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Design of fiscal consolidation packages and model-based fiscal multipliers in Croatia

MILAN DESKAR-ŠKRBIĆ, Ph.D.*
DARJAN MILUTINOVIĆ, MA*

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Milan DESKAR-ŠKRBIĆ
Croatian National Bank, Modelling Department, Trg hrvatskih velikana 3, 10000 Zagreb, Croatia
e-mail: mdeskar@hnb.hr
ORCiD: 0000-0002-7611-2071

Darjan MILUTINOVIĆ
Croatian National Bank, Economic Analysis Department, Trg hrvatskih velikana 3, 10000 Zagreb, Croatia
e-mail: dmilutinovic@hnb.hr
ORCiD: 0000-0001-5010-7437

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Abstract

The widening fiscal deficits and the increase of public debt triggered by the COVID-19 crisis suggest that fiscal policy makers will have to engage in substantial fiscal consolidation in order to stabilize public finances in the mid run. However, the implementation of a fiscal consolidation package, if it is not properly designed, can be detrimental for growth and even lead to a self-defeating outcome. In order to avoid this undesirable scenario, fiscal policy makers should rely on growth-friendly consolidation packages. The design of growth-friendly fiscal consolidation packages requires an understanding of the size of multipliers of different fiscal instruments. Thus, in this paper we provide the first deeper insights into the size of model-based disaggregated fiscal multipliers in Croatia. For this purpose, we have built a semi-structural macro-fiscal model of the Croatian economy and used Croatia's experience during the fiscal consolidation episode under the excessive deficit procedure (EDP) to retrieve fiscal multipliers, analyse the design of the policy package and provide model-based evaluation of the macroeconomic effects of this consolidation episode. Our results indicate that the fiscal consolidation implemented during the EDP was not growth-friendly and that it was partially self-defeating. We hope that our results can help fiscal policy makers to avoid similar policy mistakes in future fiscal consolidations.

Keywords: fiscal consolidation, fiscal multipliers, Croatia, economic modelling

1 INTRODUCTION

The Covid-19 pandemic has prompted governments around the world to implement large fiscal stimulus packages in order to mitigate the economic costs of this global shock. Discretionary fiscal actions led to a structural increase of budget expenditures (e.g. subsidies to companies and transfers to households) and a fall in revenues (e.g. tax reliefs), thus widening fiscal deficits. The fall in economic activity, mostly triggered by the lockdowns imposed, has put additional pressure on fiscal balances through a mechanism of automatic stabilizers. These developments will result in a strong increase of public debt in both absolute and relative terms.

The deteriorating fiscal balances in 2020 suggest that fiscal policy makers will have to make a substantial fiscal effort to consolidate public finances and stabilize public debt dynamics in the mid run.[1] This is especially important for Croatia on its path towards euro adoption. However, the implementation of fiscal consolidation packages, if not properly designed, could be detrimental for growth and thus even lead to *self-defeating* fiscal consolidation efforts. More precisely, poorly designed fiscal consolidation packages could additionally increase the public-debt-to-GDP ratio if the effects of a policy-induced fall in GDP[2] outweigh the effect of fiscal adjustment (Gros and Maurer, 2012; Eyraund and Webber, 2013; Boussard, de Castro and Salto, 2013).

[1] IMF in Regional Economic Outlook: Europe October 2020 (p.11) states that: "The extraordinary policy support needs to be anchored by credible consolidation plans to be implemented once the recovery has taken hold."
[2] Fall in GDP reduces the denominator of the ratio but also triggers the mechanism of automatic stabilizers that leads to a fall in revenues and a rise in some categories of expenditures (e.g. unemployment benefits). We explain these mechanisms in more detail in section 4.

That is why fiscal policy makers should rely on *growth-friendly* fiscal consolidation packages. The basic idea behind growth-friendly fiscal consolidations is to design a fiscal consolidation package that ensures an improvement of fiscal balances, while minimizing negative short-term effects on growth (Cournède, Goujard and Pina, 2013). To put it differently, growth-friendly consolidation packages should be based on fiscal instruments with low fiscal multipliers as they could ensure the required fiscal effort with low economic costs.

The design of growth-friendly consolidation packages requires deep understanding of fiscal policy transmission mechanisms and knowledge about the size of fiscal multipliers of different fiscal instruments, i.e. so-called "disaggregated" fiscal multipliers (e.g. Boussard, de Castro and Salto, 2013; Cortuk, 2013). Thus, the key goal of this paper is to provide the first detailed insights into fiscal policy transmission mechanisms and the size of disaggregated fiscal multipliers in Croatia. Data on disaggregated fiscal multipliers can help fiscal policy makers in designing growth-friendly fiscal consolidation packages in the future.

Estimates of fiscal multipliers in Croatia have so far been exclusively based on vector autoregression methodology (VAR) (Šimović and Deskar-Škrbić, 2013; Grdović Gnip, 2014; 2015; Deskar-Škrbić and Šimović, 2017). Although the VAR-based approach to the estimation of fiscal multipliers dominates fiscal literature, it does not allow a comprehensive analysis of the complex transmission mechanisms of fiscal policy and offers a limited framework for the analysis of macroeconomic effects of different fiscal policy instruments and feedbacks from macroeconomic to fiscal variables. This kind of analysis requires a more model-oriented approach.

References to model-based evaluation of the macroeconomic effects of fiscal policy in Croatia are scarce. To our knowledge there are only three papers investigating the effects of fiscal policy through the lenses of economic models on the macro level,[3] but only for one fiscal instrument. Nadoveza, Sekur and Beg (2016) use the computable general equilibrium (CGE) model to analyse the macroeconomic effects of changes in the income tax burden. Deskar-Škrbić (2018) calibrates a small-scale dynamic stochastic general equilibrium (DSGE) model to simulate the effects of a government consumption shock on the Croatian economy. Bokan and Ravnik (2018) present the Croatian National Bank's quarterly projection model (QPM) and simulate the effects of a change in the structural deficit.

This paper seeks to fill this gap in the literature by building and introducing for the first time a small semi-structural macro-fiscal model of the Croatian economy. This model allows us to retrieve disaggregated fiscal multipliers by comparing the realizations of macroeconomic variables in the *no policy change* and *policy*

[3] Some authors use micro-simulation models to estimate the effects of various fiscal measures on micro level. See for example Urban et al. (2018).

change scenarios, for different fiscal instruments. In addition, this model allows us to investigate the feedback from policy-induced changes in macroeconomic variables to fiscal balances and public debt. However, we want to emphasize that the model that we propose is not on a large enough scale to be able to capture all the relevant macroeconomic relations and the purpose of this model is not to describe the Croatian economy in detail but to give a basic framework for the analysis of the effects of fiscal policy. In addition, the proposed model (like other models in this class) is faced with various methodological limitations that we explain in detail in the main text.

The key challenge in the estimation of fiscal multipliers is to find episodes of *exogenous* changes in fiscal instruments, i.e. changes that are not directly related to business cycle developments.[4] However, Croatia's recent experience during the excessive deficit procedure (EDP) from 2014 to 2016 offers a capacious framework for the analysis in this sense. The EDP fiscal consolidation episode is interesting, as the fiscal authorities implemented a series of *structural* fiscal measures.[5] These measures were reported in a transparent way and subjected to continuous post-hoc evaluations by the Commission. This fact enables a precise identification of structural measures that were not only announced by policy makers but actually implemented. In addition, fiscal policy actions were dominantly motivated by the *supranational policy pressure* under the EDP framework. In this sense, the implemented fiscal measures can be seen as *exogenous*, i.e. not directly related to the business cycle (Cugnasca and Rother, 2015; Górnicka et al., 2018).

Thus, in this paper we use these structural measures as input for our model and calculate the disaggregated fiscal multipliers for different revenue-side and expenditure-side fiscal instruments. Then, we use these findings to analyse whether the EDP fiscal consolidation episode was growth-friendly. Our results show that, although the consolidation was successful in terms of fiscal outcomes, the implemented fiscal package was not growth-friendly and the consolidation was partially self-defeating. In our counter-factual scenario, if our proposal for a growth-friendly fiscal consolidation package had been adopted, recession in Croatia would have ended as early as 2014, while public-debt-to GDP ratio would at the end of the consolidation period have been lower than it actually was. We hope that our findings can help fiscal policy makers to avoid similar mistakes in future fiscal consolidation episodes.

The paper is structured as follows. After the introduction, section 2 provides a brief literature review, with the focus on the literature on fiscal consolidations and

[4] These include changes in fiscal variables due to the mechanism of automatic stabilizers and/or counter-cyclical reactions of fiscal policy to business cycle developments.

[5] Despite this fact, EDP fiscal consolidation did not attract much attention among academics in Croatia. To our knowledge, the only papers that provide an overview and partial evaluation of this fiscal consolidation episode are Bajo and Galinec (2013), Ujević (2014), Burnać (2017), Deskar-Škrbić and Raos (2018), and Šimović and Deskar-Škrbić (2019). However, these papers have a narrower scope than the present analysis and do not provide empirical assessment of the short-term growth effects of the EDP-based fiscal consolidation.

the macroeconomic effects of fiscal policy. In section 3, we analyse the main characteristics of the EDP fiscal consolidation strategy and fiscal outcomes. In section 4, we present the structure of our small-scale semi-structural macro-fiscal model of the Croatian economy. In section 5, we present the main empirical results. The paper ends with the conclusion.

2 CONCEPTUAL FRAMEWORK OF THE ANALYSIS

In this paper, we build on two inter-related strands of the literature. First, we analyse the literature on fiscal consolidations. This strand of literature provides an analytical framework for understanding the key characteristics of the EDP fiscal consolidation episode in Croatia. Second, we present the literature on the evaluation of the macroeconomic effects of fiscal policy in different methodological frameworks. This strand of the literature helps us to explain and position the methodological approach adopted in this paper more effectively.

Fiscal consolidations

The definition of fiscal consolidation mostly used in the literature is the improvement of a primary structural fiscal balance by 1.5pp of GDP in a single year ("cold shower" or "front-loaded") or an improvement of at least 1.5pp of GDP in three years, with no annual deterioration larger than 0.5pp ("gradual consolidation" or "back-loaded"). This definition was first used in a seminal paper by Alesina and Perotti (1997) and later in the influential paper by Alesina and Ardagna (2010). Different institutions, such as the European Commission (e.g. Barrios, Langedijk and Pench, 2010) or the IMF (e.g. Escolano et al., 2014) also accept this definition.

Besides the definition of fiscal consolidation, the literature also offers measurable criteria for the identification of *successful* fiscal consolidation episodes. According to Alesina and Perotti (1995) and Barrios, Langedijk and Pench (2010), a fiscal consolidation episode can be labelled successful if three years after the start of consolidation the debt to GDP ratio is 5pp lower than it was at the beginning of the consolidation. Alternatively, the fiscal consolidation episode is successful if the cumulative improvement of the public debt-to-GDP ratio during the consolidation period is greater than 4.5pp (Alesina and Ardagna, 2010).

In this context, there is abundant literature on the key factors that affect the success of fiscal consolidations. Barrios, Langedijk and Pench (2010) conclude that the probability of achieving a successful consolidation reduces if a front-loading strategy is undertaken when the economy is experiencing a slowdown. A back-loading strategy has the advantage of giving the economy more time to recover but raises uncertainty and it is considered inferior to a front-loaded approach if the debt is high and there are financial market pressures. As for the composition of consolidation measures, the literature shows that expenditure-based consolidations appear to be more effective in stabilizing debt than those that are revenue-based (e.g. Alesina and Perotti, 1995; von Hagen, Hallett and Strauch, 2002; Guichard et al., 2007; Alesina and Ardagna, 2010; Barrios, Langedijk and Pench,

2010, Alesina et al., 2017). This is mostly explained by the fact that consolidation policies based on increases in revenues (e.g. tax hikes) suggest a lack of political will for structural reforms. Nonetheless, revenue-based consolidations can also be effective, if there is room to increase the revenue-to-GDP ratio, in particular if the revenue types that are less harmful for growth (such as user fees, environmental taxes, property taxes and value-added taxes) are under-exploited (Molnar, 2013). However, the assessment of fiscal consolidation should not only be focused on the observed outcomes for fiscal variables. As Scott and Bedogni (2017) point out, the composition of fiscal adjustment can have notable effects on growth in a country under a consolidation program.

Macroeconomic effects of fiscal policy and the size of fiscal multipliers

Discussion on the growth effects of fiscal consolidations naturally leads us to the second strand of the literature, which investigates the macroeconomic effects of fiscal policy changes and deals with the estimation of fiscal multipliers.[6] The extensive literature review provided by Spilimbergo, Schindler and Symansky (2009) and Coenen, Kilponen and Trabandt (2010), the detailed theoretical and empirical discussion by Ramey (2011; 2019) and the meta-regression analysis presented in Gechert and Will (2012) show that there are two main methodological approaches in this strand of the literature: model-based and empirical-based.

Model-based approaches include structural and semi-structural economic models. Structural economic models have firm foundations in economic theory, they are micro-founded, with forward-looking expectations and based on the so-called "deep" structural parameters[7] that determine the behaviour of economic agents in the model. State of the art models in this category are New Keynesian DSGE models, while previously economists relied on real business cycle models (RBC). DSGE models are often used in central banks and international institutions. Some of the most famous DSGE models that contain fiscal blocks are QUEST (European Commission), GIMF (IMF), SIGMA (Fed) and NAWM (ECB). Semi-structural models are based on macroeconomic behavioural equations, they usually do not include forward-looking expectations and they are less rigorous in the sense of theoretical foundations as they allow ad hoc adjustments of the main behavioural equations. Semi-structural models are more common at ministries of finance as they are technically less challenging than DSGE models (see Saxegaard, 2017 and Hjelm et al., 2015).[8] Hjelm et al. (2015) note that semi-structural models are half way between highly theoretical RBC/DSGE models and purely empirical unrestricted reduced-form vector autoregressive (VAR) models. As noted in the introduction, in this paper we follow this strand of literature and develop a small semi-structural macro-fiscal model of the Croatian economy (section 4).

[6] The fiscal multiplier is defined as the ratio of a change in output (ΔY) to an exogenous change in the fiscal variable (ΔF).

[7] The term "deep structural parameter" was introduced in the 1970s, after Lucas' critic, to distinguish between the derivatives of a behavioral relationship used to define causal effects and the parameters that generate the behavioral relationship (Heckman, 2000).

[8] Ministries of finance usually do not have large research departments.

Empirical-based approaches mostly rely on structural VAR models. Despite the fact that VAR models are primarily based on data, the introduction of restrictions on parameters permits a theoretical interpretation of the model outcomes, which allows the comparison of impulse responses from (structural) VAR models with impulse responses from DSGE models. Originally, these models were used for the analysis of monetary policy shocks (Bagliano and Favero, 1998) but in the early 2000s, and especially after the outbreak of the global financial crisis, these models became a popular tool in the analysis of the macroeconomic effects of fiscal policy.[9] Although popular, VAR-based assessment of the macroeconomic effects of fiscal policy has some important limitations. The most important limitation is that the large number of parameters that have to be estimated narrows the set of variables that can be included in the analysis. This means that VAR models cannot capture some important interactions between different blocks in the economy or include different fiscal instruments while they allow a relatively frugal analysis of the transmission mechanisms of fiscal policy shocks. These are the reasons why in this paper we decided to build a semi-structural econometric model that allows this kind of analysis and not to rely on the VAR-based approach.

As for the size of fiscal multipliers, empirical-based multipliers are lower than model-based multipliers as they include fewer interactions among fiscal and macro variables. In addition, semi-structural models usually provide larger estimates of fiscal multipliers than New Keynesian DSGE models and VAR models. The key reason for this lies in the Keynesian (i.e. non-Ricardian) features of these models, due to crowding-in effects of private consumption and/or investment. However, the differences in the size of fiscal multipliers between models are not so pronounced. Spilimbergo, Schindler and Symansky (2009), Coenen, Kilponen and Trabandt (2010), Ramey (2011; 2019) and Gechert and Will (2012) report that fiscal multipliers are rarely above 1, regardless of the model used. This especially holds for small open economies, like Croatia.

As we are interested in the effects of various fiscal instruments, it is important to emphasize that there are notable differences in the size of fiscal multipliers across fiscal instruments (see appendix 4). Expenditure-based are usually higher than revenue-based multipliers. However, different types of expenditures and revenues have different macroeconomic effects. Empirical literature shows that on the expenditures side, public investments have the largest multipliers, followed by government consumption, while social transfers and subsidies have relatively low fiscal multipliers. On the revenues side, indirect taxes are more neutral than direct taxes and thus have lower fiscal multipliers. In addition, the effect of indirect taxes on the economy heavily depends on the pass-through effect from tax changes to prices, which does not have to be full (100%).

[9] The key challenge in this strand of literature lies in the identification of purely exogenous fiscal policy shocks. There are several main approaches to the identification of exogenous fiscal shocks. For detailed overview of different approaches see Ramey (2011; 2019).

3 EXCESSIVE DEFICIT PROCEDURE IN CROATIA[10]

Only six months after Croatia joined the EU, the European Commission, having noticed Croatia's unfavourable fiscal position, activated the excessive deficit procedure (EDP) in January 2014.

The European Commission required Croatia to correct its excessive deficit by 2016. The Commission estimated that the Croatia would need to adopt structural consolidation measures of 2.3% of GDP in 2014 and 1% of GDP in 2015 and 2016 (European Commission, 2013b). It was assessed that these measures would reduce the nominal deficit to below 3% of GDP by 2016 and put the public debt on a sustainable path (for details see appendix 6).

In response, in March 2014 the Croatian Parliament adopted a supplementary budget of the central government for 2014, which included a package of structural measures of 1.9% of GDP for 2014 and in April the Parliament adopted additional fiscal measures in the amount of 0.4% of GDP for 2014 and 1% of GDP structural measures for 2015 and 2016. In 2014, Croatia received a positive assessment of fiscal effort for 2014 and 2015 from the Commission and the EDP was placed in abeyance (European Commission, 2014a).

3.1 DESIGN OF THE FISCAL CONSOLIDATION PACKAGE

The Commission based its assessment of the EDP consolidation strategy in Croatia on the consolidation package presented in April 2014. However, during the implementation of the package, Croatian authorities made many adjustments and changed the initially announced fiscal measures. Thus, in the identification of implemented fiscal measures, we have evaluated *ex-post* fiscal outcomes using *Convergence Programs*, *Commission assessments* and budget executions in relevant years.

Table 1 and figure 1 show fiscal measures implemented in the period from 2013 (pre-EDP) to 2016. The data lead to two important conclusions. First, Croatian authorities relied on both expenditure and revenue measures. Second, the strongest structural adjustment was implemented in the first year, i.e. the consolidation strategy was *front-loaded*. We will discuss the repercussions of these characteristics of the fiscal consolidation package in the next subsection.

Key structural measures on the revenue side included in our analysis are the increase of the intermediate VAT rate from 10% to 13%, increase of excises on oil and tobacco products, the increase of the social contribution rate for health insurance paid by employers from 13% to 15%, limitation of the CIT tax relief usage for the new investment and increase of non-taxable amount and modification of PIT tax brackets.[11]

[10] We provide additional details on the timeline of EDP in Croatia in appendix 6.

[11] However, changes in PIT were not a consolidation measure. According to official wording in the proposal of changes in PIT legislature, this measure was introduced in order to stimulate household consumption and GDP growth.

Table 1

Structural consolidation measure (% of GDP)

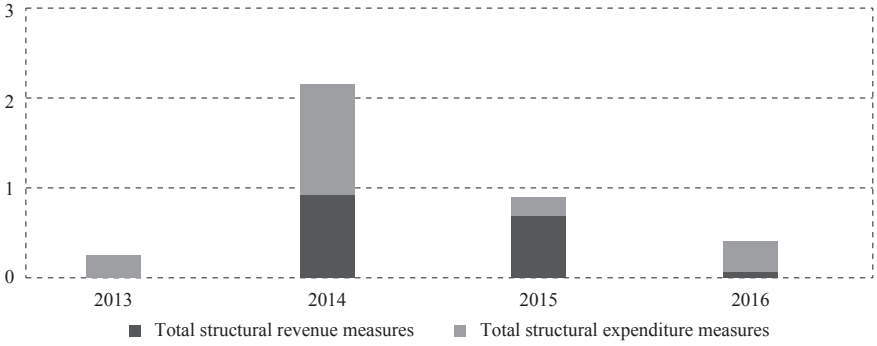
	2013	2014	2015	2016
Structural revenue measures				
Increase of the health contributions rate		0.5	0.2	
Increase of the pension contributions revenues		0.1	0.1	0.01
Increase of intermediate VAT rate		0.2		
Increase in excises on oil derivatives		0.1	0.1	0.04
Increase of excise rate on tobacco		0.03	0.04	0.01
Changes in tax on games of chance		0.03	0.01	
Limitation of CIT tax relief			0.1	
Introduction of tax on interest on savings			0.1	
Total structural revenue measures		**1.0**	**0.7**	**0.1**
Structural expenditure measures				
3% cut of public sector wages	-0.2	-0.1		
Cancelation of the holiday bonus	-0.1			
Abolishment of the service loyalty bonus		-0.1		
Reduction of subsidies		-0.3	-0.1	0.2
Constraining intermediate consumption		-0.2		-0.1
Government investment cut		-0.4	-0.1	-0.1
Social benefits savings		-0.2	-0.1	
Total structural expenditure measures	**-0.3**	**-1.3**	**-0.2**	**-0.3**
Total structural measures	**0.3**	**2.2**	**0.9**	**0.4**

Note: structural increase of pension contribution revenues is related to the transfer of public employees with accelerated pension plan from the 2nd to the 1st pension pillar.

Source: National budget; EC; authors' calculations.

Figure 1

Structural consolidation measures, % of GDP



On the other hand, structural measures on the expenditure side included cuts in gross public wages in 2013 by 3%, cancellation of the holiday bonus, abolition of service loyalty bonuses of 4%, 8% and 10%, reduction of subsidies, restraining expenditures for intermediate consumption and public investment cuts at both the central and the local government level.

Accumulated measures are presented in figures 2 and 3. These figures indicate that the consolidation package was mostly based on cuts in public wages, subsidies and public investments, accompanied by an increase of healthcare contributions and indirect taxes.

