60] Edward Glaeser, Jose Scheinkman, and Andrei Shleifer. The injustice of inequality. *Journal of Monetary Economics*, 50(1):199–222, 2003.

[61] Mark Gradstein. Inequality, democracy and the protection of property rights. *The Economic Journal*, 117(516):252–269, 2007.

[62] Sanjeev Gupta, Emanuele Baldacci, Benedict Clements, and Erwin R Tiongson. What sustains fiscal consolidations in emerging market countries? *International Journal of Finance & Economics*, 10(4):307–321, 2005.

[63] Sanjeev Gupta, Hamid Davoodi, and Rosa Alonso-Terme. Does corruption affect income inequality and poverty? *Economics of governance*, 3:23–45, 2002.

[64] Kwabena Gyimah-Brempong. Corruption, economic growth, and income inequality in africa. *Economics of governance*, 3:183–209, 2002.

[65] Kwabena Gyimah-Brempong and Samaria Munoz de Gyimah-Brempong. Corruption, growth, and income distribution: Are there regional differences? *Economics of governance*, 7:245–269, 2006.

[66] Bruce E Hansen. Inference when a nuisance parameter is not identified under the null hypothesis. *Econometrica: Journal of the econometric society*, pages 413–430, 1996.

[67] Bruce E Hansen. Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of econometrics*, 93(2):345–368, 1999.

[68] Bruce E Hansen. Sample splitting and threshold estimation. *Econometrica*, 68(3):575–603, 2000.

[69] Jean Hindriks, Michael Keen, and Abhinay Muthoo. Corruption, extortion and evasion. *Journal of Public economics*, 74(3):395–430, 1999.

[70] Oana Simona Hudea. The romanian versus eurozone economy via a dsge model. *Economic research-Ekonomska istraživanja*, 32(1):50–65, 2019.

[71] Ethan Ilzetzki, Enrique G Mendoza, and Carlos A Végh. How big (small?) are fiscal multipliers? *Journal of monetary economics*, 60(2):239–254, 2013.

[72] Simon Johnson, Daniel Kaufmann, and Pablo Zoido-Lobaton. Regulatory discretion and the unofficial economy. *The American economic review*, 88(2):387–392, 1998.

[73] Elif Oznur Kan and Aysit Tansel. Defining and measuring informality in the turkish labor market. *Available at SSRN 2475525*, 2014.

[74] Padamja Khandelwal, Mr Ken Miyajima, and Mr Andre O Santos. *The impact of oil prices on the banking system in the GCC*. International Monetary Fund, 2016.

[75] Irina Khvostova, Alexander Larin, and Anna Novak. Euler equation with habits and measurement errors: estimates on russian micro data. *Higher School of Economics Research Paper No. WP BRP*, 52, 2014.

[76] Divya Kirti. Why do bank-dependent firms bear interest-rate risk? *Journal of Financial Intermediation*, 41:100823, 2020.

[77] Ekaterina Klepikova et al. Labor supply elasticity in russia. *Voprosy economiki*, 9, 2016.

[78] Mika Kortelainen and Simo Leppänen. Public and private capital productivity in russia: a non-parametric investigation. *Empirical Economics*, 45:193–216, 2013.

[79] Rafael La Porta and Andrei Shleifer. The unofficial economy and economic development. Technical report, National Bureau of Economic Research, 2008.

[80] Norman Loayza and Steven Michael Pennings. Macroeconomic policy in the time of covid-19: A primer for developing countries. *World Bank Research and Policy Briefs*, (147291), 2020.

[81] Norman V Loayza. The economics of the informal sector: a simple model and some empirical evidence from latin america. In *Carnegie-Rochester conference series on public policy*, volume 45, pages 129–162. Elsevier, 1996.

[82] Norman V Loayza. Informality in the process of development and growth. *The World Economy*, 39(12):1856–1916, 2016.

[83] William F Maloney. Informality revisited. *World development*, 32(7):1159–1178, 2004.

[84] Biswajit Mandal and Sugata Marjit. Corruption and wage inequality? *International Review of Economics & Finance*, 19(1):166–172, 2010.

[85] Sugata Marjit, Sudeep Ghosh, and Amit Biswas. Informality, corruption and trade reform. *European Journal of Political Economy*, 23(3):777–789, 2007.

[86] Paolo Mauro. Corruption and growth. *The quarterly journal of economics*, 110(3):681–712, 1995.

[87] Leandro Medina and Mr Friedrich Schneider. *Shadow economies around the world: what did we learn over the last 20 years?* International Monetary Fund, 2018.

[88] Silvia Miranda-Agrippino, Hélene Rey, et al. *World asset markets and the global financial cycle*. National Bureau of Economic Research Cambridge, MA, 2015.

[89] Christiane Nickel and Isabel Vansteenkiste. Fiscal policies, the current account and ricardian equivalence. 2008.

[90] Maurice Obstfeld, Jay C Shambaugh, and Alan M Taylor. Financial stability, the trilemma, and international reserves. *American Economic Journal: Macroeconomics*, 2(2):57–94, 2010.

[91] IM Okumu and GF Forgues-Puccio. Is the informal sector a window of hope? corruption, informal sector and income inequality. 2014.

[92] Torsten Persson and Guido Tabellini. ls inequality harmful for growth. *American Economic Review*, 84(3):600–621, 1994.

[93] Valerie A Ramey. Ten years after the financial crisis: What have we learned from the renaissance in fiscal research? *Journal of Economic Perspectives*, 33(2):89–114, 2019.

[94] Carmen M Reinhart and Kenneth S Rogoff. Growth in a time of debt. *American economic review*, 100(2):573–578, 2010.

[95] Hélène Rey. Dilemma not trilemma: the global financial cycle and monetary policy independence. Technical report, National Bureau of Economic Research, 2015.

[96] Christina D Romer and David H Romer. The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks. *American Economic Review*, 100(3):763–801, 2010.

[97] Iulia Roşoiu. The impact of the government revenues and expenditures on the economic growth. *Procedia Economics and Finance*, 32:526–533, 2015.

[98] J Barkley Rosser Jr and Richard G Sheehan. A vector autoregressive model of the saudi arabian economy. *Journal of Economics and Business*, 47(1):79–90, 1995.

[99] Friedrich Schneider, Andreas Buehn, and Claudio E Montenegro. Shadow economies all over the world: New estimates for 162 countries from 1999 to 2007. In *Handbook on the shadow economy*. Edward Elgar Publishing, 2011.

[100] Jay C Shambaugh. The effect of fixed exchange rates on monetary policy. *the Quarterly Journal of economics*, 119(1):301–352, 2004.

[101] Konstantin Sonin. Why the rich may favor poor protection of property rights. *Journal of comparative economics*, 31(4):715–731, 2003.

[102] Mr Junji Ueda. *The evolution of potential VAT revenues and C-efficiency in advanced economies*. International Monetary Fund, 2017.

[103] Gabriel Ulyssea. Regulation of entry, labor market institutions and the informal sector. *Journal of Development Economics*, 91(1):87–99, 2010.

[104] Jürgen Von Hagen and Rolf R Strauch. Fiscal consolidations: Quality, economic conditions, and success. *Public Choice*, pages 327–346, 2001.

[105] Michael Woodford. Simple analytics of the government expenditure multiplier. *American Economic Journal: Macroeconomics*, 3(1):1–35, 2011.