Figure 2

Structural revenue measures, % of GDP

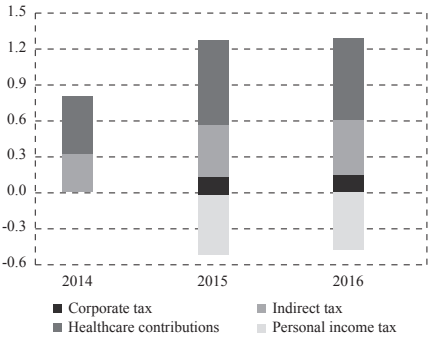
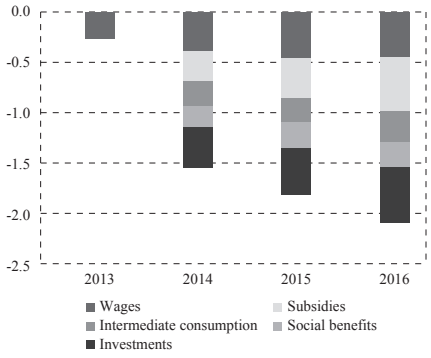


Figure 3

Structural expenditure measures, % of GDP



Source: authors.

As we noted in section 2, the composition of the fiscal consolidation package can have notable effects on the success of fiscal consolidation in terms of fiscal outcomes but also determine the economic outlook during the consolidation period. In the EDP framework, which is only relevant for policy makers in the EU, this fiscal consolidation episode was successful (in terms of fiscal outcomes). Croatia delivered the required consolidation adjustment in time and put the public debt trajectory on a sustainable downward path. In the next sub-section we briefly present the main fiscal developments during the EDP period.

3.2 FISCAL OUTCOMES AND THE ABROGATION OF THE EDP FOR CROATIA

During the EDP, the nominal general government balance improved notably, from -5.3% of GDP in 2013 to 1.0% of GDP in 2016. Such a notable reduction was primarily the result of an improved primary structural balance (figure 4).

Figure 4 also shows that primary structural balance recorded the strongest improvement in 2015. However, this improvement was only partially the result of the measures implemented. As the Commission emphasized in the *Country Report 2017*, the improvement of the structural balance was mostly determined by expenditure restraint which was facilitated by the presence of caretaker governments with no legislative powers during much of the year. Thus, in 2015 structural expenditures fell more than expected, which was mostly reflected in public investments. However, in 2016 the appointed government stayed on the fiscal consolidation path that led to an additional reduction of the deficit that was also supported by a gradually accelerating growth. Revised data show that the overall improvement of the structural balance was slightly below the Commission's initial assessment, as it stood at 2.7pp of GDP versus 3pp of GDP stated by the Commission.

FIGURE 4

Decomposition of the change of general government balance (pp of GDP)

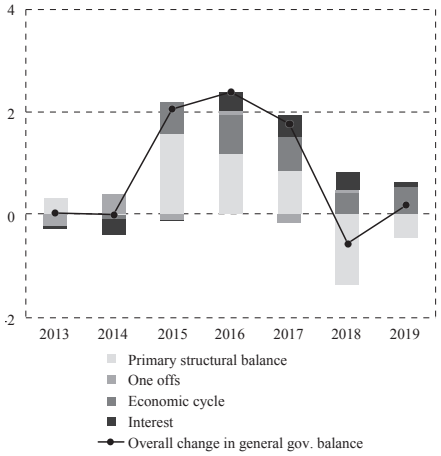
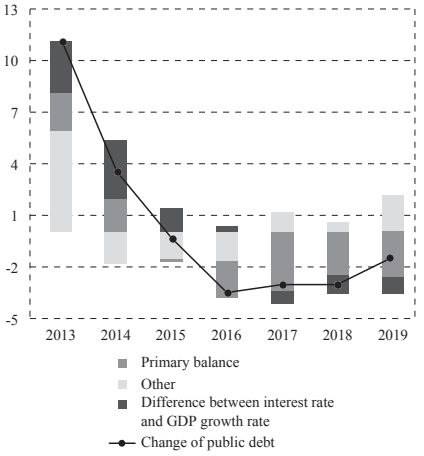


FIGURE 5

Decomposition of the change of general government debt (pp of GDP)



Source: Eurostat; EC; authors' calculations.

The improvement of structural balances translated into the stabilization of public debt-to-GDP ratio trajectory. Figure 5 shows that public debt-to-GDP ratio stabilized in 2015 and started to fall in 2016, primarily as a result of improvement in primary balance. The snowball effect (difference between implicit interest rate on public debt and nominal GDP growth) reversed only in 2017. Considering the overall reduction of public debt-to-GDP ratio of 3.9pp of GDP from 2014 to 2016, the EDP fiscal consolidation episode was only *partially successful*, according to the criterion used in the literature. As explained in section 2, the criterion for the successful consolidation episode is the reduction of public debt-to-GDP ratio of 4.5pp to 5pp of GDP. On the other hand, in the EDP framework, which is only relevant for policy makers in the EU, this consolidation episode was considered successful.

However, fiscal sustainability is only one side of the coin. Another important objective of fiscal policy is macroeconomic stabilization.[12] This goal was also put at the top of the policy agenda in Croatian *National Reform Programmes* in the period from 2014 to 2016. Macroeconomic stabilization implies a countercyclical response of fiscal policy, which may be constrained by the need for fiscal adjustment. Thus, in the periods of deteriorating public finances there is always a challenging trade-off between fiscal sustainability and macroeconomic stabilization.

Nonetheless, fiscal consolidations can be *growth-friendly* (Cournède, Goujard and Pina, 2013). Growth-friendly fiscal consolidations are based on measures that minimize adverse effects on short-term economic growth. More precisely, growth-friendly fiscal consolidations should heavily rely on fiscal instruments with low

[12] Musgrave (1957) defines macroeconomic stabilization as one of the key functions of public finance, along with redistribution and allocation.

fiscal multipliers. On the other hand, budget categories with large fiscal multipliers should be tightened minimally or should even be used in order to stimulate the economy. Thus, in the next section we provide estimates of fiscal multipliers of the implemented fiscal measures and assess the growth-friendliness of the EDP fiscal consolidation.

4 MACRO-FISCAL MODEL OF THE CROATIAN ECONOMY

In this section, we build a small short-term semi-structural macroeconometric model of the Croatian economy (MFMC), developed for the purpose of this analysis. To our knowledge, this is the first model of this kind designed for Croatian economy in the literature. While building the model we relied on similar models for other countries (e.g. Baghli et al., 2004; OeNB, 2004; Danielsson et al., 2006; Grech et al., 2014; Burns et al., 2019), but we also tried to take into account the specificities of the Croatian economy.

4.1 MAIN CHARACTERISTICS OF THE MODEL

Following Brillet (2019), we describe our model as a small model as it includes fewer than fifty behavioural equations. As previously explained, the model is semi-structural as it does not retrieve "deep" structural parameters but still offers a rigorous analytical framework for counterfactual analysis. As for the theoretical field, our model is mostly demand-driven, following the tradition of Keynes-Klein macroeconometric models (Challen and Hagger, 1983). In this sense the model can also be described as a short-term model as it does not include long-run relations based on potential growth. To put it differently, we do not model the "supply-side" of the economy. The rationale for such a modelling approach is that the focus of our paper is on the stabilization role of fiscal policy, which is always analysed through the lenses of short-term or medium-term macroeconomic models and the effects of fiscal policy on aggregate demand (for example see Musgrave, 1973 or Jurković, 2002). However, in some equations we also include some important short-term supply side elements (costs) in some of the key behavioural equations. Finally, as the model is based on a description of the macroeconomic and fiscal block of the Croatian economy we label it a "macro-fiscal" model, following Burns et al. (2019).

Our decision to rely on this type of model in the analysis is based on several important factors (Hjelm et al., 2015). First, compared to DSGE models, semi-structural macroeconometric models offer more flexibility in the modelling approach. Second, these models contain a more disaggregated fiscal block and provide an analytically rich framework for the analysis of the transmission mechanisms of fiscal policy, which is due in part to the fact that they usually constitute inputs for public finance calculations. On the other hand, fiscal policy transmission mechanisms in DSGE models are often weak. As we noted previously, one of the main purposes of our model is to explain these transmission mechanisms in detail.

However, this class of models is faced with various shortcomings (for detailed discussion see Hjelm et al., 2015 and Pagan, 2019) but in the context of our analysis the most important one is related to the role of expectations. Unlike DSGE models that are based on forward-looking expectations, semi-structural macroeconometric models usually do not explicitly include expectations or else expectations are modelled as backward-looking. Thus, our model cannot capture the effects of fiscal shocks on expectations, which can be an important factor of the transmission mechanism of fiscal policy.

Key behavioural macro equations are estimated in an error correction (EC) form, which is a standard approach in this type of economic model (e.g. Cappelen, 1991; Baghli et al., 2004; Baumgartner, Breuss and Kaniovski, 2004; Danielsson et al., 2006; Grech et al., 2014; Saxegaard, 2017; Burns et al., 2019). Error-correction equations are used because they can match empirical regularities in the data, while having stable long-run properties. Under this approach, economic variables are assumed to revert to long-run growth paths based on cointegrating relationships in the data that are consistent with economic intuition. The long-run relationships in an error-correction model ensure that the whole model system stabilizes in a plausible way.[13] Also, the EC approach has some important statistical advantages as it eliminates the problem of spurious regressions and ensures compliance with a set of assumptions about the classic linear regression model, that are a prerequisite for adequate estimation of coefficients by the ordinary least squares (OLS) method. Other estimated behavioural equations[14] also rely on economic theory but do not differentiate between long-run and short-run relations among variables.

The model's equations are estimated independently of each other and are then combined to form a model system. When the model is run, the equations in the system are solved simultaneously. This means that model simulations capture the interdependencies and feedback mechanisms in the model equations. The model is simulated using Broyden's algorithm in a dynamic, deterministic framework.

4.2 STRUCTURE OF THE MODEL

Our model includes four blocks of the economy: real sector (aggregate demand), labour market, prices and fiscal sector. The model is based on seven behavioural equations that capture important aspects of economic behaviour (detailed equations are presented in appendix 1). In addition to behavioural equations, a number of endogenous variables are constructed based on accounting identities: eleven identities in the aggregate demand block, three identities in the labour market block and twenty four identities in the fiscal block.[15]

[13] In order to assess the overall stability of the model we analyzed impulse responses of various exogenous shocks. Impulse responses in all cases converged and we found no evidence of "explosive" impulse responses. These results are available upon request.

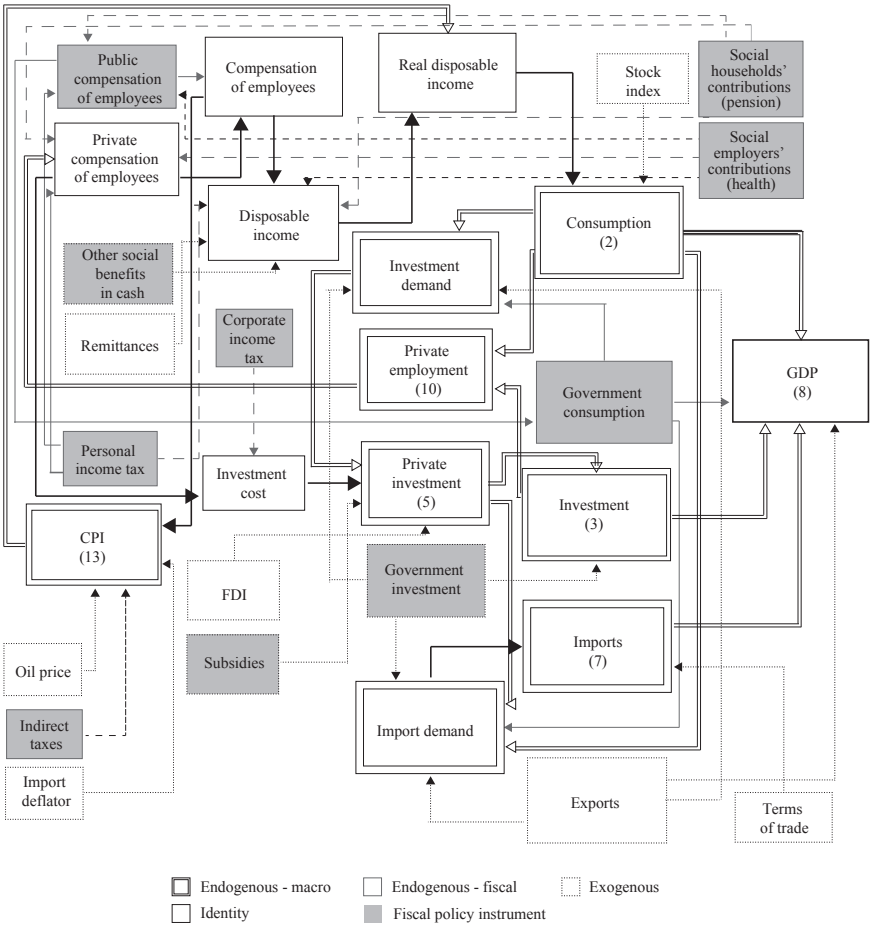
[14] CPI, implicit rate on public debt and unemployment benefits.

[15] Appendix 2 shows the results of the baseline simulation. For more details on estimation results and detailed description of data see appendix 3 and appendix 8.

In order to facilitate the understanding of the key relations and mechanisms in our model, figure 6 describes its structure. In this figure we have highlighted exogenous and endogenous macro and fiscal variables as well as the difference between behavioural relations and identities. Fiscal variables are presented in shaded boxes in order to make it easier for the reader to track key transmission mechanisms of fiscal policy throughout the model.

FIGURE 6

Structure of the macro-fiscal model of the Croatian economy



Note: numbers in brackets correspond to respective model equation.

Source: authors.

As for the direct, "first round" effects of fiscal policy, the figure shows that government consumption affects GDP directly through the national accounts identity but also it affects the investment demand that stimulates private investments. Government investments also enter the GDP identity and stimulate private investments through the crowding-in mechanism, which was confirmed by data. Subsidies only have a direct effect on private investments. Public compensation to

employees enters the GDP identity relation through government consumption but it also affects real disposable income, as the main determinant of private consumption. Social benefits only have a direct effect on real disposable income. On the revenues side, personal income tax and social contributions paid by employees directly affect nominal disposable income, while indirect taxes affect real disposable income through the effect on prices. Corporate income tax and social contributions payed by employers have direct effects on investments, while social contributions payed by employers in the public sector also enter the GDP identity through the government consumption.

5 RESULTS

This section provides an overview of the main results of our analysis. First, we present the disaggregated fiscal multipliers for both the revenue-side and the expenditure-side fiscal instruments and explain the main transmission mechanisms, based on figure 7. After that, we provide the results of a counterfactual scenario analysis, where we ask ourselves whether the Croatian authorities could have achieved similar fiscal outcomes with lower economic costs.

5.1 DISAGGREGATED FISCAL MULTIPLIERS

In this subsection, the fiscal multipliers for each fiscal instrument are calculated as the ratio of the difference in GDP and the difference in fiscal instruments in the baseline and the alternative scenario:

$$FM_t = \frac{GDP_{t,alternative} - GDP_{t,baseline}}{FI_{t,alternative} - FI_{t,baseline}} \quad (1)$$

The alternative scenario is a result of the implemented shock to exogenous fiscal variables. More precisely, baseline scenario includes estimations of the model with implemented EDP measures, while in the alternative scenario we add (in the case of expenditure cuts) or subtract (in the case of tax and social contribution hikes) the fiscal measures presented in table 1 from the baseline scenario. To put it in other words, in our counterfactual scenario we analyse what would have happened if some EDP measure had not been implemented and/or if some other measures were implemented.

The sizes of implemented shocks are presented in figures 3 and 4, and are obtained by summing up the measures presented in table 2 in their relevant categories according to the ESA methodology, while discarding the categories with the total size of measures of 0.1% of GDP and less due to their marginal effect on GDP. We divided the full year effect of the measures throughout quarters according to the date of their implementation. As structural measures have permanent effects on the level of the budget category, fiscal shocks are applied for each quarter in the consolidation period. We implemented shocks to exogenous fiscal variables in terms of absolute deviations from the baseline scenario (in HRK mn), which allows a direct interpretation of fiscal multipliers in units. However, changes in revenue categories were obtained through shocks to implicit tax/contribution rates.

Revenue-side instruments

Table 2 presents fiscal multipliers for different revenue-side instruments used during the EDP. The table shows that, depending on the instrument, the sizes of the multipliers range from -0.3 in the case of personal income tax to 0 for healthcare contributions. These results are mostly in line with model-based estimations of fiscal multipliers presented in Spilimbergo, Schindler and Symansky (2009), Gechert and Will (2012), and Kilponen et al. (2019). These authors report tax multipliers in the range of -0.5 to -0.1, meaning that direct tax multipliers are higher than indirect tax multipliers (also see appendix 4).

Table 2

Fiscal multipliers: revenue-side instruments

	2014	2015	2016	Average
Indirect taxes	0.0	-0.1	-0.1	-0.1
Personal income tax		-0.2	-0.3	-0.2
Corporate income tax		-0.2	-0.2	-0.2
Healthcare contribution	0.0	-0.1	0.0	-0.1

Source: authors' calculations.

The average indirect tax multiplier in our model stands at -0.1. The negative sign indicates that the increase of indirect taxes leads to a fall of GDP, while the size of the multiplier indicates relatively weak macroeconomic effects of changes in indirect taxes. As figure 6 indicates, the transmission mechanism in this case is based on the effects of indirect taxes on prices, which then affect real disposable income and consumption. However, an empirically based estimate of the pass-through effects of indirect taxes to prices in Croatia, presented in CNB (2019) and Buljan (2020), indicate that the pass-through is not full and it is estimated to around 0.6. Thus, changes in indirect taxes do not fully translate into changes in prices, which subdues the effect of indirect taxes on real disposable income. The effects of changes in indirect taxes on consumption are additionally mitigated by the fact that only part of the real disposable income is used for consumption. In addition, in economies with a relatively high level of import-dependency, such as Croatia, a notable part of the effects of indirect taxes on consumption (and indirectly on investments) is offset by changes in imports.

The next important fiscal instrument comprises direct taxes. We estimate the average personal income tax multiplier at -0.2, which is quite strong as compared to the effects of indirect taxes, in line with the theoretical and empirical findings. This is because changes in direct taxation directly affect and are fully transmitted to the nominal disposable income. However, the multiplier is still relatively low as changes in disposable income affect consumption only partially. In addition, as in the previous case, changes in imports offset the effects of changes in consumption (appendix 1).

Corporate income tax affects the aggregate demand through the effects on investments, i.e. investment costs. However, corporate income tax presents only a small

portion of total investment costs. In addition, investments contain a substantial import component, which means that part of increased investment automatically translates to higher imports (appendix 1). Thus, changes in this tax form do not have pronounced effects on GDP, in line with findings in related literature.

Finally, the average fiscal multiplier for healthcare contributions is -0.1. At first, this result may seem a bit surprising. However, our model captures two effects that act in opposite directions. First, the increase of healthcare contributions increases the costs of investment and leads to a fall in investments, employment and thus in disposable income. On the other hand, the increase of healthcare contributions increases the total compensation of employees in the public sector. As this is one of the key components of government consumption G, which directly enters the GDP equation (7), this effect can offset the fall in private investments and consumption. Nonetheless, a modelling approach that also included the supply-side effects of this measure would yield larger fiscal multipliers, especially in the long run.

Expenditure-side instruments

Table 3 presents the fiscal multipliers for these instruments. The table shows that, depending on the instrument, the sizes of the multipliers range from 0.3 in the case of social benefits to 1.3 for public wages. Thus, as expected, fiscal multipliers for expenditure-based measures are in (absolute terms) higher than those of revenue-side measures.

These results are also mostly in line with model-based estimations of fiscal multipliers presented in Spilimbergo, Schindler and Symansky (2009), Gechert and Will (2012), and Kilponen et al. (2017). The authors report model-based government consumption multipliers in the range from 0.5 to 0.9 and social benefits multipliers in the range from 0.2 to 0.4. On the other hand, fiscal multipliers of public investment are usually above one (although most estimates are for more closed economies), while in our case the public investment multiplier is below one. Finally, we report the size of the fiscal multiplier of public wages, which is especially interesting as there is almost no model-based literature on public wage multipliers, while other empirical and theoretical results are ambiguous.

Table 3

Fiscal multipliers: expenditure-side instruments

	2014	2015	2016	Average
Public wages	1.2	1.3	1.3	1.3
Intermediate consumption	0.6	0.5	0.5	0.6
Subsidies	0.0	0.1	0.1	0.1
Investments	0.7	0.6	0.7	0.7
Social benefits	0.2	0.3	0.3	0.3

Source: authors' calculations.

In our model, public sector wages have the largest multiplier, of around 1.3. Such a large multiplier reflects two channels of fiscal policy transmission. First, as

previously noted, public sector wages are an important component of government consumption that directly enters the equation (7) for the calculation of GDP. As this component of government consumption does not have an import component it translates to GDP "one-for-one". Additionally, any increase of (net) public sector wages increases total disposable income and thus stimulates consumption and finally investments, through higher demand for them. The comparison of our results with those of the existing literature is challenging, as to our knowledge there are no many model-based estimates of public wage fiscal multipliers.[16] However, many authors point out that changes in public sector wages can affect wages in the private sector (see Alesina, Favero and Giavazzi, 2019). In our model, we treat wages in these two sectors as independent, which can have a notable effect on the size of the multiplier. Thus, we discuss the relevance of the assumption on the relation between public and private wages in the section on the limitations of our modelling approach.

Unlike public wages, intermediate consumption does contain an import component.[17] Thus, despite the fact that intermediate consumption also directly affects GDP (7), this effect is less than "one for one" as part of the increase of intermediate consumption directly flows to imports. The second-round effects then operate through increased investment demand, which leads to higher investments and employment and thus higher consumption. However, these second-round effects are rather small as government consumption presents a small portion of total investment demand so the size of the multiplier is mostly determined by the first-round effect, i.e. the direct effect on GDP through the national accounting identity. Our estimate of the intermediate government consumption multiplier is 0.6, which is as expected, due to the openness of Croatian economy.

As for subsidies, our results point to a relatively low fiscal multiplier of around 0.1. A low size of the multiplier was expected as subsidies affect the economy only through the effect on investments. However, this effect is not strong. This especially holds true in countries like Croatia, where subsidies are used more as grants and less as investment-promoting instruments, i.e. they are not efficient (World Bank, 2014). Generally, the literature treats subsidies as an unproductive component of government expenditure and OECD positions subsidies at the top of the list of the instruments used in growth−friendly consolidation packages (Cournède, Goujard and Pina, 2013).

The public investment multiplier estimated in our model stands at around 0.7. As in other model-based analyses, the multiplier for this component of government expenditures is higher compared to the intermediate consumption multiplier. However, as previously noted, most papers report public investment multipliers above one, even in open economies. The reason why the multiplier in our model is somewhat low compared to other analyses is that our model includes only the short-run demand-side effects of public investments (appendix 1).

[16] Chang et al. (2019) report the public wage multiplier of -0.03 for the US in the NK DSGE model as they calibrate the model in a way that cuts in public wages crowd-in private consumption. However, their model does not take into account the national accounts identity on GDP calculation (eq. 7).
[17] Using input-output data for the Croatian economy Mikulić (2018) estimates the import component of total government consumption at around 20%, which is mostly related to intermediate consumption.

Finally, we estimate the fiscal multiplier for social benefits at around 0.3, which is in line with the findings in model-based literature. Social benefits affect the economy through the effects on disposable income and thus consumption (first-round) and induce an increase of investments through higher investment demand (second-round) (appendix 1). The size of the multiplier is in this case mostly determined by the marginal propensity to consume out of disposable income and by the openness of the economy.

Role of automatic stabilizers

In the explanation of transmission mechanisms so far, we consciously neglected the role of automatic stabilizers, due to the brevity of the exposition. However, automatic stabilizers, i.e. the automatic reaction of fiscal variables to changes in economic activity, are an important determinant of the size of fiscal multipliers (Peackok and Shaw, 1976; Batini, Eyraud and Weber, 2014). Every fiscal measure that affects economic activity leads to a feedback effect from economic activity to fiscal variables. For example, as we explained previously, any increase in government consumption will tend to increase investments, employment and consumption, while changes in these macro variables will lead to an increase of corporate income tax, personal income tax and VAT revenues. This raises the tax burden in the economy and alleviates the total effects of the initial fiscal impulse on economic activity. Thus, all fiscal multipliers reported in this paper also capture the role of automatic stabilizers.

5.2 COUNTERFACTUAL POLICY ANALYSIS

Our analysis so far showed that the EDP fiscal consolidation in Croatia was successful in terms of fiscal outcomes. On the other hand, the reported fiscal multipliers imply that the consolidation measures had detrimental effects on growth throughout the whole consolidation period.

In this sense, our results confirm the Commission's assessment that implementation of the EDP measures would keep the Croatian economy in recession in 2014 (table 1) and lead to lower growth rates in 2015 and 2016. In the no-policy change scenario the 2014 growth rate was projected to be around 0.5%, while the EDP scenario implied a fall of GDP. In 2015 and 2016 under the EDP scenario, the Commission projected positive growth rates, if around 0.6pp lower than in the no-policy change scenario. This motivated us to take an additional step in our analysis and provide an illustrative counterfactual policy analysis[18] based on an alternative, growth-friendly, fiscal consolidation package.[19]

The basic idea behind growth-friendly fiscal consolidations is to design a fiscal consolidation package that ensures improvement of the fiscal balance, while minimizing negative short-term effects on growth (Cournède, Goujard and Pina, 2013). This

[18] We are aware of the fact that counterfactual analyses should be based on structural economic models (not subject to Lucas' critique). Hence, counterfactual analyses presented in this paper should be seen as an illustrative analytical exercise.

[19] IMF applied similar approach in the analysis of the EDP fiscal consolidation episode in Czechia in 2011 (see Klyuev and Snudden, 2011).

is important because a deterioration of economic activity triggered by the implementation of consolidation measures could lead to an additional increase in instead of the stabilization of the debt-to-GDP ratio. Thus, ill-conceived design of fiscal consolidation packages can lead to "self-defeating" consolidation episodes.

Eyraud and Weber (2013) provide a relatively simple framework for the understanding of these contradictory effects of fiscal contractions on public debt dynamics. They explain an "unpleasant fiscal arithmetic" that shows that the debt ratio does not decrease one-for-one with fiscal tightening. The reason for this is that fiscal contraction leads to a fall in economic activity through the fiscal multiplier mechanism. Then, lower economic activity leads to a higher (not lower) share of public debt in GDP for two reasons. First, the fall in GDP decreases the denominator of the debt-to-GDP ratio ("denominator effect"). Second, the fall in GDP also reduces government revenues, which can increase the deficit ("numerator effect"). The total effect of fiscal contraction on public debt dynamics in the short run depends on the size of the fiscal multiplier, the initial level of public debt and the strength of automatic stabilizers (i.e. elasticity of revenues to GDP). These relations can be described by the equation:

$$\Delta\left(\frac{debt}{GDP}\right) = -fiscal\ effort + multiplier * debt\ ratio + multiplier * revenue\ ratio \quad (2)$$

The first term on the right side of the equation shows that the implemented consolidation fiscal effort reduces the debt-to-GDP ratio ("direct effect of fiscal consolidation"). However, this effect is mitigated by the above mentioned "denominator effect" (second term on the right side) and the "numerator effect" (third term on the right side). The higher the fiscal multiplier, the stronger are the mitigating effects.

Having this in mind, in the counterfactual analysis we propose a consolidation package that lowers the size of the weighted fiscal multiplier on the expenditure side of the budget.[20] The structure of the consolidation package is presented in table 4, which shows that we only changed the structure of the expenditure-based measures, while keeping the revenue-side measures unchanged. Regarding the size of total fiscal effort, our package is in line with the structural adjustment in the original EDP scenario. There are four main differences in our growth-friendly consolidation package from the EDP consolidation package that was actually implemented.

First, in our view, a growth-friendly consolidation package should keep public investments intact. This view is also supported by the Commission which points out that many EU countries cut investments during the EDP as such measures are politically expedient as compared to cuts in other current expenditure categories. However, the Commission also emphasizes that cuts in public investments have a negative impact on growth and affect debt dynamics (European Commission, 2020). The SGP framework even gives special treatment to public investments in the calculation

[20] We concentrate only on the expenditure-based measures as we showed that revenue-based measures yield relatively low fiscal multipliers.

of the MTO, i.e. allows room for budgetary manoeuvre, in particular taking into account the needs for public investment.[21] Thus in our growth-friendly fiscal consolidation package, policy makers would not rely on cuts in public investments.[22]

Table 4

Growth-friendly fiscal consolidation package

	2013	2014	2015	2016
Structural revenue measures				
Increase of the healthcare contributions rate		0.5	0.2	
Transfer of pension contributions		0.1	0.1	0.01
Increase of intermediate VAT rate		0.2		
Increase in excises on oil derivatives		0.1	0.1	0.04
Increase of excise rate on tobacco		0.03	0.04	0.01
Changes in tax on games of chance		0.03	0.01	
Limitation of CIT tax relief			0.1	
Introduction of tax on interest on savings			0.1	
Total structural revenue measures		1.0	0.7	0.1
Structural expenditure measures				
3% cut of public sector wages	-0.2	-0.1		
Cancellation of holiday bonus	-0.3 **(0.0)**			
Abolishment of service loyalty bonuses		-0.1 **(0.0)**		
Reduction of capital transfers		0.0 **(-0.2)**	0.0 **(-0.2)**	0.0 **(-0.2)**
Reduction of subsidies	0.0 **(-0.3)**	-0.3 **(-0.2)**	-0.1 **(-0.2)**	-0.2 **(-0.2)**
Constraining intermediate consumption		-0.2		-0.1
Government investment cut		-0.4 **(0.0)**	-0.1 **(0.0)**	-0.1 **(0.0)**
Social benefits savings		-0.2	-0.1	
Total structural expenditure measures	-0.3 **(-0.5)**	-1.3 **(-0.9)**	-0.2 **(-0.4)**	-0.3 **(-0.4)**
Total structural measures	0.3 **(0.5)**	2.2 **(1.9)**	0.9 **(1.1)**	0.4 **(0.5)**

Note: new measures of the growth-friendly fiscal consolidation package are bolded in parenthesis. The rest of the measures of the growth-friendly fiscal consolidation package are the same as in the original EDP scenario.

Source: authors.

[21] Regulation EC 1466/97.

[22] However, we are aware that public investments in Croatia are not fully effective as they are often subject of political corruption (Bađun, 2011).

Our model suggests that cuts in public sector wages during recessions can lead to substantial pro-cyclical effects as they yield the largest fiscal multipliers. However, we are aware that the public sector wage bill in Croatia is excessive (e.g. World Bank, 2014) and many relevant authors point to important confidence and credibility effects triggered by cuts in the public sector. As we explained in section 2, cuts in public sector wages signal the commitment of policy makers to the implementation of structural reforms. Thus, our growth-friendly fiscal consolidation package would rely only minimally on cuts in public wages. More precisely, in our counterfactual scenario we propose a package that would include 3% cuts in gross public wages but without additional cuts in holiday and loyalty bonuses.

Third, we already mentioned that subsidies are generally viewed as an unproductive component of government expenditure. Thus, in our counterfactual scenario we propose substantial cuts in subsidies. Rationalization of subsidies was also proposed as a fiscal consolidation measure by the World Bank in the *Public Finance Review Croatia* in 2014. In addition, Cournède, Goujard and Pina (2013) and Kolev and Matthes (2013) position subsidies at the top of the list of the instruments used in growth-friendly consolidation packages.

Finally, data on general government expenditures indicate that Croatian authorities disburse notable funds on capital and current transfers. For example, in the period from 2013 to 2016 these expenditures amounted on average to over 10 billion HRK. These expenditures are usually directed to inefficient public-owned enterprises (e.g. invoked guarantees of un-restructured shipyards). In our view, part of these expenditures that would be aimed at restructuring could be transferred to EU funds, while the other part could be rationalized. As these transfers are not recognized as a productive part of government expenditure we would not expect them to yield high multipliers. More precisely, in our model they do not trigger any multiplicative effects on the economy although they do affect fiscal balances.

A growth-friendly consolidation package would yield a lower expenditure-side multiplier (table 5), thus soothing the mitigating effects defined in equation (2). As previously explained, lower fiscal multipliers would thus reduce the probability of self-defeating fiscal consolidation episodes.

Table 5

Weighted expenditure-based fiscal multipliers

	2013	2014	2015	2016
EDP	1.3	0.6	0.7	0.6
Growth-friendly	0.6	0.3	0.1	0.2

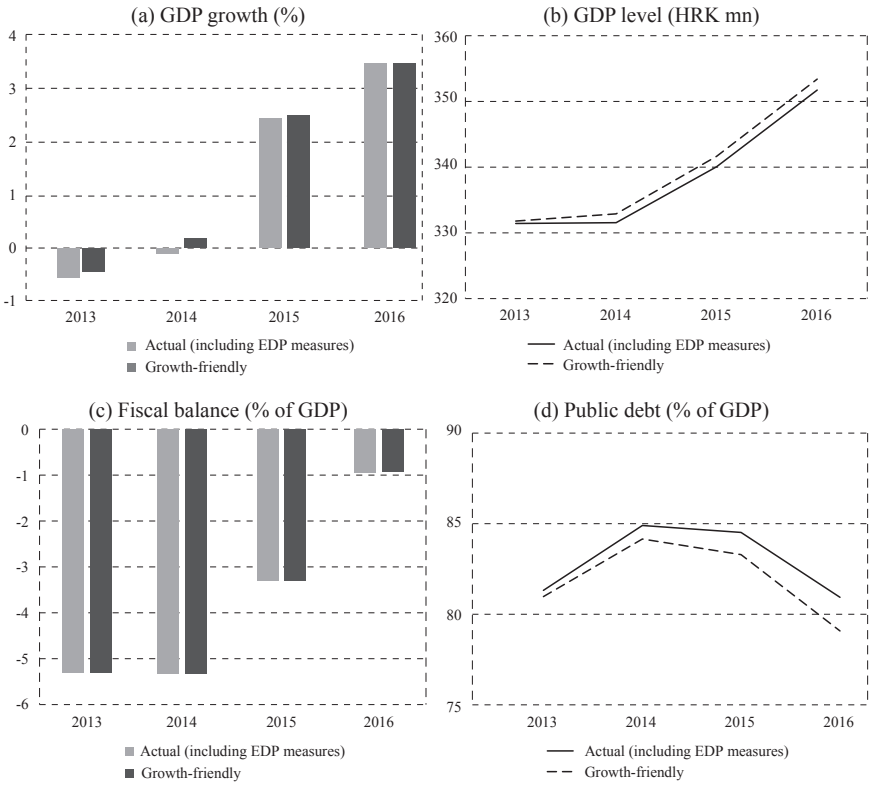
Source: authors.

In order to analyse the effects of the proposed growth-friendly fiscal consolidation package we evaluated fiscal and macroeconomic outcomes in the counterfactual scenario and compared it to the EDP baseline scenario. We then calculated the differences between outcomes in the two scenarios and applied these differences to actual data to make the results easier to interpret (figure 7).

Our results indicate that the EDP fiscal consolidation strategy was partially self-defeating since the unfavourable composition of the fiscal consolidation package led to weaker economic activity and thus to a higher public debt-to-GDP ratio than would have been the case in the alternative scenario, based on the growth-friendly consolidation package. According to the results of the counterfactual scenario, had a more growth-friendly fiscal consolidation package been implemented, recession in Croatia could have ended in 2014. However, it is important to emphasize that in both scenarios public debt-to-GDP ratio increases in the first year of consolidation. This is because in both scenarios interest rates notably exceed GDP growth, thus triggering a snowball effect, while the general government budget records a primary deficit. These two factors were identified as the main drivers of public debt in 2014 (see figure 5).

Figure 7

Fiscal and macroeconomic outcomes of the EDP and counterfactual scenario



Source: authors' calculations.

The illustrative counterfactual analysis presented in this section serves only as an illustrative example. Nonetheless, it shows that the design of fiscal consolidation packages can have notable effects on macroeconomic and fiscal outcomes during fiscal consolidation episodes. Thus, in our view, policy makers in Croatia should in the future rely more on this kind of model-based evaluation and take into account the different macroeconomic effects of various fiscal measures.

5.3 MAIN METHODOLOGICAL LIMITATIONS

Before we move to the conclusions, it is important to explain some of the key limitations of our modelling approach.

As previously noted, the purpose of this model is to provide an analytical framework for the analysis of the short-term macroeconomic effects of fiscal policy. Thus, this model does not include the supply side of the economy and variables such as the potential GDP, the natural rate of unemployment, demographic changes and TFP. These variables are crucial for the long-term analysis but do not play a decisive role in short-term analyses. Of course, we are aware that the exclusion of these factors can have some important effects in the short run as well. For example, the literature shows that public investments have the largest multiplier among all government expenditure components because they stimulate aggregate demand but also increase the overall productive capacity of the economy, through capital accumulation. In addition, standard models of inflation include the output gap or deviation of the unemployment rate from the natural level as important determinants of price developments. Next, changes in direct taxes do not affect only the demand but also the supply side of the economy, through the effects on incentives to work. Our model cannot capture these effects.

However, this does not mean that we have completely neglected the role of some other important supply-side factors in the short run. As we showed in the paper, we recognize that inflation can be affected not only by demand-side factors but also by oil-price shocks and import prices or that decisions on private investments do not depend only on demand for investments but also on the costs (labour costs and corporate tax). In this way, we tried to overcome some of the main shortcomings of purely demand-driven models in the Keynes-Klein tradition (Challen and Hagger, 1983; Wallis and Whitley, 1991).

Another important weakness of our model is that it does not include the monetary authority. From the theoretical and empirical point of view, the most important role that the monetary authority plays in these kinds of analyses is based on its reactions on the money market and the foreign exchange market after the implementation of fiscal measures. If, for example, fiscal expansion leads to a countercyclical increase of the key monetary policy interest rate, the macroeconomic effects of fiscal expansion can be subdued (Ramey, 2011; 2019). As for the reactions on the foreign exchange market, it is well known that fiscal policy is more effective in countries with stabilized exchange rate regimes (Perotti and Lane, 1996) as potential

appreciation pressures in times of fiscal expansion are subdued by FX interventions. The reason why we did not include a monetary policy block in our model stems from the specific nature of the monetary policy framework in Croatia which is based on the exchange rate as the key monetary policy anchor. This makes FX interventions a key monetary policy instrument. Thus, in our model we could not include some explicit monetary policy rule, such as the Taylor rule, which is applicable for inflation-targeting countries. Bokan and Ravnik (2018) proposed an implicit monetary policy rule for Croatia, based on the reactions of monetary policy to deviation of exchange rate and inflation rate from implicit targets. Although their proposal represents a notable contribution to the literature and covers the effects of monetary policy on exchange rate developments, it does not provide a complete coverage of the effects of FX interventions on money supply and liquidity. In addition, as Bokan et al. (2009) and Galac (2011) show, the Croatian National Bank relies on many other (regulatory) instruments that can have notable effects on liquidity and money supply in the Croatian economy. Although all the aforementioned factors can have notable effects on the effectiveness of fiscal policy, the development of a model with a monetary block that includes all these factors goes beyond the scope of this paper. Also, in the period from 2014-2016, which is in the focus of our analysis, there were no major changes in monetary policy in Croatia. Thus, in our view, our main conclusions would not be altered even if we explicitly included the monetary policy block in the model.

The next important limitation of the model is a result of our decision to treat exports as an exogenous variable. The effects of fiscal policy on exports can arise from the effects of fiscal policy on nominal exchange rate, consumer prices and producer prices (through labour costs). Thus, in some circumstances, the effects of fiscal policy on exports can hinder the effects of fiscal policy on domestic demand. However, in our view, the decision to treat exports as an exogenous variable can be seen as plausible, if one takes into account several factors. First, the series of exports of goods and services in Croatia in the period of our analysis was dominated by various specific factors, such as exports of ships, tourism revenues, effects of the accession to the EU, etc. The other, more important reason is that exports in Croatia are significantly more sensitive to exogenous changes in foreign demand than to changes in relative prices (Bobić, 2010). In addition, Croatian National Bank data show that the average change of the real effective exchange rate in the period from 2014-2016 stood at around only 1% to 2%.[23] Hence, we do not expect that changes in fiscal policy had a decisive effect on exports developments during the EDP.

Next, we treat public sector and private sector wages independently. However, changes in public sector wages can affect private sector wages and thus induce changes in private sector consumption, investments and employment. Alesina, Favero and Giavazzi (2019) state that a reduction in the public sector wage bill has

[23] REER based on CPI and PPI. Table H11, Croatian National Bank.

a depressing effect on aggregate demand, but that may be compensated for by the fact that a reduction in public sector wages could translate into lower private sector wages, thus raising profitability and investment. For Croatia, there is some evidence that the public sector leads long-run wage dynamics. Orsini and Ostojić (2015) showed that public sector wage in Croatia is independent from wage dynamics in other sectors, while exerting an attraction force on wages in other sectors. This fact can notably affect the estimated size of the fiscal multiplier of public sector wages.

Although theory argues that investments should depend on the level of interest rates on corporate loans, in this paper we did not include this determinant of investments in our investment function. The reason is that in Croatia it is hard to find a statistically significant relationship between interest rates and investments.[24] This was also confirmed in Tica (2007), who reviewed the literature on the transmission mechanism of monetary policy in Croatia and concluded that it seems that the IS curve in Croatia is vertical. This can be explained by the fact that only around 25% of total investments are financed by loans[25] and that large companies often use external sources of financing, which additionally breaks the link between domestic interest rates on loans and investments. Although empirically and economically plausible, the decision to exclude interest rates from the investment function has an important drawback. With no interest rates in the model we cannot take into account the relation between the risk premium, mostly determined by developments of public debt, and investments, i.e. we cannot capture the potential "crowding-out" effect. This is important because Kunovac and Pavić (2018) found that the risk premium, if increased, will spill over to higher interest rates on loans, especially in the corporate sector. However, with no empirically determined relation between interest rates and investments, the effect of the rise in risk premium on investments could be less pronounced than expected.

Finally, results of all model-based analyses always depend on the main theoretical assumptions and the empirical nature of the model. As we stated before, our model is mostly demand-driven and Keynesian in nature. Thus, our model cannot generate Ricardian reactions of economic agents (e.g. a rise in government consumption raises interest rates, reduces the present value of wealth and thus reduces consumption). In addition, expectations do not play an important role in our model. All these factors can affect the size of calculated fiscal multipliers. As for the empirical nature, we emphasized that our model is not structural, which means that it is subject to Lucas's critique (Lucas, 1976), like other semi-structural models.

Given all these limitations, we take the results of our analysis with a grain of salt. However, we hope that the analysis provides a solid foundation for future model-based evaluations of the macroeconomic effects of fiscal policy in Croatia and a framework for understanding of complex fiscal policy transmission mechanisms.

[24] We tested different specifications of the model and could not obtain statistically significant result with the expected sign in none of specifications.
[25] Croatian Bureau of Statistics data, publication *Investments in Croatia*.

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6 CONCLUSION

Fiscal consolidations are always a subject of intensive public and professional debate. The reason is that, apart from the social dimension of fiscal consolidation programs, the effects of fiscal consolidations on economic activity presented in literature are somewhat ambiguous.

In this paper, we tried to contribute to the understanding of the macroeconomic effects of fiscal consolidations in Croatia, using the EDP episode as a case study. For this purpose, we developed a semi-structural macro-fiscal model of the Croatian economy (MFMC). With its disaggregated fiscal sector, the model offers a deeper insight into the transmission mechanisms of various fiscal instruments on Croatian economy.

The main result of our model-based analysis are disaggregated fiscal multipliers that capture the first-round and second-round effects of the fiscal measures implemented during the EDP. Our estimates of fiscal multipliers for revenue-based (0-0.3) and expenditure-based (0.3-1.3) fiscal instruments are mostly in line with the current literature and characteristics of Croatian economy. Data on disaggregated multipliers can help policy makers in designing the consolidation packages that can deliver the required fiscal effort while minimizing the negative short-term effects on growth.

However, non-complementarity and an ad hoc introduction of fiscal measures, together with a high degree of policy uncertainty during the 2014-2016 EDP episode, weighed down on Croatia's pursuit of a growth-friendly consolidation strategy. Thus, although it successfully stabilized the public-debt-to-GDP trajectory, Croatia's fiscal consolidation strategy was growth-detrimental and partially self-defeating. Our analysis suggests that an alternative choice and timing of fiscal instruments would have shortened the recession in Croatia and improved the overall fiscal outcomes.

As Croatia is preparing to join the euro area in the near future, sustainability of public finances, as one of the key nominal convergence criteria, will be at the top of the economic policy agenda. Thus, we can expect that fiscal policy makers in Croatia will have to engage in a new fiscal consolidation episode in the medium run. In this context, we hope that our results can help policy makers to avoid the policy mistakes made during the EDP.

Disclosure statement

No potential conflict of interest was reported by the authors.

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APPENDIX 1
MODEL BLOCKS AND EQUATIONS

Aggregate demand

This block defines the behaviour of the main components of aggregate demand. GDP, consumption, private investments and imports are determined endogenously in this block, while we treat exports, government consumption and government investments as exogenous variables.[26] All macro variables are expressed in real terms,[27] which is standard in this type of model.

The consumption function in our model is broadly based on Modigliani's life-cycle consumption theory. Thus, private consumption depends on disposable income Y_t^D and wealth W_t. Disposable income is defined as the total income (sum of gross wages, government transfers and remittances) minus income taxes and social contributions paid by employees. As there is no publicly available long time series of quarterly data on household financial wealth in Croatia, we approximate it by the deflated stock-exchange index CROBEX.[28] D_t is a dummy variable that takes the value of 1 in the case of some outliers in the data. The long run consumption function is defined as:[29]

$$\log\left(C_t\right) = C_0 + C_1 \log\left(Y_t^D\right) + C_2 \log\left(W_t\right) + D_t + \varepsilon_t^C \qquad \text{(A.1)}$$

while the short-run equation is then defined as:

$$\text{dlog}\left(C_t\right) = \text{c}_0 + c_1 \text{dlog}\left(Y_t^D\right) + c_2 \text{dlog}\left(W_t\right) + c_3 \varepsilon_{t-1}^C + \mu_t^C \qquad \text{(A.2)}$$

The term $c_3 \varepsilon_{t-1}^C$ captures the error correction mechanism.

Total real investments are defined as the sum of private investments and government investments.

$$IT_t = IP_t + \overline{IG_t} \qquad \text{(A.3)}$$

Private investments are the function of investment demand ID_t (sum of consumption, exports and government investment) (accelerator effect), foreign direct investment FDI_t, costs of production $COST_t$ (defined as the sum of gross private wages and corporate tax per unit of investment) and subsidies in the previous quarter $SUBS_{t-1}$. Subsidies are included in the model with a lag because we cannot expect

[26] As explained in the subsection on fiscal variables, we treat most of components of government expenditure as exogenous, while government revenues are mostly determined endogenously. This is a standard assumption in this type of analysis. Overbar denotes exogenous variables.
[27] We only use nominal data on GDP when we need to calculate the share of fiscal variables in GDP. Nominal GDP is calculated as the real GDP multiplied by GDP deflator that is determined by CPI developments.
[28] Although some authors also use house prices as a proxy of wealth, in our view consumption in the short run is determined only by liquid form of assets.
[29] Equations also include some dummy variables in case of some unexplainable breaks and/or outliers that cannot be explained by economic factors.

this type of government support to companies to be able contemporaneously to increase investment activity.

$$\log\left(IP_t\right) = I_0 + I_1 \log\left(ID_t\right) + I_2 \log\left(FDI_t\right) + I_3\left(COST_t\right) + I_4 \log\left(SUBS_{t-1}\right) + \varepsilon_t^I \quad \text{(A.4)}$$

$$\begin{aligned} \mathrm{dlog}\left(IP_t\right) = \mathrm{i}_0 + i_1 \mathrm{dlog}\left(ID_t\right) + i_2 \mathrm{dlog}\left(FDI_t\right) + i_3 d\left(COST_t\right) \\ + i_4 \mathrm{dlogg}\left(SUBS_{t-1}\right) + i_5 \varepsilon_{t-1}^I + \mu_t^I \end{aligned} \quad \text{(A.5)}$$

Imports are determined by the import demand (MD_t) in the economy (sum of domestic demand and exports) and terms of trade, which are defined as the ratio of export and import prices. D_t is a dummy variable that takes the value of 1 in case of some outliers in the data:

$$\log\left(M_t\right) = M_0 + M_1 \log\left(MD_t\right) + M_2 \log\left(\overline{TOT_t}\right) + D_t + \varepsilon_t^M \quad \text{(A.6)}$$

$$\mathrm{dlog}\left(M_t\right) = \mathrm{m}_0 + m_1 \mathrm{dlog}\left(TD_t\right) + m_2 \mathrm{dlog}\left(\overline{TOT_t}\right) + m_3 \varepsilon_{t-1}^M + \mu_t^M \quad \text{(A.7)}$$

Real gross domestic product based on the expenditure approach can be understood as the total aggregate demand in the economy:

$$GDP_t = C_t + \overline{G_t} + IT_t + \overline{X_t} - M_t \quad \text{(A.8)}$$

Labour market

On the labour market we define private employment $EMPPRIV_t$ and public employment $EMPUB_t$. Private employment is a function of investment activity and private consumption,[30] while public employment is defined exogenously. D_t is a dummy variable that takes the value of 1 in case of some outliers in data:

$$\log\left(EMPPRIV_t\right) = EMP_0 + EMP_1 \log\left(IT_{t-1}\right) + EMP_2 \log\left(C_{t-1}\right) + D_t + \varepsilon_t^{EMP} \quad \text{(A.9)}$$

$$\begin{aligned} \mathrm{dlog}\left(EMPPRIV_t\right) = emp_0 + emp_1 \mathrm{dlog}\left(IT_{t-1}\right) + emp_2 \mathrm{dlog}\left(C_{t-1}\right) \\ + \mathrm{emp}_3 \varepsilon_{t-1}^{EMP} + D_t + \mu_t^{EMP} \end{aligned} \quad \text{(A.10)}$$

The behaviour of private investment is broadly based on orthodox Keynesian theory where employment is mostly determined by domestic demand (Snowdon and Vane, 2005). However, as there are rigidities on the labour market we expect that components of domestic demand can affect labour market only with a lag.

Total employment is given by the term:

$$EMPTOT_t = EMPPRIV_t + \overline{EMPPUB_t} \quad \text{(A.11)}$$

[30] This equation also contains quadratic trend to improve the fit of the model. More precisely, although investments and consumption adequately describe the dynamics of private employment they cannot capture the size of the amplitude.

Total compensation of employees $WTOTAL_t$ is then the sum of compensation of employees in the private sector and compensation of employees in the public sector. Compensation of employees is defined as the sum of net wages per employee, income taxes per employee, social contributions for healthcare security per employee and social contributions for pension security per employee multiplied by the number of the employed. All variables are treated exogenously besides private sector employment:

$$WTOTAL_t = WPRIV_t + \overline{WPUB_t} \tag{A.12}$$

Prices

The equation that describes the dynamics of prices is broadly based on an open economy version of the Phillips curve.[31] As Croatia has a small open economy, prices are determined by both domestic and external factors (Jovičić and Kunovac, 2017). In addition, when modelling inflation behaviour in Croatia, it is important to consider the "stickiness" of prices (Pufnik and Kunovac, 2013). Having all this in mind, our inflation equation takes the following form:

$$\begin{aligned} dlog(CPI_t) = \pi_0 + \pi_1 dlog(CPI_{t-1}) + \pi_2\, dlog(WTOTAL_{t-1}) + \pi_3\, dlog(MP_t) \\ + \pi_4\, dlog(OIL_t) + \pi_5 d(IMPL\_IND_t) + D_t + \varepsilon_t^{CPI} \end{aligned} \tag{A.13}$$

The equation shows that quarterly inflation is determined by the quarterly inflation from the previous quarter (sticky prices argument) CPI_{t-1}, changes in total compensation of employees in the previous period $WTOTAL_{t-1}$ that captures the effect of both demand-side and cost-push pressures, changes in import prices MP_t, changes in oil prices OIL_t expressed in Croatian kuna and changes in implicit indirect tax rate ($IMPL\_IND_t$). D_t is a dummy variable that takes the value of 1 in case of some outliers in data.

Fiscal sector

One of the main purposes of the model is to estimate the effects of the fiscal consolidation measures implemented and to analyse the transmission mechanisms of fiscal policy. To capture the full effects of various revenue and the expenditure measures on the economy, we have disaggregated the fiscal sector as much as possible. The fiscal categories fully reflect ESA methodology. Key relations among variables in the fiscal block are presented in appendix 5.

We start from the basic identity of the fiscal balance, which is the difference between total general government revenues and expenditures:

$$FB_t = TR_t - TE_t \tag{A.14}$$

[31] Of course, as our model does not include the supply-side block that determines the potential output, this equation does not contain output gap. Instead, we use total compensation to employees as a measure of demand-side pressures. However, this variable also captures some cost-push pressures as rising nominal wages can motivate firms to increase prices.

From here, we disaggregate the total general government revenues,

$$TR_t = IND\_TAX_t + INCOME\_TAX_t + SC\_H_t + SC\_P_t + \overline{SALES_t} + \overline{REV\_OTHER_t} \quad \text{(A.15)}$$

where total revenues are the sum of the indirect and income taxes, social contributions for health and pension insurance, government sales and other revenues. Indirect taxes are defined as a product of implicit indirect tax rate and nominal consumption as relevant macroeconomic base:

$$IND\_TAX_t = \overline{IMPL\_IND_t} * C_t^{nominal} \quad \text{(A.16)}$$

On the other hand, income taxes consist of corporate income tax (CIT) and personal income tax (PIT):

$$INCOME\_TAX_t = CIT_t + PIT_t \quad \text{(A.17)}$$

where, as with indirect tax, corporate income tax is defined as the product of the implicit corporate tax rate and private investment:[32]

$$CIT_t = \overline{IMPL\_CIT_t} * IP_t \quad \text{(A.18)}$$

On the other hand, personal income tax is divided between private sector and public sector personal income tax to better isolate the effect of income tax changes on private sector and public sector, which is exogenous. Personal income tax is the product of implicit personal tax rates and the compensations of employees:

$$PIT_t = PIT_t^{Private} + PIT_t^{Public} \quad \text{(A.19)}$$

$$PIT_t^{Private} = \overline{IMPL\_PIT_t}^{Private} * WPRIV_t \quad \text{(A.20)}$$

$$PIT_t^{Public} = \overline{IMPL\_PIT_t}^{Public} * \overline{WPUB_t} \quad \text{(A.21)}$$

Furthermore, social contributions for pension and health insurance are identically divided, and their relevant macroeconomic bases are also compensations of employees:

$$SC\_P_t = SC\_P_t^{Private} + SC\_P_t^{Public} \quad \text{(A.22)}$$

$$SC\_P_t^{Private} = \overline{IMPL\_SC\_P_t}^{Private} * WPRIV_t \quad \text{(A.23)}$$

$$SC\_P_t^{Public} = \overline{IMPL\_SC\_P_t}^{Public} * \overline{WPUB_t} \quad \text{(A.24)}$$

[32] Investments serve as a proxy for gross operating surplus of corporations, which is commonly used as a macro base for corporate income tax. However, this variable is not available for Croatia on a quarterly level.

$$SC\_H_t = SC\_H_t^{Private} + SC\_H_t^{Public} \tag{A.25}$$

$$SC\_H_t^{Private} = \overline{IMPL\_SC\_H_t}^{Private} * WPRIV_t \tag{A.26}$$

$$SC\_H_t^{Public} = \overline{IMPL\_SC\_H_t}^{Public} * \overline{WPUB_t} \tag{A.27}$$

On the other hand, total general government expenditures are defined as the sum of the government consumption, social benefits (including unemployment benefits), interest, government investment, subsidies, other current and capital transfers:[33]

$$TE_t = \overline{G_t}^{nom} + \left(\overline{SB_t^{cash}} - UNEMP\_B_t\right) + UNEMP\_B_t + INT_t + \overline{IG_t} \tag{A.28}$$
$$+ \overline{SUBSIDIES_t} + \overline{OTHER\_TRANS} + \overline{CAP\_TRANS} - \overline{CAP\_C} + \overline{SALES}_t$$

Interest expenditure is defined in the public debt section, while unemployment benefits are the function of employment:

$$dlog(UNEMP\_B_t) = UNEMP\_B_0 + dlog\left(EMPTOT_t\right) + \varepsilon_t^{UNEMPB} \tag{A.29}$$

Nominal government consumption is defined as the sum of public compensation of wages, social benefits in kind, intermediate consumption, consumption of fixed capital with government sales subtracted:

$$\overline{G_t}^{nom} = WPUB_t + \overline{SB_t^{kind}} + \overline{INT\_C_t} + \overline{CAP\_C} - \overline{SALES_t} \tag{A.30}$$

At last, public debt is integrated in the model via traditional decomposition of debt dynamics, where the level of public debt depends on the previous level of public debt and the fiscal balance:

$$DEBT_t = DEBT_{t\text{-}1} + FB_t \tag{A.31}$$

Primary fiscal balance is defined as total fiscal balance adjusted for interest expenditures:

$$FB_t^{prim} = TR_t - TE_t + INT_t \tag{A.32}$$

Interest expenditure is annualized and defined as the product of the implicit interest rate and the previous level of debt:

$$INT_t^{annual} = IIR_t * DEBT_{t-4}, \tag{A.33}$$

[33] Consumption of fixed capital is subtracted, while government sales are added to annul the terms in government consumption identity.

Implicit interest rate is calculated as a ratio of interest expenditures and the level of debt. Their behaviour is modelled as a function of changes in public debt that affect credit rating and borrowing conditions,

$$dlog\,(IIR_t) = IIR_0 + dlog\,(DEBT_t) + \varepsilon_t^{IIR} \tag{A.34}$$

Finally, the decomposition of public debt dynamics is given by the standard formula,

$$\frac{DEBT_t}{GDP_t^{nom}} = \frac{(1+IIR_t)}{\left(1+\left(GDP_t^{nom}\ growth\right)\right)} * \frac{DEBT_{t-1}}{GDP_{t-1}^{nom}} - \frac{FB_t^{prim}}{GDP_t^{nom}} \tag{A.35}$$

Equations (34) and (35) enable us to analyze important feedbacks from macro variables to public debt-to-GDP ratio and feedbacks from debt-to-GDP-ratio to interest rates. These feedbacks can play a crucial role in the success of fiscal consolidations episodes.

The baseline scenario in our analysis is the result of the model estimation for the period from 2003q3 to 2019q4. This scenario includes all fiscal measures implemented during the EDP. All macroeconomic and fiscal variables are obtained from Eurostat, except data on employment, which are based on Croatian Pension Insurance Institute data. The appendix provides a comparison of the simulated baseline scenario and actuals for key macro and fiscal endogenous variables.

APPENDIX 2
ORIGINAL AND SIMULATED ENDOGENOUS VARIABLES (BASELINE)

FIGURE A2.1
Endogenous variables – baseline scenario vs. actuals (levels)

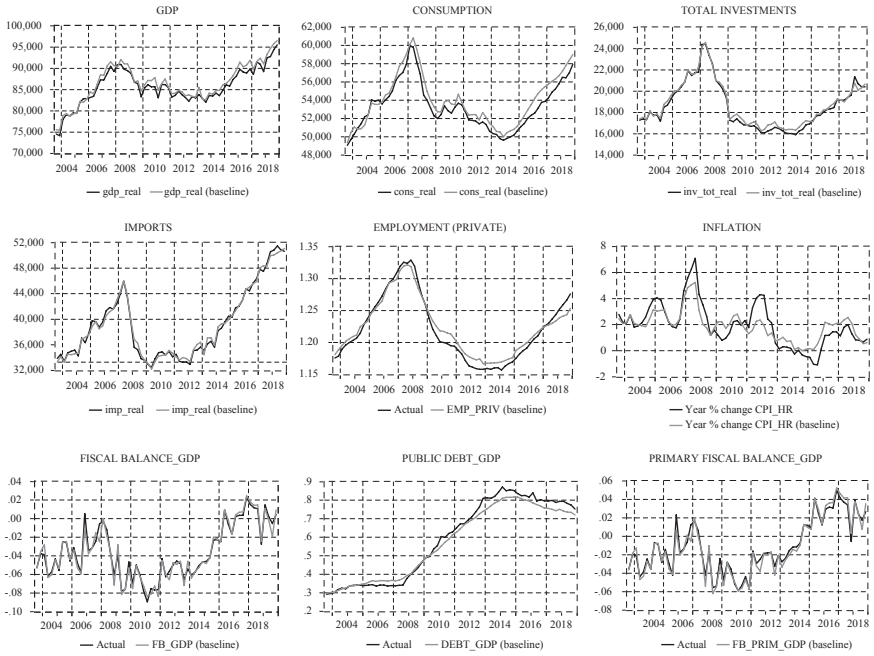
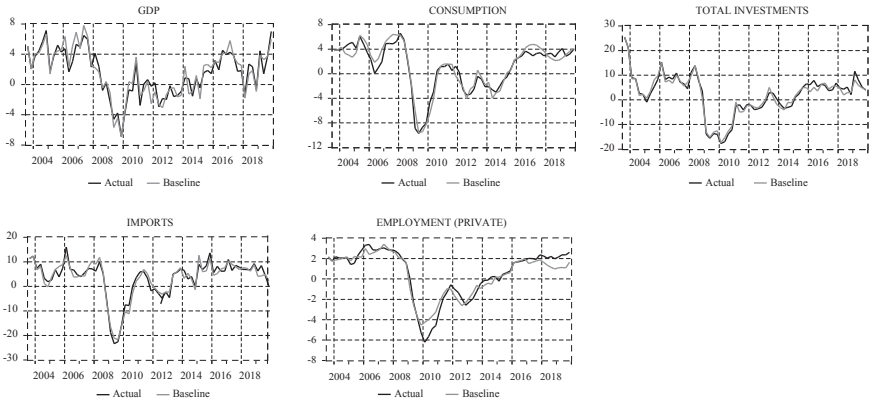


FIGURE A2.2
Endogenous variables – baseline scenario vs. actuals (growth rates)



Note: these figures shows only key endogenous macro and fiscal variables; figures of other variables are available upon request.

Source: authors.

APPENDIX 3

ESTIMATION RESULTS – KEY MACRO EQUATIONS

Consumption (long-run)

Dependent variable: $\log(C_t)$

	Coefficient	Std. error	t-Statistic	Prob.
C_0	3.71	0.37	9.94	0.00
$\log(Y_t^D)$	0.60	0.04	15.83	0.00
$\log(W_t)$	0.10	0.01	8.20	0.00
D_t	0.03	0.00	7.31	0.00
R-squared 0.95				

Regression: $\log(C_t) = C_0 + C_1 \log(Y_t^D) + C_2 \log(W_t) + D_t + \varepsilon_t^C$

Consumption (short-run)

Dependent variable: $\text{dlog}(C_t)$

	Coefficient	Std. error	t-Statistic	Prob.
c_0	0.00	0.00	3.86	0.00
$\text{dlog}(Y_t^D)$	0.53	0.22	2.37	0.02
$\text{dlog}(W_t)$	0.03	0.01	3.00	0.00
ε_{t-1}^C	-0.19	0.05	-3.87	0.00
R-squared 0.63				

Regression: $\text{dlog}(C_t) = c_0 + c_1 \text{dlog}(Y_t^D) + c_2 \text{dlog}(W_t) + c_3 \varepsilon_{t-1}^C + \mu_t^c$

Investments (long-run)

Dependent variable: $\log(IP_t)$

	Coefficient	Std. error	t-Statistic	Prob.
I_0	-5.74	0.49	-11.75	0.00
$\log(ID_t)$	1.32	0.04	35.40	0.00
$\log(FDI_t)$	0.03	0.01	2.57	0.01
$COST_t$	-0.55	0.05	-10.24	0.00
$SUBS_{t-1}$	0.04	0.02	2.28	0.03
D_t	0.03	0.02	1.73	0.09
R-squared 0.92				

Regression: $\log(IP_t) = I_0 + I_1 \log(ID_t) + I_2 \log(FDI_t) + I_3(COST_t) + I_4 \log(SUBS_{t-1}) + D_t + \varepsilon_t^I$

Investments (short-run)

Dependent variable: $\text{dlog}(IP_t)$

	Coefficient	Std. error	t-Statistic	Prob.
i_0	0.01	0.00	2.52	0.01
$\text{dlog}(ID_t)$	0.32	0.11	3.06	0.00
$\text{dlog}(FDI_t)$	0.02	0.01	1.87	0.07
$\text{d}(COST_t)$	-0.84	0.08	-10.63	0.00
$\text{dlog}(SUBS_{t-1})$	0.00	0.02	0.12	0.90
ε_{t-1}^I	-0.33	0.08	-4.10	0.00
R-squared 0.87				

Regression: $dlog(IPt) = i_0 + i_1 dlog(ID_t) + i_2 dlog(FDI_t) + i_3 d(COST_t) + i_4 dlog(SUBS_{t-1}) + i_5 \varepsilon_{t-1}^I + \mu_t^I$

Imports (long-run)

Dependent variable: log(M_t)

	Coefficient	Std. error	t-Statistic	Prob.
M_0	-7.72	0.69	-11.14	0.00
log(MD_t)	1.58	0.07	22.03	0.00
log($\overline{TOT_t}$)	-0.95	1.35	-0.71	0.48
D_t	0.07	0.01	7.30	0.00
R-squared 0.98				

Regression: $\log(M_t) = M_0 + M_1 \log(MD_t) + M_2 \log(\overline{TOT_t}) + D_t + \varepsilon_t^M$

Imports (short-run)

Dependent variable: dlog(M_t)

	Coefficient	Std. error	t-Statistic	Prob.
m_0	-7.04	1.01	-6.96	0.00
dlog(TD_t)	0.87	0.11	8.23	0.00
dlog($\overline{TOT_t}$)	0.21	0.07	3.02	0.00
ε_{t-1}^M	-0.46	0.07	-6.96	0.00
R-squared 0.85				

Regression: $\text{dlog}(M_t) = \text{m}_0 + m_1 \text{dlog}(TD_t) + m_2 \text{dlog}(\overline{TOT_t}) + m_3 \varepsilon_{t-1}^M + \mu_t^M$

Employment (long-run)

Dependent variable: log($EMPPRIV_t$)

	Coefficient	Std. error	t-Statistic	Prob.
EMP_0	-0.62	0.78	-0.79	0.43
log(IT_{t-1})	0.34	0.07	5.23	0.00
log(C_{t-1})	-0.23	0.13	-1.83	0.07
D_t	0.98	0.42	2.35	0.02
R-squared 0.85				

Regression: $\log(EMPPRIV_t) = EMP_0 + EMP_1 \log(IT_{t-1}) + EMP_2 \log(C_{t-1}) + D_t + \varepsilon_t^{EMP}$

Employment (short-run)

Dependent variable: dlog($EMPPRIV_t$)

	Coefficient	Std. error	t-Statistic	Prob.
emp_0	0.00	0.00	3.20	0.00
dlog(IT_{t-1})	0.12	0.06	1.91	0.06
dlog(C_{t-1})	0.12	0.04	2.99	0.00
ε_{t-1}^{EMP}	-0.10	0.03	-3.71	0.00
D_t	0.01	0.00	6.81	0.00
R-squared 0.75				

Regression: $\text{dlog}(EMPPRIV_t) = emp_0 + emp_1 \text{dlog}(IT_{t-1}) + emp_2 \text{dlog}(C_{t-1}) + emp_3 \varepsilon_{t-1}^{EMP} + \mu_t^{EMP}$

Inflation

Dependent variable: $dlog(CPI_t)$

	Coefficient	Std. error	t-Statistic	Prob.
π_0	0.00	0.00	3.53	0.00
$dlog(CPI_{t-1})$	0.32	0.08	4.13	0.00
$dlog(WTOTAL_{t-2})$	0.02	0.01	2.38	0.02
$dlog(MP_t)$	0.12	0.06	2.00	0.05
$dlog(OIL_t)$	0.01	0.00	5.61	0.00
$d(IMPL\_IND_t)$	0.01	0.00	2.24	0.03
D_t	0.01	0.00	6.41	0.00
R-squared 0.64				

$$Regression:\ dlog(CPI_t) = \pi_0 + \pi_1 dlog(CPI_{t-1}) + \pi_2 dlog(WTOTAL_{t-2}) + \pi_3 dlog(MP_t) + \pi_4 dlog(OIL_t) + \pi_5 d(IMPL\_IND_t) + D_t + \varepsilon_t^{CPI}$$

Unemployment benefits

Dependent variable: $UNEMP\_BEN_t$

	Coefficient	Std. error	t-Statistic	Prob.
ub_0	52433.02	11322.75	4.63	0.00
$UNEMP\_BEN_{t-1}$	0.83	0.04	22.99	0.00
$d(EMPTOT_t,4)$	-6892.60	1531.59	-4.50	0.00
D_t	69767.78	13227.75	5.27	0.00
R-squared 0.95				

$$Regression:\ UNEMP\_BEN_t = ub_0 + ub_1 UNEMP\_BEN_{t-1} + ub_2 d(EMPTOT_t,4) + D_t + \varepsilon_t^{ub}$$

Implicit interest rate

Dependent variable: IIR_t

	Coefficient	Std. error	t-Statistic	Prob.
iir_0	0.04	0.00	53.77	0.00
$d(DEBT_t,4)$	0.07	0.01	12.27	0.00
D_t	0.01	0.00	4.42	0.00
R-squared 0.68				

$$Regression:\ IIR_t = iir_0 + iir_1 d(DEBT_t,4) + D_t + \varepsilon_t^{ub}$$

APPENDIX 4
FISCAL MULTIPLIERS OF DIFFERENT FISCAL INSTRUMENTS

TABLE A4.1
Model-based approach

	Research / Fiscal instrument	Coenen, Kilponen and Trabandt (2010)	Cournede, Goujard and Pina (2013)	Gechert (2015)	Kilponen et al. (2019)	Snudden and Klyuev (2011)	Muir and Weber (2013)	Zubairy (2014)
Public expenditures	Government consumption (G)	0.7-0.8	0.6-0.8	0.8	0.5-0.9	0.4	0.5	0.8-0.9
	Social transfers	0.0-0.2	0.2-0.5	0.4		0.1	0.1	
	Public investment	0.8-1.1	1.3	1.4		0.4	0.6	
	Subsidies							
Public revenues	Personal income tax	0.2-0.3	0.2-0.5		0.0-0.5	0.1	0.4	0.3-0.4
	Corporate income tax	0.1-0.1			0.1-0.3		0.5	
	Social contributions							
	Indirect taxes	0.1-0.3	0.1-0.3		0.1-0.7	0.1	0.3	
Country		Euro area/EU	OECD	meta study	Euro area countries	Czechia	Bulgaria	USA
Model		DSGE	semi-structural	across models	across models	DSGE	DSGE	DSGE

Source: authors.

APPENDIX 5
ANNOUNCED STRUCTURAL MEASURES DURING THE EDP

TABLE A5.1

Announced structural measures during the EDP

Revenues	Expenditures
2014	
• Increase of the rate of healthcare contributions from 13% to 15% (0.49% of GDP) • Increased social security contributions due to the shift of part of the future pension contributions to the first pillar (0.12% of GDP) • Higher fuel excises (0.11% of GDP) • Other revenues side measures: changes in the lottery and gambling taxes, SOEs dividend and profit withdrawal, increase of telecom fees and other concession fees (0.1% of GDP) • increase of reduced VAT rate from 10% to 13% (0.12% of GDP)	• Lower intermediate consumption due to savings, among other, on maintenance costs, transportation costs, IT services (0.3% of GDP) • Reduction of subsidies, mostly to shipyards, HBOR and railways (0.4% of GDP) • Savings in social transfers, mostly in the health sector and privileged pension outlays (0.3% of GDP) • Reduction of current and capital transfers, mostly due to replacement with EU funding (0.1% of GDP) • Reduction of subsidies (0.2% of GDP) • Lower public investment (0.1% of GDP) • Extrabudgetary users and other general government entities, mainly in Croatian Roads and Croatian Waters (0.4% of GDP) • Savings on general government compensation of employees (0.2% of GDP)
2015	
• Increase of the rate of healthcare contributions from 13% to 15% (0.25% of GDP) – a residual effect of the measure introduced in 2014 • Changes in the lottery and gambling taxes (0.05% of GDP) – a residual effect of the measure introduced in 2014 • Increased social security contributions due to the shift of part of the future pension contributions to the first pillar (0.04% of GDP) – a residual effect of the measure introduced in 2014 • Tax on savings interest (0.07% of GDP) • Higher fuel and tobacco excises (0.16% of GDP)	• Reduction of subsidies for agriculture, active labor market policies and Croatian Bank for Reconstruction and Development (0.03% of GDP) • Social benefits savings on housing loan subsidies and preferential pensions above 5,000 HRK, and consolidation of social benefits (0.05% of GDP) • Savings of extrabudgetary users, in particular Croatian Waters, Croatian Health Insurance Fund, Croatian Highways, Croatian Railway Infrastructure (0.5% of GDP) • Reduction of transfers, mainly guarantee funds (0.13% of GDP) • Reduction of investment expenditure of the central and local government units (0.5% of GDP)
2016	
• SOEs dividend and profit withdrawal (0.2% of GDP) • Higher fuel and tobacco excises (0.06% of GDP) – a residual effect of the measure introduced in 2014 • New treatment of reinvested earnings in the corporate income tax system (0.15% of GDP) • Introduction of capital gains tax	• Lower intermediate consumption due to implementation of "standard material costs guidelines" (0.05% of GDP) • Further reduction of subsidies of some activities and substitution with EU funds (0.16% of GDP) • Reduction of social benefits through their further integration and decreasing unemployment (0.13% of GDP) • Savings in other transfers through expiry of certain programs and substitution with EU funds (0.21% of GDP) • Reduction of investment expenditure in defense, health, education, science (0.07% of GDP)

Revenues	Expenditures
2017	
	• Reduction of investment expenditure of the central and local government units (0.5% of GDP) • Reduction of capital transfers (0.5% of GDP)

Source: European Commission, Assessments of the Convergence Program (different years); authors.

APPENDIX 6
MORE DETAILS ON THE EDP IN CROATIA

The Recommendation issued in December 2013 required Croatia to correct its excessive deficit by 2016, with an annual improvement in the structural balance of 0.5%, 0.9% and 0.7% of GDP in 2014, 2015 and 2016. The Commission estimated that the mentioned consolidation required Croatia to adopt structural consolidation measures of 2.3% of GDP in 2014 and 1% of GDP in 2015 and 2016 (European Commission, 2013b). It was assessed that these measures would reduce the nominal deficit to below 3% of GDP by 2016 and put the public debt on a sustainable path.

TABLE A6.1

Forecast of macro and fiscal variables under baseline and EDP scenario (December 2013)

Real GDP growth %	**2014**	**2015**	**2016**
No policy change	0.5	1.2	1.7
EDP scenario	-1.0	0.6	1.1
Required structural measures, % of GDP	2.3	1.0	1.0
Structural balance, no policy change	-5.9	-5.8	-6.1
Structural balance, EDP scenario	-4.0	-3.1	-2.4
General government balance, no policy change	-6.4	-6.0	-6.0
General government balance, EDP scenario	-4.6	-3.5	-2.7
General government debt, no policy change	64.7	68.8	72.3
General government debt, EDP scenario	63.9	66.1	66.8

Source: European Commission (2013a).

The Recommendation set a deadline of three months for Croatia to undertake a fiscal effort, i.e. until 30 April 2014. In January 2014, the Council adopted both the Commission's proposal for a decision on the existence of the excessive deficit and the recommendation on its correction, and officially activated the EDP for Croatia (European Commission, 2014b).

In response to Recommendations of the Council, in March 2014 the Croatian Parliament adopted a supplementary budget of the central government for 2014, which included a package of structural measures of 1.9% of GDP for 2014. As the size of the announced structural measures was below the Commission's recommendations, additional fiscal measures were adopted in April in the amount of 0.4% of GDP. In the same month, the Government introduced the *Convergence Program*, which adopted structural measures to correct the excessive deficit in 2015 and 2016, amounting to 1% of GDP in those years.

At the beginning of June 2014, the Commission published an assessment of Croatia's fiscal effort, where Croatia received a positive assessment of fiscal effort for 2014 and 2015 (European Commission, 2014a). Thus, the nominal target in 2014

was achieved in accordance with the recommendation, while in 2015 it was breached by 0.25% of GDP. The evaluation therefore noted that the 2015 Budget needed to adopt additional structural measures that would enable the achievement of the nominal target in 2015. However, according to the criterion of the "bottom-up" analysis, i.e. summarizing structural measures, Croatia met the requirements of the recommendation.

With the expectation that the 2015 Budget would include additional structural adjustment to meet the set targets, the Commission proposed to put the EDP on hold and announced further close monitoring of public finances. Although Croatia struggled to deliver the required structural effort through 2015 (as noticed by the Commission while assessing the Convergence Program for 2015 (European Commission, 2015)), the Procedure stayed in abeyance and no further action by the Commission was pursued.

The EDP timeline

When looking at the EDP fiscal consolidation episode in Croatia, we can identify three main policy phases: pre-EDP consolidation phase, main EDP consolidation phase and implementation phase (see figure 1).

1) Pre-EDP consolidation phase

This phase started in 2013 and ended with the 2014 Budget revision that anticipated the activation of the EDP for Croatia and already tackled the unsustainable trajectory of Croatia's public finance. The most significant measures from this period were a public sector wage bill cut in 2013 and other measures implemented with the 2014 Budget, such as pensions cut for the war veterans and a rise of the intermediate VAT rate. The Commission assessed in its December 2013 Report that those measures were not sufficient to correct the excessive deficit.

2) Main EDP consolidation phase

In this phase, Croatian authorities introduced the main consolidation package after the official activation of the EDP. The package included the main consolidation measures presented in the 2014 Budget revision and additional measures from April 2014. The consolidation package followed the Commission recommendation with 2.3% of GDP structural measures in 2014 and 1% of GDP in both 2015 and 2016. After the introduction of the package, the Council decided to put the EDP procedure in abeyance. The main measures on the revenue side included an increase of the health contribution, oil and tobacco excises, limitation of CIT tax relief and the introduction of tax on savings, while the expenditure side measures included cuts in investments, intermediate consumption, subsidies and additional cuts of wage bill, through loyalty bonuses.

3) Implementation phase

This phase continued throughout 2015 and 2016. During this phase, Croatian authorities made adjustments that led to deviations of the size and type of measures initially proposed by the main EDP consolidation package (see table A5.1 in

appendix 5 with all measures listed). As the government dropped some of the measures from the consolidation package (e.g. property tax), it intensified some expenditure cuts such as those in subsidies and investment. Furthermore, consolidation was supported by the expenditure restraint from September 2015 to March 2016 determined by the temporary financing of the Budget and the absence of a government with legislative powers.

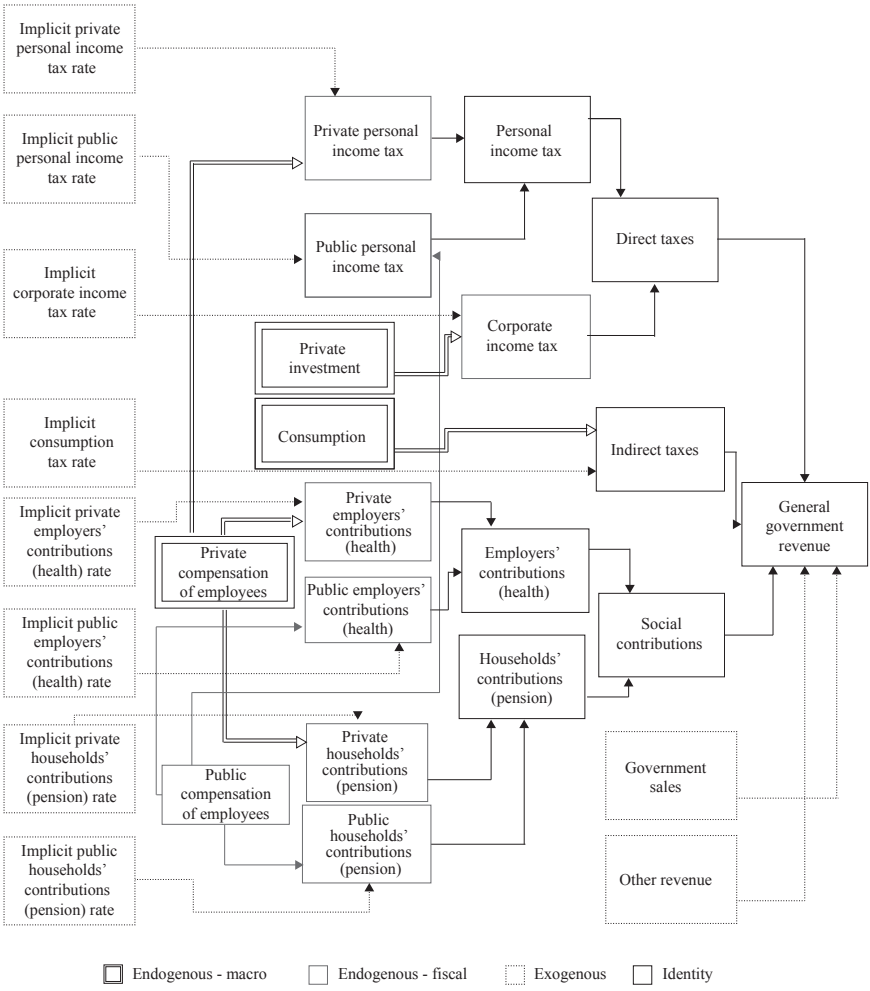
Table A6.2
Timeline of the EDP consolidation

2013			2014				2015				2016				2017		
Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Pre-EDP consolidation phase				**Main EDP consolidation phase**			**Implementation phase of the EDP measures**										
	Croatia joins EU	EC proposes opening of EDP for Croatia	Council opens EDP for Croatia	Main EDP fiscal package of measures	EC gives positive assesment of the fiscal effort	EDP in abeyance										EC proposes closing of EDP for Croatia	Council closes EDP for Croatia

Source: authors.

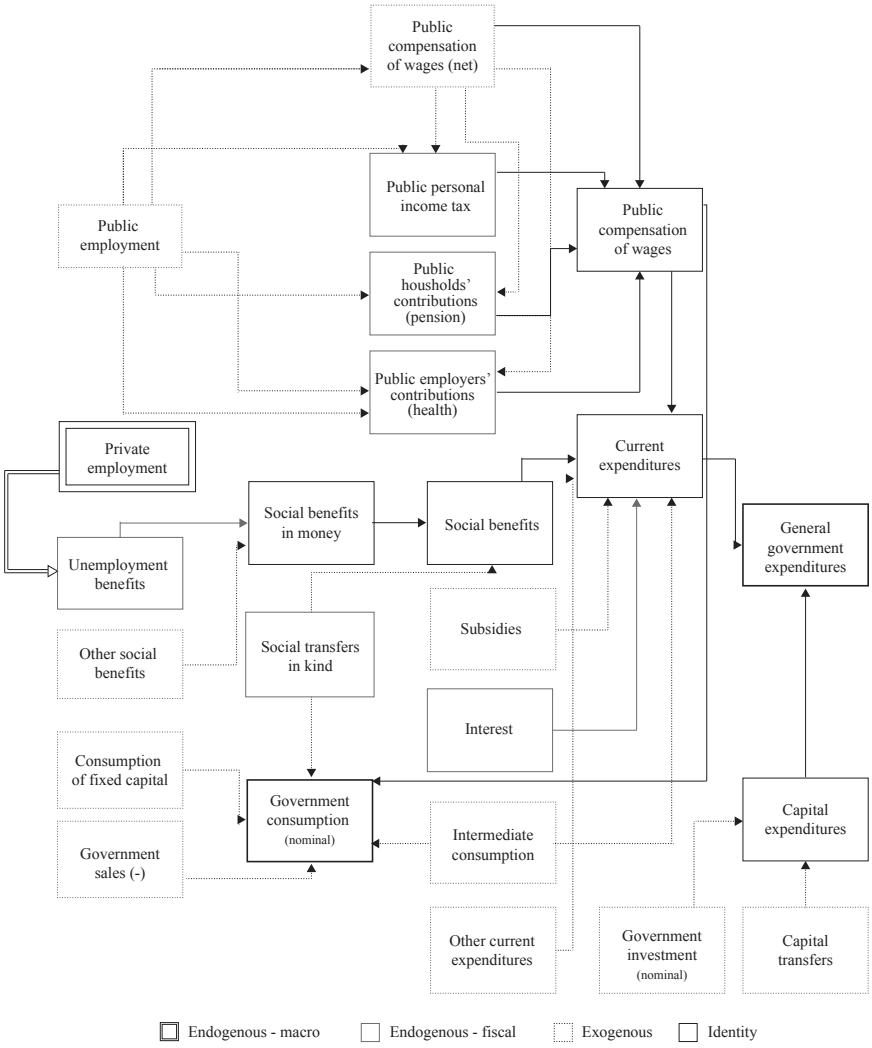
APPENDIX 7
DISAGGREGATED FISCAL SECTOR

FIGURE A7.1
Revenues



Source: authors.

FIGURE A7.2
Expenditures



Source: authors.

APPENDIX 8

DETAILED DESCRIPTION OF VARIABLES AND ADDITIONAL IDENTITIES

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
Behavioural equations				CBS
Consumption	C_t	Private consumption	Consumption of households and NPISH, National accounts, constant prices (2015=100)	CBS
	Y_t^D	Real disposable income	See below (identity)	CBS
	W_t	Real wealth	Zagreb Stock Market Exchange (ZSE) index CROBEX, deflated by CPI	ZSE, CBS
Private investments	IP_t	Private investments	Gross capital formation (GCF), National accounts – Gross capital formation of the government (ESA 2010, sectoral government accounts), deflated by investments deflator	CBS
	ID_t	Investment demand	See below	CBS
	FDI_t	Foreign direct investment	Balance of Payments, Financial account, Direct investment (liabilities) (converted from EUR to HRK)	CNB
	$COST_t$	Private investment cost	See below (identity)	
	$SUBS_t$	Subsidies	Sectoral government accounts (ESA 2010)	CBS
Imports	M_t	Imports	Imports of goods and services (GS), National accounts, constant prices (2015=100)	CBS
	MD_t	Import demand	See below (identity)	
	$\overline{TOT_t}$	Terms of trade	Ratio between deflator of exports and deflator of imports, National accounts	CBS
Private employment	$EMPPRIV_t$	Private employment	Number of employed persons in all sectors except O, P, Q activities according to NKD 2007, in thousands	CHIF
	IT_t	Total investment	Gross capital formation, National accounts, constant prices (2015=100)	CBS
	C_t	Private consumption	Consumption of households and NPISH, National accounts, constant prices (2015=100)	
Prices	CPI_t	Consumer price index	Consumer price index, 2015=100	CNB
	$WTOTAL_t$	Total wage bill	See below	
	MP_t	Imports deflator	(Imports of GS in current prices)/(imports of GS in constant prices, 2015=100)*100	CBS
	OIL_t	OIL prices	Brent oil price in US dollars (converted to HRK)	Fred
	$\overline{IMPL\_IND_t}$	Implicit indirect tax rate	$\overline{IMPL\_IND_t} = \frac{IND\_TAX_t}{C_t^{nominal}}$	

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
Interest rate	IIR_t	Implicit interest rate	$IIR_t = \frac{INT_t^{annual}}{DEBT_{t-4}}$	
	$DEBT_t$	Public debt	General government debt (ESA 2010), millions of HRK	CNB
Unemployment benefits	$UNEMP\_B_t$	Unemployment benefits	Unemployment benefits (COFOG 10.5.0, ESA 2010)	Eurostat
	$EMPTOT_t$	Total employment	Total number of employed persons, in thousands	CHIF
Identities (macro)				
Real GDP	GDP_t	Gross domestic product (GDP)	$GDP_t = C_t + \overline{G_t} + IT_t + \overline{X_t} - M_t$	
	C_t	Private consumption	Consumption of households and NPISH, National accounts, constant prices (2015=100)	CBS
	IT_t	Total investment	Gross capital formation (GCF), National accounts, constant prices (2015=100)	CBS
	$\overline{G_t}$	Government consumption	General government (GG) consumption, National accounts, constant prices (2015=100)	CBS
	$\overline{X_t}$	Exports	Exports of goods and services (GS), National accounts, constant prices (2015=100)	CBS
	M_t	Imports	Imports of goods and services (GS), National accounts, constant prices (2015=100)	CBS
Nominal GDP	GDP_t^{nom}	Nominal GDP	$GDP_t^{nom} = GDP_t * (GDP\_DEF_t) * 100$	
	GDP_DEF_t	GDP deflator	(GDP in current prices)/(GDP in constant prices, 2015=100)*100	CBS
Nominal consumption	CT_t^{nom}	Nominal private consumption	$CN_t = C_t * (CPI_t) * 100$	
	C_t	Private consumption	Consumption of households and NPISH, National accounts, constant prices (2015=100)	CBS
	CPI_t	Consumer price index	Consumer price index, 2015=100	CNB
Real G	$\overline{G_t}$	Government consumption	$\overline{G_t} = (\overline{\overline{G_t^{nom}}} / \overline{G\_DEF_t}) * 100$	CBS
	$\overline{G_t^{nom}}$	Nominal government consumption	See below	
	$\overline{G\_DEF_t}$	Government consumption deflator	(GG consumption in current prices)/(GG consumption in constant prices, 2015=100)*100	CBS
Real GDP annual	$GDPY_t$	Annual GDP	$GDPY_t = GDP_t + GDP_{t-1} \mp GDP_{t-2} + GDP_{t-3}$	
Total investment	IT_t	Total investment	$IT_t = IP_t + \overline{IG_t}$	

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
	IP_t	Private investments	Gross capital formation (GCF), National accounts – Gross capital formation of the government (ESA 2010, sectoral government accounts), constant prices (2015=100)	CBS
	$\overline{IG_t}$	Government investment	See below	
Private investment costs	$ICOST_t$	Private investment costs	$ICOST_t = (WPRIV_{t-1} + CIT_{t-1}) / IP_{t-1}$	
	$WPRIV_t$	Private wage bill	See below	
	CIT_t	Corporate income tax	Direct taxes by corporations (sectoral accounts of S.11+S.12, ESA 2010)	Eurostat
Investment demand	ID_t	Investment demand	$ID_t = C_t + \overline{G_t} + \overline{X_t} + \overline{IG_t}$	
	C_t	Private consumption	Consumption of households and NPISH, National accounts, constant prices (2015=100)	CBS
	$\overline{G_t}$	Government consumption	See above	CBS
	$\overline{X_t}$	Exports	Exports of goods and services (GS), National accounts, constant prices (2015=100)	CBS
	$\overline{IG_t}$	Government investment	See below (identity)	
Real government investment	$\overline{IG_t}$	Government investment	$\overline{IG_t} = (\overline{IG_t^{nom}} / \overline{IG\_DEF_t}) * 100$	
	$\overline{IG_t^{nom}}$	Nominal government investment	Gross fixed capital formation (ESA 2010, sectoral government accounts)	CBS
	$\overline{IG\_DEF_t}$	Government investment deflator	$\overline{IG\_DEF_t} = (\overline{IG_t^{nom}} / \overline{IG_t}) * 100$	CBS
	$\overline{IG_t}$	Government investment	Government investment in constant prices, 2015=100	CBS
Imports demand	MD_t	Import demand	$MD_t = C_t + IP_t + \overline{G_t} + \left(\overline{G_t} - WPUB_t\right) + \overline{X_t}$	
	C_t	Private consumption	Consumption of households and NPISH, National accounts, constant prices (2015=100)	CBS
	IP_t	Private investment	Gross capital formation (GCF), National accounts – Gross capital formation of the government (ESA 2010, sectoral government accounts), deflated by investments deflator	
	$\overline{IG_t}$	Public investment	$\overline{IG_t} = (\overline{IGN_t} / \overline{IG\_DEF_t}) * 100$	
	$\overline{G_t}$	Government consumption	See above	
	$WPUB_t$	Public wage bill	See below	CHIF

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
	$\overline{X_t}$	Exports	Exports of goods and services (GS), National accounts, constant prices (2015=100)	CBS
Private wage bill	$WPRIV_t$	Private wage bill	$WPRIV_t = \left(W_{NET_{PRIV_t}} + PIT_t^{Private}{}_{emp} + SC_{Ht}{}^{Private}{}_{emp} + SC_{Pt}{}^{Private}{}_{emp}\right) * EMPPRIV_t$	
	$W\_NET\_PRIV_t$	Net private wages	Average net wage in all activities except O, P, Q according to NKD 2007, adjusted	CBS
	$PIT_t^{Private}{}_{emp}$	Personal income tax paid by private sector per empl.	$PIT_t^{Private}{}_{emp} = \frac{PIT_t - PIT_{PUBt}}{EMPPRIV_t}$	
	$SC\_H_t^{Private}{}_{emp}$	Healthcare social contribution paid by private sector employers	$SC\_H^{Private}{}_{t_{emp}} = \frac{SC\_H_t - SC\_H_{PUB_t}}{EMPPRIV_t}$	
	$SC\_P_t^{Private}{}_{emp}$	Pension social contribution paid by private sector employees	$SC\_P^{Private}{}_{t_{emp}} = \frac{SC\_P_t - SC\_P_{PUB_t}}{EMPPRIV_t}$	
	$EMPPRIV_t$	Private employment	Number of employed persons in all activities except O, P, Q according to NKD 2007, in thousands	CHIF
Public wage bill	$WPUB_t$	Public wage bill	$WPUB_t = \left(W_{NET_{PUB_t}} + PIT_t^{Public}{}_{emp} + SC_{Ht}{}^{Public}{}_{emp} + SC_{Pt}{}^{Public}{}_{emp}\right) * EMPPUB_t$	
	$W\_NET\_PUB_t$	Net public wages	Average net wage in O, P, Q activities according to NKD 2007, adjusted	CBS
	$PIT_t^{Public}{}_{emp}$	Personal income tax paid by public sector employees	$PIT_t^{Public}{}_{emp} = \frac{PIT_t}{EMPTOT_t} * \frac{W\_NET\_PUB_t}{W\_NET_t}$	
	$SC\_H_t^{Public}{}_{emp}$	Healthcare social contribution paid by public employers	$SC\_H_t^{Public}{}_{emp} = \frac{SC\_H_t}{EMPTOT_t} * \frac{W\_NET\_PUB_t}{W\_NET_t}$	
	$SC\_P_t^{Public}{}_{emp}$	Pension social contribution paid by public employees	$SC\_P_t^{Public}{}_{emp} = \frac{SC\_P_t}{EMPTOT_t} * \frac{W\_NET\_PUB_t}{W\_NET_t}$	
	$EMPPUB_t$	Public employment	Number of employed persons in O, P, Q activities according to NKD 2007, in millions	CHIF
Disposable income	NY_t^D	Nominal disposable income	$NY_t^D = (WPUB_t + WPRIV_t + \mathrm{SB}_t + \mathrm{REM}_t) - (SC\_P_t + SC\_H_t + PIT_t)$	
	$WPUB_t$	Public wage bill	See above	
	$WPRIV_t$	Private wage bill	See above	
	SB_t	Social benefits	Social benefits other than social transfers in kind (ESA 2010)	CBS
	REM_t	Remittances	Balance of Payments, Secondary income, Other sectors, Revenues (converted from EUR to HRK)	CNB

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
	SC_P_t	Social security contributions for pensions	Households' actual social contributions (ESA 2010)	
	SC_H_t	Social security contributions for healthcare	Employers' actual social contributions (ESA 2010)	CBS
	PIT_t	Personal income tax	Direct taxes by households (sectoral accounts of S.14+S.15, ESA 2010)	CBS
Real disposable income	Y_t^D	Real disposable income	$Y_t^D = (NY_t^D / CPI_t) * 100$	
	NY_t^D	Nominal disposable income	$NY_t^D = (WPUB_t + WPRIV_t + SB_T + REM_t) - (SC\_P_t + SC\_H_t + PIT_t)$	
	CPI_t	Consumer price index	Consumer price index, 2015=100	CNB
Identities (fiscal)				
Fiscal balance	FB_t	General government fiscal balance	$FB_t = TR_t - TE_t$	
General government revenues	TR_t	Total general government revenues	$TR_t = IND\_TAX_t + INCOME\_TAX_t + SC\_H_t + SC\_P_t + \overline{SALES_t} + \overline{REV\_OTHER_t}$	
	IND_TAX_t	Indirect taxes	$IND\_TAX_t = \overline{IMPL\_IND_t} * C_t^{nom}$	
	$\overline{IMPL\_IND_t}$	Implicit indirect tax rate	$\overline{IMPL\_IND_t} = \frac{\overline{IND\_TAX_t}}{C_t^{nom}}$	
	$\overline{IND\_TAX_t}$	Indirect taxes	Taxes on production and imports (ESA 2010)	Eurostat
	C_t^{nom}	Private consumption	Consumption of households and NPISH, National accounts, current prices	CBS
	$INCOME\_TAX_t$	Personal and profit income taxes	$INCOME\_TAX_t = CIT_t + PIT_t$	
	CIT_t	Corporate income tax	$CIT_t = \overline{IMPL\_CIT_t} * IP_t$	
	$\overline{IMPL\_CIT_t}$	Implicit direct tax rate	$\overline{IMPL\_CIT_t} = \frac{\overline{CIT_t}}{IP_T}$	
	$\overline{CIT_t}$	Corporate income tax	Direct taxes by corporations (sectoral accounts of S.11+S.12) (ESA 2010)	Eurostat
	IP_t	Private investments	Gross capital formation (GCF), National accounts – Gross capital formation of the government (ESA 2010, sectoral government accounts), deflated by investments deflator	CBS, Eurostat

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
	PIT_t	Personal income tax	$PIT_t = PIT_t^{Private} + PIT_t^{Public}$	
	$PIT_t^{Private}$	Personal income tax paid by private sector employees	$PIT_t^{Private} = \overline{IMPL\_PIT_t}^{Private} * WPRIV_t$	
	$\overline{IMPL\_PIT_t}^{Private}$	Implicit personal income tax rate for private sector employees	$\overline{IMPL\_PIT_t} = \frac{\overline{PIT_t}^{Private}}{WPRIV_t}$	
	$\overline{PIT_t}^{Private}$	Personal income tax paid by private sector employees	$\overline{PIT_t}^{Private} = PIT_t^{Private}{}_{emp} * EMPPRIV_t$	
	$PIT_t^{Private}{}_{emp}$	Personal income tax paid by private sector employees per employee	See above	
	$EMPPRIV_t$	Private sector employment	See above	
	$WPRIV_t$	Private wage bill	See above	
	PIT_t^{Public}	Personal income tax paid by public sector employees	$PIT_t^{Public} = \overline{IMPL\_PIT_t}^{Public} * \overline{WPUB_t}$	
	$\overline{IMPL\_PIT_t}^{Public}$	Implicit personal income tax rate for private sector employees	$\overline{IMPL\_PIT_t} = \frac{\overline{PIT_t}^{Public}}{WPUB_t}$	
	$\overline{PIT_t}^{Public}$	Personal income tax paid by private sector employees	$\overline{PIT_t}^{Public} = PIT_t^{Public}{}_{emp} * EMPPUB_t$	
	$PIT_t^{Public}{}_{emp}$	Personal income tax paid by public sector employees per employee	See above	
	$EMPPUB_t$	Private sector employment	See above	
	$WPRIV_t$	Public wage bill	See above	
	SC_P_t	Social contributions for pension insurance	$SC\_P_t = SC\_P_t^{Private} + SC\_P_t^{Public}$	
	$SC\_P_t^{Private}$	Social contributions for pension insurance paid by the private sector employees	$SC\_P_t^{Private} = \overline{IMPL\_SC\_P_t}^{Private} * WPRIV_t$	
	$\overline{SC\_P_t}^{Private}$	Social contributions for pension insurance paid by the private sector employees	$\overline{SC\_P_t}^{Private} = SC\_P_t^{Private}{}_{emp} * EMPPRIV_t$	

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
	$SC\_P_t^{Public}$	Social contributions for pension insurance paid by the public sector employees	$SC\_P_t^{Public} = \overline{IMPL\_SC\_P_t}^{Public} * WPRIV_t$	
	$\overline{IMPL\_SC\_P_t}^{Public}$	Implicit personal pension contribution rate for public sector employees	$\overline{IMPL\_SC\_P_t}^{Public} = \frac{\overline{SC\_PT_t^{Public}}}{WPRIV_t}$	
	$\overline{SC\_P_t^{Public}}$	Social contributions for pension insurance paid by the public sector employees	$\overline{SC\_P_t^{Public}} = SC\_P_t^{Private}{}_{emp} * EMPPRIV_t$	
	SC_H_t	Social contributions for health insurance	$SC\_H_t = SC\_H_t^{Private} + SC\_H_t^{Public}$	
	$SC\_H_t^{Private}$	Social contributions for health insurance paid by the private sector employers	$SC\_H_t^{Private} = \overline{IMPL\_SC\_H_t}^{Private} * WPRIV_t$	
	$\overline{IMPL\_SC\_H_t}^{Private}$	Implicit health contribution rate for private sector employers	$\overline{IMPL\_SC\_H_t}^{Private} = \frac{\overline{SC\_H_t^{Private}}}{WPRIV_t}$	
	$\overline{SC\_H_t^{Private}}$	Social contributions for health insurance paid by the private sector employers	$\overline{SC\_H_t^{Private}} = SC\_H_t^{Private}{}_{emp} * EMPPRIV_t$	
	$SC\_H_t^{Public}$	Social contributions for health insurance paid by the public sector employers	$SC\_H_t^{Public} = \overline{IMPL\_SC\_H_t}^{Public} * WPRIV_t$	
	$\overline{IMPL\_SC\_H_t}^{Public}$	Implicit health contribution rate for public sector employers	$\overline{IMPL\_SC\_H_t}^{Public} = \frac{\overline{SC\_H_t^{Public}}}{WPRIV_t}$	
	$\overline{SC\_H_t}^{Public}$	Social contributions for health insurance paid by the public sector employers	$\overline{SC\_H_t^{Public}} = SC\_H_t^{Private}{}_{emp} * EMPPRIV_t$	
	$\overline{SALES_t}$	Government sales	Sales (ESA 2010)	Eurostat
	$\overline{REV\_OTHER_t}$	Other revenues	Residual of total general government revenues after deduction of all abovementioned revenue categories	

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
General government expenditures	TE_t	Total general government expenditures	$TE_t = \overline{G}_t^{nom} + \left(\overline{SB_t^{cash}} - UNEMP\_B_t\right) + UNEMP\_B_t + INT_t + \overline{IG_t} + \overline{SUBSIDIES_t} + \overline{OTHER\_TRANS} + \overline{CAP\_TRANS} - \overline{CAP\_C} + \overline{SALES_t}$	
	$\overline{G}_t^{nom}$	Nominal government consumption	$\overline{G}_t^{nom} = WPUB_t + \overline{SB_t^{kind}} + \overline{INT\_C_t} + \overline{CAP\_C} - \overline{SALES_t}$	
	$WPUB_t$	Public wage bill	See above	
	$\overline{SB_t^{kind}}$	Social benefits in kind	Social transfers in kind – purchased market production (ESA 2010)	Eurostat
	$\overline{INT\_C_t}$	Intermediate consumption	Intermediate consumption (ESA 2010)	Eurostat
	$\overline{CAP\_C}$	Consumption of fixed capital	Consumption of fixed capital (ESA 2010)	Eurostat
	$\overline{SALES_t}$	Government sales	See above	
	$\overline{SB_t^{cash}}$	Social benefits other than social transfers in kind and unemployment benefits	$\overline{SB_t^{cash}} = SB_T - UNEMP\_B_t$	
	$UNEMP\_B_t$	Unemployment benefits	Unemployment benefits (COFOG 10.5.0, ESA 2010)	Eurostat
	INT_t	Interest expenditure	$INT_t^{annual} = IIR_t * DEBT_{t-4}$	
	IIR_t	Implicit interest rate	$IIR_t = \frac{\overline{INT_t}}{DEBT_{t-4}}$	
	$\overline{INT_t}$	Interest expenditure	Interest payable (ESA 2010)	Eurostat
	$DEBT_t$	Public debt	General government debt (ESA 2010), millions of HRK	CNB
	$\overline{IG_t}$	Public investments	Gross capital formation of the public sector (ESA 2010, sectoral government accounts)	Eurostat
	$\overline{SUBSIDIES_t}$	Subsidies	Subsidies payable (ESA 2010)	Eurostat
	$\overline{OTHER\_TRANS}$	Other current expenditure	Other current expenditure (ESA 2010)	Eurostat
	$\overline{CAP\_TRANS}$	Capital transfers	Capital transfers payable (ESA 2010)	Eurostat
Public debt	$\frac{DEBT_t}{GDP_t^{nom}}$	Public debt, % of GDP	$\frac{DEBT_t}{GDP_t^{nom}} = \frac{(1+IIR_t)}{\left(1+\left(GDP_t^{nom}\ growth\right)\right)} * \frac{DEBT_{t-1}}{GDP_{t-1}^{nom}} - \frac{FB_t^{prim}}{GDP_t^{nom}}$	

Equation/ Identity	Variable label	Variable name	Description/definition	Variable source
	$DEBT_t$	Public debt	General government debt (ESA 2010), millions of HRK	CNB
	GDP_t^{nom}	Nominal GDP	$GDP_t^{nom} = GDP_t * (GDP\_DEF_t) * 100$	
	IIR_t	Implicit interest rate	See above	
	$GDP_t^{nom}\ growth$	Growth rate of nominal GDP	$GDP_t^{nom}\ growth = \frac{GDP_t^{nom} - GDP_{t-1}^{nom}}{GDP_{t-1}^{nom}}$	
Primary fiscal balance	FB_t^{prim}	Primary fiscal balance	$FB_t^{prim} = \mathrm{TR}_t - \mathrm{TE}_t - INT_t$	

Note: CBS – Croatian Bureau of Statistics; CNB – Croatian National Bank; CHIF – Croatian Health Insurance Fund; Fred – Fred Statistics (St. Louis Fed).

Source: authors.

Costs and benefits of government borrowing in foreign currency: is it a major source of risk for EU member states outside the Euro?

MISLAV BRKIĆ, univ. spec. oec.*

Review article**
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Mislav BRKIĆ
Croatian National Bank, Trg hrvatskih velikana 3, 10000 Zagreb, Croatia
e-mail: mislav.brkic@hnb.hr
ORCiD: 0000-0003-3872-4824

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Abstract

This paper discusses the costs and benefits of government borrowing in foreign currency. While discussing the main costs, such as increased exposure to currency and rollover risks, and limited capacity to respond to financial crises, this paper also identifies two benefits of foreign currency borrowing. The paper also explores to what extent governments of non-euro area EU member states rely on foreign currency borrowing and whether they have sufficient capacity to preserve currency stability in the event of adverse shocks. The analysis suggests that the public finances of these countries are not heavily exposed to currency risk. Exceptions to this are Bulgaria and Croatia, whose government debt is mainly denominated in euros, and who also suffer from high loan and deposit euroization. It is therefore not surprising that they are the first two among the remaining non-euro area EU member states to take steps towards the introduction of the euro.

Keywords: foreign currency, government debt, international reserves, debt crisis, dollarization

1 INTRODUCTION

Since the 1970s, it has been illustrated many times that government borrowing in foreign currency can be a major source of risk. Not only does it tend to create currency mismatches and thus expose public finances to exchange rate shocks, but it can also make refinancing of government debt more challenging. In particular, being aware that the government suffers from a currency mismatch, investors can be very sensitive to changes in the country's risk profile. If the risk profile deteriorates, investors may choose to withdraw from its bonds to avoid losses that could occur if the government runs out of foreign currency. In such a context, it can become increasingly difficult for the government to refinance its foreign currency liabilities as they mature. Therefore, if the government is heavily indebted in foreign currency, it becomes vulnerable to self-fulfilling prophecies: investors' worries about a default could easily result in the country actually defaulting on its debt.

Although economic history has clearly taught us that borrowing in foreign currency can be very harmful to macroeconomic stability, even today many countries rely heavily on foreign currency sources of funding. One of the objectives of this paper is to explain why this is so. In addition to discussing the costs and risks, it identifies two main benefits of government borrowing in foreign currency, which are most evident in small, highly dollarized emerging market countries. One of these benefits is that funding sources in major global currencies are typically more abundant and cheaper than local sources of funding in domestic currency. Therefore, in countries where local funding sources are scarce, external borrowing by the government, if allocated to productive projects, can be an important driver of economic growth and development. The second benefit stems from the fact that government borrowing in foreign currency enables the central bank – at least temporarily, as the debt stock is increasing – to accumulate foreign exchange reserves that serve as a backstop for the domestic currency. To illustrate this point, the

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paper shows that government borrowing in foreign currency accounted for almost 40% of the cumulative increase in Croatia's foreign exchange reserves over the last two decades.

The second objective of this paper is to explore to what extent governments of non-euro area EU member states rely on foreign currency borrowing, and whether they have sufficient capacity to preserve currency stability in the event of a negative shock. The analysis suggests that public finances of these countries are not heavily exposed to currency risk. In most countries, a large majority of outstanding government debt is denominated in domestic currency, leaving public finances largely isolated from exchange rate fluctuations. Exceptions to this are Bulgaria and Croatia, whose government debt consists mainly of euro-denominated liabilities. Given their relatively higher exposure to currency risk, it is not surprising that Bulgaria and Croatia are the first among the remaining non-euro area EU member states to take concrete steps towards the introduction of the euro. However, even these two countries seem to have contained currency risk with their generally strong fiscal and external fundamentals. This was demonstrated in 2020 after the outbreak of the COVID-19 pandemic, when both countries managed to keep their currencies stable despite the adverse economic impact of the necessary disease containment measures.

The main contribution of this paper is that it provides a nuanced overview of the costs and benefits of government borrowing in foreign currency. While borrowing in foreign currency makes a country vulnerable and therefore should be avoided if possible, the paper shows that in some specific cases – such as when the financial system is highly euroized (dollarized) – this can actually be beneficial from the financial stability perspective. In addition, based on an analysis of the currency composition of government debt in EU member states outside the euro area, the paper suggests a potential explanation for why some of these countries are eager to adopt the euro while others are not.

The structure of the paper is as follows. Chapter 2 discusses the main disadvantages and some advantages of government borrowing in foreign currency from the perspective of emerging market countries, taking into account specific features of their economies. Chapter 3 reviews the literature to identify how a country that relies heavily on foreign currency funding can minimize the risk of a currency and debt crisis. Chapter 4 looks into the currency composition of government debt and other macroeconomic fundamentals of non-euro area EU member states to determine whether foreign currency borrowing is a major source of risk for these countries. Chapter 5 concludes the paper.

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2 COSTS AND BENEFITS OF GOVERNMENT BORROWING IN FOREIGN CURRENCY

2.1 COSTS OF FOREIGN CURRENCY BORROWING

2.1.1 Exposure to currency risk

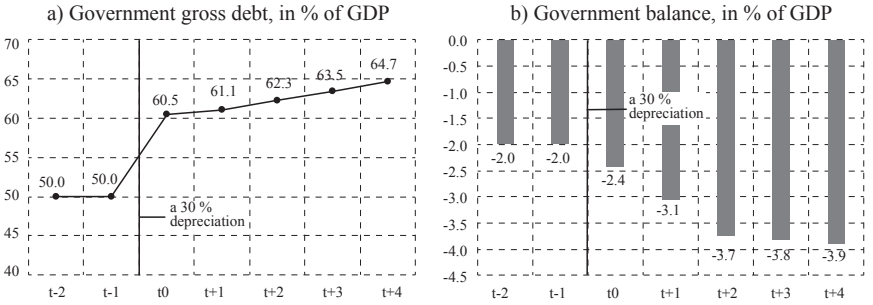
Unhedged foreign currency borrowing is risky because it makes the borrower sensitive to exchange rate fluctuations. If a government borrows in the markets in foreign currency, while generating (tax) revenue exclusively in domestic currency, it will be vulnerable to a potential depreciation of the domestic currency. In the event of a depreciation, the government debt-to-GDP ratio will become larger, while interest expenditures will also increase, negatively affecting the budget balance. If the government, companies and households are indebted in foreign currency at the same time, the entire economy will be heavily exposed to currency risk.

There is a vast literature dealing with the causes and consequences of unhedged foreign currency borrowing. In an influential paper, Eichengreen and Hausmann (1999) note that most developing countries are unable to issue external debt in domestic currency, so they have no other option but to issue debt securities denominated in one of the key global currencies. The inability to borrow abroad in domestic currency is what these authors call "the original sin", because it generates currency mismatch at the aggregate level, which represents a major constraint for policy makers. In particular, in the context of high exposure to currency risk, preserving the stability of the domestic currency usually becomes a top policy priority for the central bank. A strong focus on currency stability, however, narrows the space for flexible use of monetary policy, as remaining policy objectives, such as managing the business cycle, become less important (Eichengreen, Hausmann and Panizza, 2003). As a result, countries that borrow in foreign currency tend to have a higher degree of macroeconomic volatility than those that borrow mainly in their own currency.

The impact of currency depreciation on public finances is very straightforward. If part of the government debt is denominated in or indexed to foreign currency, that part will mechanically increase (expressed in domestic currency) in line with the strengthening of the foreign currency, generating a step increase in the debt-to-GDP ratio (figure 1). In addition, annual interest expenses will increase due to the now higher debt stock, even if the average interest rate is unaffected. However, it is very likely that, following a large depreciation of the currency, the country's risk premium would rise, making new government borrowing costlier. This would produce second-round effects because a higher average interest rate would entail even higher interest expenses, with an adverse impact on the government budget balance and the debt trajectory.

Figure 1

Impact of a currency depreciation on the public finances



Note: The simulation is performed assuming that the initial debt-to-GDP ratio is 50%, the primary deficit is zero, the share of foreign currency debt in total government debt equals 70%, the nominal GDP growth rate is 4%, while the weighted nominal interest rate on debt, initially set at 4%, increases following the depreciation of the currency to 5% in t+1, and further to 6% in t+2, remaining stable thereafter.

Source: Author.

What could cause currency depreciation in a country that is heavily borrowing in foreign currency? Several factors can lead to such an outcome, with banking system fragility being one of the most common triggers.[1] Specifically, if banks have large, uncovered short-term foreign currency liabilities, the decision of creditors and depositors to call on their loans and withdraw their deposits will put a strain on the banks' limited stocks of liquid foreign currency assets (Chang and Velasco, 1999). Due to the shortage of foreign currency relative to domestic currency, the domestic currency would depreciate, forcing the central bank to deploy international reserves in an attempt to stabilize the currency. An extreme example of such a scenario was the financial crisis in Iceland in 2008. This event clearly demonstrated how an oversized and poorly regulated banking system could bring down the currency and the economy as a whole (Claessens, Herring and Schoenmaker, 2010). Furthermore, currency depreciation may occur if investors, concerned about the country's deteriorating macroeconomic fundamentals[2] or inflated asset prices, begin to liquidate their positions in government bonds and other domestic currency-denominated securities. The risk of a destabilizing sell-off of domestic currency assets is less pronounced in countries with shallow capital markets. In these countries, the supply of securities denominated in domestic currency is

[1] Kaminsky and Reinhart (1999) empirically investigated the link between banking and currency crises. They found that banking and currency crises often coincide, with the banking typically preceding the currency crisis. The currency crisis in turn aggravates the banking crisis, creating a vicious circle with an adverse impact on the real economy. However, although banking crises usually start before currency crises, they are not necessarily the immediate cause of currency crises. In fact, two crises are sometimes manifestations of the same root cause – excessive credit growth backed by favourable access to international financial markets.

[2] Frankel and Rose (1996) found that the likelihood of a currency crisis is high when international reserves are modest, the share of FDIs in total external debt is low, the real exchange rate is overvalued, credit growth is strong and interest rates in the advanced economies are rising. Most of these variables are identified as critical also by Sachs, Tornell and Velasco (1996).

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limited, so there is little risk that transactions in the securities market will exert strong downward pressure on the currency.

2.1.2 Increase in refinancing risk

Apart from giving rise to currency risk, foreign currency borrowing is associated also with greater refinancing (rollover) risk. In fact, these two risks are mutually reinforcing. The former risk tends to exacerbate the latter, in the sense that a large presence of currency risk may trigger the materialization of refinancing risk. The link is quite intuitive: if a government borrows in foreign currency, its creditors will be indirectly exposed to currency risk, because a sharp depreciation of the domestic currency may reduce the government's ability to meet its foreign currency obligations.[3] Therefore, in the event that creditors suspect that the borrower's currency might lose ground, they would no longer be interested in financing the borrower. As a result, the government would be forced to repay its foreign currency liabilities as they fall due, which, if large sums have to be repaid within a short time period, could lead to a debt and currency crisis. In such a case, the only remaining option for the government – if it wants to avoid defaulting on its foreign currency debt – would be to seek international financial assistance.

There are numerous historical examples of debt crises caused by excessive foreign currency borrowing. Indeed, financial crises in emerging market countries are usually preceded by periods of abundant inflow of foreign currency funding. Namely, if global financial conditions are favourable, emerging market countries will have an incentive to import capital from abroad to finance domestic consumption and investment at low cost. The favourable impact of externally funded spending on output and employment will reflect positively on consumer and business confidence and thus lead to an even higher propensity to borrow and spend. If left unaddressed, excessive external borrowing might lead to an unsustainable expansion of domestic demand and leave the economy vulnerable to external shocks. As these shocks tend to emerge abruptly, emerging market countries are often caught by surprise. External shocks can take various forms, ranging from sudden changes in global monetary conditions, deteriorating investor confidence[4], falling prices of the main export commodities, to main trading partners announcing protectionist measures[5]. Irrespective of the type of the external shock, the shock usually leads to a deterioration in the borrowing country's access to external financing. The most widely known examples of such events are the crises in Latin America in the 1980s and 1990s.

[3] This risk is often referred to as foreign currency-induced credit risk because the materialization of currency risk on the side of the borrower leads to the materialization of credit risk for the creditor.

[4] A deterioration in investor confidence may concern a single country or a group of countries sharing similar characteristics. A notable example of a broad-based confidence shock was the so-called "taper tantrum" of May 2013. As the Federal Reserve announced that it was considering winding down its program of unconventional monetary policy measures, a sudden reassessment of global risk premiums took place, which had a negative effect on several emerging market economies that were vulnerable at the time due to elevated macroeconomic imbalances (Sahay et al., 2014).

[5] For instance, in November 2016 the Mexican peso depreciated sharply against the dollar following Donald Trump's victory in US presidential elections, as investors feared that the new President would keep his campaign promise to revise the North American Free Trade Agreement (NAFTA) (Banco de Mexico, 2017).

The debt crisis in Latin America in the early 1980s was a consequence of the borrowing spree that took place during the previous decade. In the 1970s, countries such as Argentina, Brazil and Mexico borrowed heavily abroad in US dollars to cover their large balance of payments needs. By the late 1970s, it had become clear that the rapid accumulation of debt was not sustainable and that external adjustment was needed (Federal Deposit Insurance Corporation, 1997). Despite that, foreign banks, especially those from the US, continued to increase their lending to the region. The situation, however, changed dramatically at the beginning of 1980s, when the Federal Reserve (Fed) tightened monetary policy to combat high inflation in the US. This had a devastating impact on the heavily indebted Latin American countries. Not only did interest rates on their foreign liabilities increase, but also their national currencies depreciated considerably against the US dollar, increasing the repayment burden of large stocks of US dollar liabilities. While most Latin American countries continued to service their liabilities without defaulting, the heavy repayment burden contributed to a deep and prolonged recession, which lasted for most of the decade.

Heavy government borrowing in foreign currency was also a major factor behind the 1994 Mexican crisis. In light of Mexico's pronounced macroeconomic imbalances and large refinancing needs on the domestic front, and deteriorating global monetary conditions on the external front, investors were worried that the Mexican authorities would be unable to defend the peso from depreciating. These fears were further exacerbated by domestic political instability, which culminated in late 1994, triggering significant capital outflows (IMF, 2012). The liquidity crisis soon transformed into a currency and debt crisis, prompting Mexican authorities to seek financial assistance from the US and IMF.

Vulnerability to recurrent debt and currency crises are not an exclusive feature of the modern globalized economy characterized by flexible exchange rates and extensive cross-border financial flows. These disruptive events have occurred from time to time throughout history, even when the entire world relied on fixed exchange rates and when gross capital flows were subdued by modern standards. A notable case is the default of Germany from the early 1930s. Germany had returned to the gold standard by the mid-1920s, after which it borrowed heavily in foreign currency, mainly to obtain the gold and convertible currencies needed to settle large reparations following its World War I defeat (Ritschl, 2013). In 1929, a revised, much more demanding reparations agreement was announced, which raised concerns among creditors and resulted in Germany losing access to external financing. The outbreak of the Great Depression further exacerbated the already dire situation. Confronted with large refinancing needs and a rapid loss of international reserves, in 1931 the German central bank imposed capital controls. Finally, in 1933, Germany declared a default on most of its foreign liabilities.

2.1.3 Reduced ability to tackle financial crises

The episodes of debt crisis documented above illustrate how excessive foreign currency borrowing can make countries vulnerable to self-fulfilling prophecies.[6] The vulnerability to sudden shifts in investor confidence stem from the borrowing country's inability to create the foreign currency needed to repay the creditors if many of them decide to withdraw funding at the same time. In contrast, countries with the privilege of borrowing exclusively in domestic currency do not suffer from the same weakness.

While borrowing in domestic currency does not eradicate the risk of a debt crisis altogether, it indirectly enables the country to cope better with the crisis should it occur. In particular, if both the government and the private sector borrow mainly in domestic currency, the central bank will be less concerned about exchange rate fluctuations. Owing to this, the central bank will be able to lend freely to commercial banks in times of crisis to contain liquidity disruptions. Liquidity disruptions are very common during sovereign debt crises, as depositors may become concerned about the possible adverse impact of the crisis on bank solvency. By acting as lender of last resort, the central bank provides fundamentally healthy banks with additional cash needed to meet the increased withdrawal requests. This not only helps cure liquidity problems in the banking system, but it also enables the government to refinance its debts with commercial banks at favourable terms.

The European sovereign debt crisis of 2010-2012 has shown very clearly that central bank emergency lending can have an instrumental role in containing the fallout from the crisis. At the height of the sovereign debt crisis, the Eurosystem – consisting of the ECB and the euro area national central banks – provided massive amounts of liquidity to Greek, Irish, Portuguese and Spanish banks, which had almost completely lost access to market funding (figure 2). There is no doubt that the debt crisis in Europe would have been much worse had the Eurosystem not intervened to prevent the collapse of peripheral countries' banking systems. In addition to enhanced liquidity provision to banks, which indirectly assisted the vulnerable governments to obtain the much needed funding, the Eurosystem implemented several measures aimed directly at tackling the turmoil in the sovereign debt market.[7]

The ECB's virtually unlimited capacity to act as crisis manager came into focus again in 2020 after the outbreak of the COVID-19 pandemic. While member states initially failed to reach an agreement on a common fiscal response to the crisis, by mid-March 2020, the ECB had already stepped in by announcing the Pandemic Emergency Purchase Programme (PEPP) worth EUR 750 billion.[8]

[6] There is a large body of literature dealing with the vulnerability of emerging market countries to self-fulfilling panics (Obstfeld, 1986; 1994; Eichengreen, Rose and Wyplosz, 1995; Flood and Marion, 1996; Cole and Kehoe, 2000).

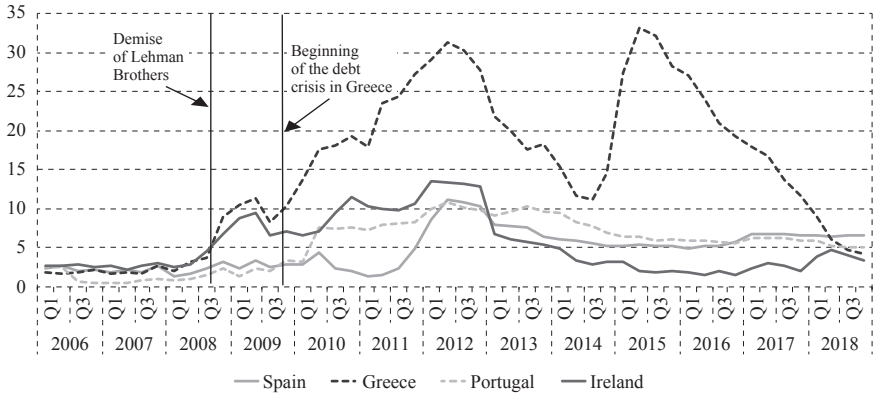
[7] For a review of unconventional policy measures of the ECB, see Constancio (2012), Gros, Alcidi and Giovanni (2012) and Micossi (2015).

[8] In June 2020, the ECB decided to scale up the total size of the program from EUR 750 billion to EUR 1,350 billion.

Under this program, the ECB has been purchasing large amounts of euro area public and private sector securities each month in order to prevent borrowing costs from increasing significantly. Such an intervention by the ECB was critical in the acute phase of the crisis as it eased pressures on the countries particularly affected by the pandemic and enabled their governments to finance healthcare spending and economic relief programs at low cost. Central banks of other advanced countries took similar actions in response to the crisis.

Figure 2

Borrowing from the Eurosystem as percent of banks' total liabilities



Sources: ECB SDW; author's calculation.

The capacity of the central bank to tackle financial crises is much lower in countries where liabilities of the government and other sectors are mainly denominated in foreign currency. There are at least three reasons for this. First, if government debt is denominated mainly in foreign currency and the government experiences refinancing difficulties, the central bank can provide support only to a limited degree, as it can only create domestic currency.[9] Second, if liabilities of commercial banks, such as deposits and received loans, are largely denominated in foreign currency, the provision of domestic currency liquidity by the central bank will fall short of mitigating liquidity disturbances in the banking system. What banks need in case of liquidity disturbances is foreign currency.[10] Third, in dollarized countries, massive purchases by the central bank of government bonds or heavy lending to commercial banks in local currency would be imprudent as it could fuel

[9] The capacity of the central bank to support government debt in foreign currency is limited by the size of its foreign exchange reserves. On the other hand, the capacity to intervene in domestic currency funding markets is not directly determined by the level of foreign exchange reserves. At the peak of the COVID-19 crisis, several emerging market central banks pursued unconventional monetary policies to support their economies, including the purchase of government debt securities denominated in domestic currency (IMF, 2020a). However, for such programs to be credible, the central bank should have comfortable foreign exchange reserves to assure financial markets that the newly created money will not lead to a currency devaluation.

[10] The first thing the central bank will do in such a context is reduce the reserve requirement to release banks' own foreign currency liquidity buffers. If these buffers prove insufficient, the central bank may decide to sell a portion of its foreign exchange reserves to banks through foreign exchange interventions or swap transaction. Obviously, the ability of the central bank to supply foreign currency to banks in this way is constrained again by the available stock of foreign exchange reserves (Chang and Velasco, 1998).

speculation against the currency and lead to a harmful depreciation of the exchange rate. Hence, in heavily dollarized countries, the ability of the central bank to act as lender of last resort is significantly weakened, and so is the ability of these countries to tackle banking and sovereign debt crisis on their own. In this respect, dependence on foreign currency borrowing could definitely be considered a "curse" because it makes the country both more likely to experience a financial crisis and less capable of managing the crisis if one occurs.

2.2 BENEFITS OF FOREIGN CURRENCY BORROWING

2.2.1 Lower cost of financing

Currency risk is non-existent and refinancing risk is typically lower when debts are denominated in domestic currency. The question arises then why some borrowers decide to take on debts in foreign currency when it is far more risky than borrowing in domestic currency. The main reason is that funding in major global currencies, such as the US dollar and the euro, tends to be cheaper and more abundant, especially for small open economies. Specifically, if the domestic financial sector is relatively small, the local supply of financing may not be sufficient to satisfy the overall demand for credit at a favourable cost. This may encourage the government and other borrowers to seek cheaper financing abroad, either directly – by obtaining loans from foreign banks or issuing bonds in international markets, or indirectly – by borrowing from local banks that import capital to finance domestic lending. Since only a handful of countries are able to borrow abroad in their own currencies, external borrowing in most cases results in increased exposure to currency risk.

Moreover, even when borrowing takes place in the domestic market, debts are often indexed to foreign currency. As Claessens, Schmukler and Klingebiel (2007) explain, small countries typically have limited local investor bases, and thus may prefer issuing government securities linked to a major currency in order to attract foreign investors. The additional demand coming from foreign investors will likely ensure both greater availability and lower cost of funding for the government.

Borrowing in foreign currency may facilitate investment and economic development to the extent that it provides the country with more affordable financing and that the borrowed funds are channelled to productive sectors. In particular, if the country is underdeveloped, the government can borrow abroad to carry out productive investment, such as large infrastructure projects, which set the stage for higher growth in the future. In this way, by importing additional capital from abroad, the government eases the pressure on scarce local sources of funding, so that crowding-out of private investment does not occur. Policy makers need to ensure that funds borrowed from abroad are not channelled to excessive domestic consumption, which could lead to economic overheating. Having in mind the large number of financial crises which were caused by excessive external borrowing and spending, it is safe to say that emerging market countries have not been very successful in managing capital inflows. For example, Kaminsky, Reinhart

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and Végh (2005) found that in emerging market countries the size of net capital inflows is positively correlated with the level of government consumption, suggesting that fiscal policy tends to be procyclical.

2.2.2 Contribution to financial stability in highly euroized (dollarized) countries

In some circumstances, foreign currency borrowing can also be vital to maintaining financial stability. In particular, if the government is already heavily indebted in foreign currency, its sustained ability to borrow in foreign currency is important so that it can refinance the maturing debt without depleting international reserves. In the event that the government is cut off from international financial markets, it will have to purchase foreign currency in the domestic market to repay its debts, which may destabilize the domestic currency and ultimately lead to its collapse. The crisis events mentioned earlier clearly support this claim.

Moreover, government borrowing in foreign currency can be beneficial for financial stability if the banking system is highly dollarized. One of the main problems associated with dollarization is that central banks in such countries cannot perform the role of lender of last resort at full capacity (Chang and Velasco, 2002). The reason is that if liabilities of commercial banks are denominated in foreign currency, in the event that they face a liquidity crisis, the central bank cannot help them by printing domestic currency. Under these conditions, the capacity of the central bank to act as lender of last resort will depend entirely on the size of its foreign exchange reserves: the large the reserves, the higher the capacity of the central bank to intervene.[11] In this respect, the inflow of foreign currency liquidity through government borrowing may be helpful as it enables the central bank to set up foreign currency reserves that can later be used to contain liquidity disturbances in the banking system.

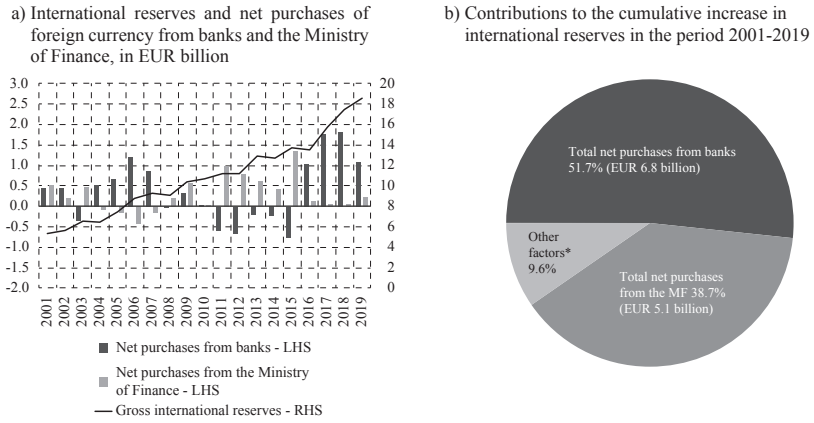
Government borrowing as a channel of reserve accumulation is particularly important in countries such as Croatia, where the problem of dollarization is mostly internally created, rather than being a reflection of banks' external borrowing. Specifically, in some countries citizens have a strong preference for saving in major foreign currencies, such as the euro or the US dollar, although most of them do not have any earnings in foreign currency. Therefore, depositors technically bring the domestic currency into a bank, and leave the bank with a foreign currency claim on the bank. Although no hard currency was brought to the bank, the bank ended up with a foreign currency deposit as a liability on its balance sheet. To protect itself from exchange rate fluctuations, the bank will probably grant loans denominated in or indexed to foreign currency, effectively passing the currency risk on to its clients. Under these conditions, the central bank will seek to

[11] However, in the case of a severe banking crisis, even large foreign exchange reserves may prove insufficient to contain the turmoil in the banking system and support the currency at the same time. An example of this is the Latvian crisis from 2008, when a dramatic outflow of foreign currency deposits from a major bank led to a rapid depletion of central bank reserves, which undermined the credibility of the currency peg. This in turn prompted the Latvian authorities to request international financial assistance (Purfield and Rosenberg, 2010; IMF, 2009).

build up sufficient foreign exchange reserves so that it is able to defend the domestic currency and the easiest way to accumulate reserves is to acquire foreign currency that the government has imported from abroad.

FIGURE 3

Government foreign currency borrowing and reserve accumulation in Croatia



** Other factors relate to exchange rate changes and transactions with the EU budget.*

Source: CNB; author's calculation.

Figure 3 shows that government borrowing has been a major factor behind the accumulation of reserves in Croatia over the last two decades. From 2001 to 2019, the reserve assets of the Croatian National Bank increased cumulatively by EUR 13.2 billion (from 5.3 to 18.6 billion), with outright purchases of foreign currency from the Ministry of Finance accounting for EUR 5.1 billion (38.7%) of the total increase. Clearly, government borrowing boosted the reserves particularly in the aftermath of the global financial crisis when Croatia issued large amounts of foreign currency debt to finance persistent fiscal deficits (CNB, 2012). From 2016 to 2019, with the fiscal deficit turning into a surplus, the Croatian government merely refinanced the maturing foreign currency debt without incurring additional debt. As a result, the net purchases of foreign currency from the Ministry of Finance decreased significantly. This, however, changed in 2020, as high fiscal spending to contain the economic fallout of the COVID-19 pandemic required additional financing from abroad (CNB, 2020).

Finally, a minor benefit of government borrowing in foreign currency is that it enables the central bank to acquire foreign assets that indirectly generate revenue for the state budget. To be specific, if the government borrows in foreign currency to finance fiscal expenditures in the local economy, the foreign currency liquidity collected by government borrowing will be exchanged at the central bank for domestic currency. The central bank in turn invests this foreign currency liquidity, as part of its foreign exchange reserves, in some high quality assets abroad, such as low-risk government bonds and bank deposits. Given that in normal times these

assets carry a positive interest rate, the central bank makes a profit from managing them.[12] As most central banks – after covering their operational expenses – allocate a large part of their profits to the state budget, the government indirectly makes some revenue from the assets purchased with the proceeds of external borrowing. These revenues make the ultimate cost of the government's external borrowing effectively lower.[13]

Admittedly, government borrowing in foreign currency cannot be a source of reserve accumulation indefinitely. At some point, the government debt-to-GDP ratio must stabilize, or otherwise debt sustainability will be jeopardized. In such conditions, the government will merely refinance the existing foreign currency liabilities or even partly repay them in order to reduce the exposure to currency risk. Reducing foreign currency debt is prudent and beneficial if carried out in a favourable macroeconomic environment when the country's balance-of-payments position is strong, as has been the case in Croatia in recent years. As it is shown later in this paper, persistent current account surpluses and abundant domestic currency liquidity have enabled the Croatian government to improve somewhat the currency composition of debt without depleting foreign exchange reserves.

3 HOW CAN A COUNTRY THAT BORROWS IN FOREIGN CURRENCY REDUCE THE RISK OF A DEBT CRISIS?

As discussed in the previous chapter, government borrowing in foreign currency can make a country more exposed to debt and currency crises. The mechanism that is activated during sovereign debt crises resembles the one that is at work during bank runs. Diamond and Dybvig (1983) defined the bank run as an undesirable equilibrium in a setup where banks are mainly financed by demand deposits. If depositors lose confidence in a bank and begin withdrawing deposits on a large scale, the bank will have trouble meeting their requests because only a fraction of its assets is held in the form of cash. Eventually, the bank will be forced to liquidate part of its assets at a loss, which can lead to its insolvency. A similar chain of events leads to a sovereign debt crisis: when bondholders become unsure whether a country can continue servicing its debt, the country is forced to repay its liabilities at maturity, which is difficult to achieve if access to funding is impaired.

There are certain mechanisms that have proven effective in preventing bank runs, such as well-enforced prudential regulation and supervision, deposit insurance schemes and central bank lender-of-last-resort lending. Minimizing the risk of a

[12] There are, indeed, some alternative sources of revenue for the central bank other than foreign exchange reserves. In particular, central banks typically charge commercial banks a positive interest rate on repo loans granted through regular monetary operations. In addition, if the central bank implemented a government bond purchase program, it could earn interest on bonds accumulated during the implementation of the program. This interest revenue, however, would at some stage be paid back to the state budget as part of the distribution of central bank profits.

[13] As an example, if the government issues a bond internationally with a coupon rate of 4%, and the central bank makes 1.5% on the reserve assets it acquired after converting the bond placement proceeds into domestic currency, the effective nominal interest rate on the bond will be roughly 2.5% (assuming that all central bank profits are allocated to the state budget).

sovereign debt crisis when the government is indebted in foreign currency is even more challenging than setting up safeguards for the banking system. The main approach is, however, similar: it is crucial to ensure that liquidity buffers – in the form of foreign exchange reserves – are abundant and that the country's macro-financial fundamentals are sound.

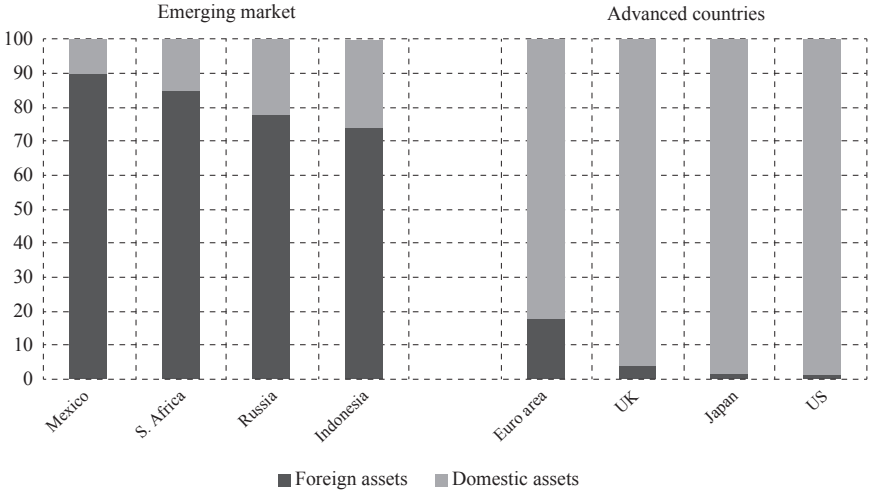
3.1 THE ROLE OF FOREIGN EXCHANGE RESERVES

The benefits of having ample foreign exchange reserves are manifold (Ljubaj, 2019). If reserves are large enough, they shield the currency from excessive fluctuations and speculative attacks, guarantee that the country is capable of conducting international transactions in convertible currencies, and boost the country's credibility in the financial markets. As a result, the likelihood of a currency crisis tends to be low when reserves are abundant.[14]

Maintaining ample foreign exchange reserves is particularly important in countries where the government is heavily indebted in foreign currency. A large stock of reserves provides assurance to investors that the government will be able to continue servicing its foreign currency liabilities even if it temporary loses access to financial markets. As mentioned earlier, if the financial system is dollarized, foreign exchange reserves play an additional important role, as they enable the central bank to assist banks in the event of a liquidity crisis.

Figure 4

Composition of central bank assets, end-2018 (in %)



Source: IMF (2020b).

[14] Most studies that deal with currency crises identify inadequate reserves as one of the best early warning indicators of currency crises (Kaminsky, Lizondo and Reinhart, 1998; Kruger, Osakwe and Page, 1998; Vlaar, 2000; Abiad, 2003; Babecky et al., 2012).

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Hausmann, Panizza and Stein (2001) found that emerging market countries, which borrow abroad mainly in foreign currency, are more concerned about exchange rate volatility than advanced countries. For that reason, emerging market countries tend to maintain much larger stocks of foreign exchange reserves that allow them to intervene in the foreign exchange market if pressures on the currency emerge. The data strongly support this view. Figure 4 depicts the composition of central bank assets for a sample of four large advanced and four large emerging market countries. Clearly, there is a large difference between advanced and emerging market countries in the relative shares of foreign assets in central banks' balance sheets. While in the selected emerging market countries foreign assets account for more than three quarters of total central bank assets, in large advanced countries the share of foreign assets is typically very low.

3.2 THE ROLE OF OTHER MACRO-FINANCIAL FUNDAMENTALS

The most effective instrument in preventing a sovereign debt crisis is obviously prudent fiscal policy. By maintaining a balanced budget and keeping the debt-to-GDP ratio low enough, the government will minimize the risk of a sudden loss of access to financing. Conversely, if the fiscal deficit is excessive and government debt is large and rapidly increasing, investors will have every reason to worry about debt sustainability. It should be noted, however, that weak fiscal indicators do not necessarily lead to a debt crisis immediately. If global monetary conditions are loose and investors' risk appetite is high, the country may enjoy favourable financing conditions for some time despite its poor fiscal performance. However, due to weak fundamentals, the country will be increasingly sensitive to self-fulfilling prophecies, as illustrated by the Greek sovereign debt crisis (Higgins and Klitgaard, 2014).

The maturity of debt also matters.[15] The longer the average maturity of government debt, the less vulnerable the country is to sudden changes in market sentiment. In particular, when debt repayment dates are spread over a long period, a transitory shock that raises government bond yields will only affect the portion of the debt that matures during a period when the impact of the shock is noticeable, while the rest will not be affected. In contrast, if the average maturity of government debt is short, many liabilities will have to be refinanced in an unfavourable market environment, which can be very expensive and in some cases even impossible. In most of the crisis episodes documented in the previous chapter, the main problem was that countries relied too heavily on short-term external financing.

Not only should a responsible fiscal policy be conducted but due attention should be devoted to monetary and financial sector policies. As is generally accepted today, monetary policy should focus on keeping inflation in check. By keeping the inflation rate close to the inflation rates of the main trading partners, the central bank can prevent the harmful overvaluation of the currency. With regard to

[15] An event that clearly confirms the importance of the maturity composition of government debt is the 1994 Mexican crisis, which was triggered by a run on short-term US dollar-denominated government liabilities called *Tesobonos* (Sachs, Tornell and Velasco, 1996).

financial sector policies, authorities should exercise vigilant supervision and proactively use micro and macro-prudential regulation, because errors in this area may have negative consequences for the public finances.[16] Macro-prudential regulation has become increasingly popular in the aftermath of the global financial crisis (Dumičić, 2015). Not only does it help increase the resilience of banks through the introduction of various capital buffers, but it also enables authorities to tackle broader macroeconomic risks by slowing down rapid credit growth and preventing banks from relying on unstable external funding sources.

Weak fundamentals can lead to a debt crisis even if the government debt is denominated entirely in domestic currency. The European sovereign debt crisis of 2010-2012 is very illustrative in this respect. Each of the countries affected by the debt crisis had borrowed almost exclusively in euros, their domestic currency, but this did not protect them from losing access to market funding when the crisis escalated. Investors were no longer willing to lend to peripheral euro area countries because of the serious weaknesses in their public finances and banking systems. In Greece and Portugal, the main source of vulnerability was the rapidly growing government debt created by persistently high budget deficits. Ireland and Spain, on the other hand, experienced a rapid rise in debt not due to irresponsible fiscal policy but because of costly government intervention to recapitalize failing banks (Brkić, 2019).

4 ARE PUBLIC FINANCES IN THE EU EXPOSED TO CURRENCY RISK?

4.1 FOREIGN CURRENCY BORROWING IN NON-EURO AREA EU MEMBER STATES

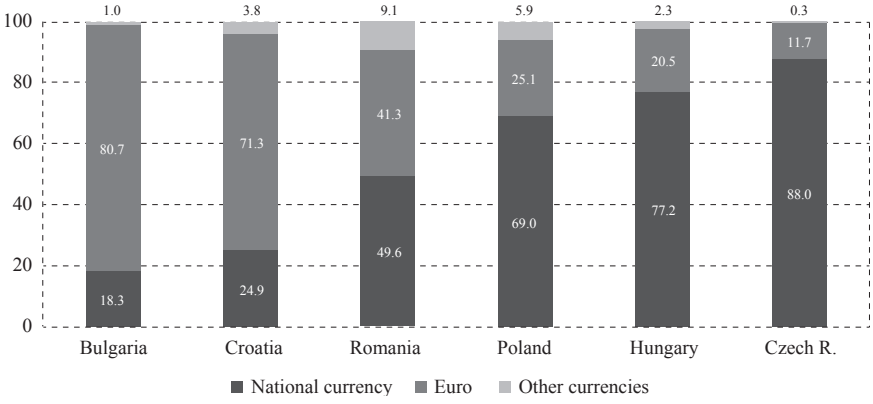
Some non-euro area EU member states borrow heavily in foreign currency, predominantly in euros. This applies above all to countries from Central and Eastern Europe (CEE), which have shallow local financial markets and therefore often rely on external sources of funding. By contrast, in the northern non-euro area member states – Denmark and Sweden – foreign currency borrowing is not a systemic problem. In these advanced countries, foreign currency borrowing is mainly used by export-oriented firms to protect against foreign exchange risk, while households and the government sector typically do not have large unhedged foreign currency exposures.[17]

[16] As the recent crises in Iceland, Spain and Ireland have shown, even if fiscal indicators are generally sound, debt sustainability may soon come into question if severe losses in systemically important banks force the government to implement costly recapitalization programs in order to avoid the collapse of the banking system.

[17] At the end of 2018, the Danish government had virtually no foreign currency liabilities (Danmarks Nationalbank, 2019). Although about a quarter of Sweden's government debt is denominated in foreign currency, the level of foreign currency exposure is much lower as the national debt office has purchased large amounts of foreign currency in recent years to reduce the exposure to currency risk (Swedish National Debt Office, 2019).

FIGURE 5

Currency composition of government debt, 2018 (in %)



Source: Eurostat (2020a).

Figure 5 depicts the currency composition of government debt for six EU member states from CEE. While the share of foreign currency debt is on average notably higher than in the northern member states, there is a substantial difference between individual CEE countries in the reliance on foreign currency funding. Two countries, Bulgaria and Croatia, stand out, with more than three quarters of total government debt denominated in or indexed to foreign currency.[18] Vulnerability of public finances to exchange rate fluctuations is also high in Romania, where government debt is split equally between the national currency and foreign currency components. Conversely, as figure 5 clearly indicates, currency risk is much less of a concern in Poland, Hungary and, in particular, the Czech Republic.

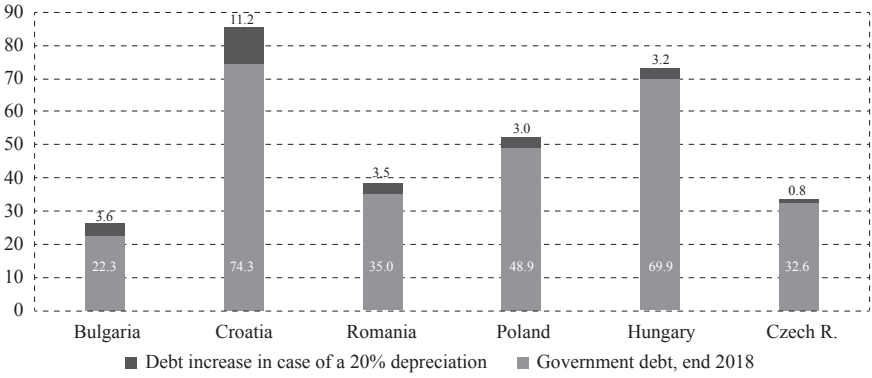
Being indebted in foreign currency is not problematic for a country if its access to external markets is maintained and the exchange rate is stable. However, if for some reason the local currency begins to lose ground against the foreign currency in which debt is denominated, the government will see its debt ratio increase. Figure 6 illustrates a simple, back-of-the-envelope simulation of the impact of a currency depreciation on the debt-to-GDP ratios. Obviously, in case of a depreciation, countries that have large portions of debt linked to foreign currency, such as Bulgaria and Croatia, will experience a much stronger relative deterioration of the debt-to-GDP ratio than countries that rely less on foreign currency funding. When interpreting these results it should be borne in mind that initial debt levels differ across countries, because this affects the absolute change in the debt-to-GDP ratio following the currency depreciation. Specifically, although Bulgaria has the highest share of foreign currency debt in this group of countries, due to its low initial debt ratio the absolute increase in the debt ratio is not very large. In the event of a 20% depreciation,

[18] While Bulgaria borrows almost exclusively in euros, a small part (less than 5%) of Croatia's government debt is denominated in US dollars. However, given that the Croatian government uses EUR/USD currency swaps to hedge the exposure to the US dollar, its public finances are sensitive only to fluctuations in the EUR/HRK exchange rate (MoF, 2017).

Bulgaria's debt ratio would increase by 3.6 percentage points of GDP, which is only slightly higher than the values for Romania and Hungary (3.5 and 3.2 pp, respectively), and much lower than the absolute increase for Croatia (11.2 pp).

Figure 6

Exposure of public finances to currency risk, 2018, in % of GDP



Source: Eurostat (2020a); author's calculations.

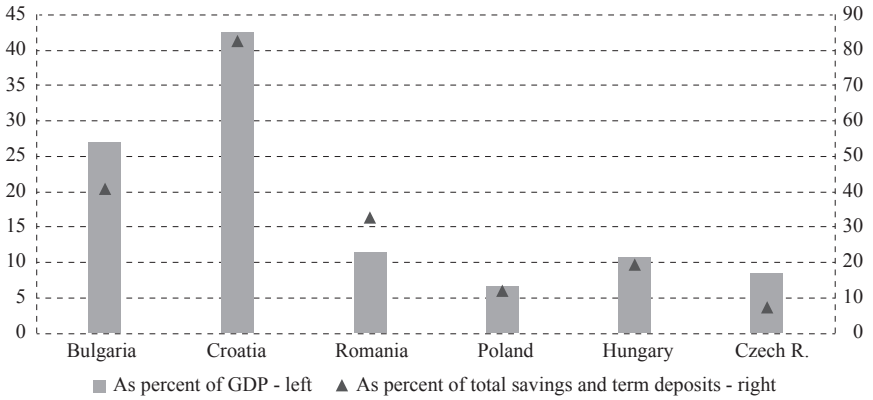
As figure 7 shows, the same countries that stand out with a particularly high share of foreign currency debt in total government debt are the countries that have the most heavily euroized banking systems. Specifically, in Bulgaria and Croatia, foreign currency deposits account for a large share of total banking system liabilities, while this is not the case in countries such as Poland or the Czech Republic. The link between the currency composition of government debt and the degree of euroization is not surprising given that local banks are typically among the main holders of government debt instruments issued in the domestic market. If a large part of their liabilities is denominated in foreign currency, banks will prefer to invest in foreign currency assets to hedge against currency risk. Since local banks are key investors in government debt securities, the government will naturally consider their preferences when deciding in which currency treasury bills or bonds will be issued.[19] Due to this, in highly euroized countries the share of foreign currency debt in the currency composition of government debt is typically higher than the share of debt held by non-residents in the ownership composition of government debt.[20] In other words, it is not only the external part of government debt that is denominated in foreign currency, but also a major share of the domestic debt.

[19] In addition to investing in foreign currency-denominated debt securities issued domestically, local banks with a preference for foreign currency assets may also purchase Eurobonds issued by the government in international financial markets. This is a common practice in Croatia.

[20] Specifically, in Bulgaria and Croatia the shares of foreign currency debt in total debt amount to 81% and 72% respectively, while the shares of debt held by non-residents are much lower, at 44% and 33%. By contrast, in Poland and the Czech Republic, which are much less euroized, the shares of foreign currency debt are actually lower than the shares of debt held by non-residents (28% and 11%, compared to 44% and 41%), suggesting that foreign investors hold non-negligible stocks of domestic currency debt issued by these two countries.

Figure 7

Foreign currency deposits with commercial banks, 2018, in %



Sources: Eurostat (2020b); national central banks; author's calculations.

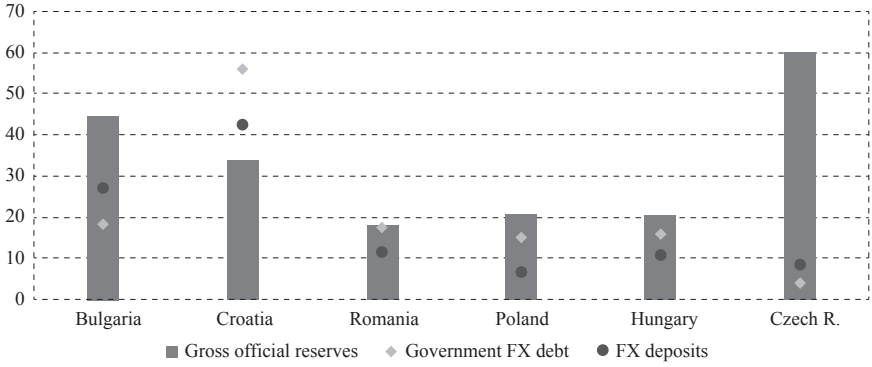
As argued in the previous chapters, large stocks of foreign currency deposits pose a threat to financial stability, because they impair the ability of the central bank to act as lender of last resort. Therefore, in highly dollarized (euroized) banking systems, it is critical for central banks to maintain abundant foreign exchange reserves. The importance of reserves is even greater if banking system dollarization exists alongside large government debt in foreign currency. Some CEE countries suffer from both of these problems. Figure 8 compares, for each country of the group, the level of liabilities in foreign currency – as represented by foreign currency deposits and government debt in foreign currency – with the level of central bank foreign exchange reserves. The figure indicates that individual CEE countries differ widely with respect to the degree of currency risk exposure. Croatia and Bulgaria have the highest relative amounts of foreign currency liabilities, far exceeding, in the case of Croatia, the available stock of foreign exchange reserves. The Czech Republic, on the other hand, has accumulated in recent years an extremely high stock of reserves against a very low level of foreign currency liabilities. It is therefore safe to say that the Czech Republic is significantly less sensitive to exchange rate fluctuations than Croatia and Bulgaria.

Admittedly, the illustration given in figure 8 does not provide a full picture of the countries' exposure to currency risk. First, it does not take note of the private sector's external debt. Second, the data on government foreign currency debt presented in this figure includes liabilities that are indexed to foreign currency, but repaid in local currency, which means that the government is not required to use foreign currency to service this debt. In other words, settling this part of the debt does not put pressure on foreign exchange reserves. Third, foreign currency deposits are not the only potential drain on reserves stemming from private sector behaviour. The reason is that local currency deposits and local currency in circulation can also contribute to the depletion of foreign exchange reserves if citizens, worried that the local currency could collapse, start buying foreign currency on a large scale. Nonetheless,

while not a perfect indicator, the level of foreign currency deposits still contains important information as it reveals the extent to which citizens trust their own currency (Honohan, 2007). If confidence in the local currency is low, as evidenced by a high share of foreign currency deposits in total deposits, it is more likely that citizens will rush to convert their remaining local currency holdings into foreign currency if the local currency actually begins to depreciate. It is therefore reasonable to assume that in the event of currency depreciation heavily euroized countries like Croatia and Bulgaria would experience a faster depletion of reserves than Poland or the Czech Republic, where confidence in local currencies seems to be higher.

Figure 8

Foreign currency liabilities and gross international reserves, 2018, in percent of GDP



Source: Eurostat (2020c); national central banks; author's calculations.

4.2 THE STATE OF MACROECONOMIC FUNDAMENTALS IN NON-EURO AREA EU MEMBER STATES

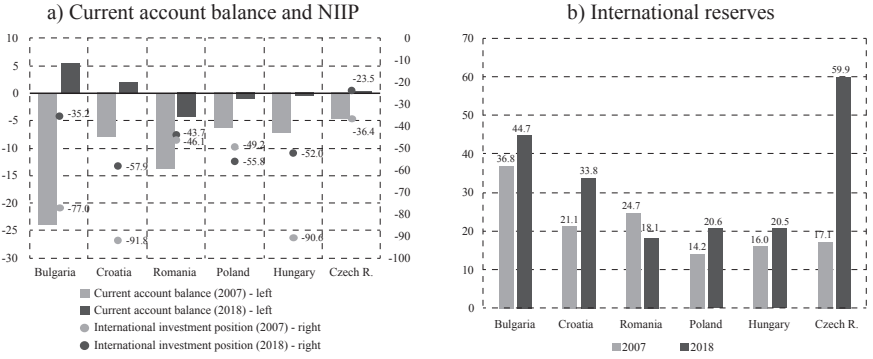
In the years following the global financial crisis, countries from Central and Eastern Europe have enjoyed a sustained, well-balanced economic growth supported by accommodative monetary policies and the recovery of the main trading partners from the EU. Compared to the pre-crisis period, this is a large switch in the pattern of growth. Until the outbreak of the crisis in 2008, most CEE countries had experienced a strong domestic demand-driven expansion fuelled by massive debt-creating capital inflows. The period of abundant capital flows ended with the escalation of the global crisis, and CEE countries had to adapt to this by cutting down on private and public spending. In Hungary and Romania, the required macroeconomic adjustment and capital outflows were so large that their authorities resorted to financial assistance from the IMF and the EU to make the transition easier. Although painful at the beginning, this rebalancing set the stage for a healthy recovery in the following years.

The data depicted in figure 9 confirm that external fundamentals of the CEE countries have improved considerably since the global financial crisis. Previously large current account deficits have narrowed or even turned into surpluses, while the net international investment position increased markedly in most cases, mainly due to

a decline in non-FDI liabilities and an increase in international reserves.[21] On the fiscal front, after several years of large crisis-driven budget deficits, from 2015 until the outbreak of the COVID-19 pandemic most CEE countries showed solid fiscal performance facilitated by positive nominal GDP growth and, consequently, strong revenue collection. The government debt-to-GDP ratios were declining rapidly, which applies also to Croatia and Hungary, whose debt levels are highest in this group of countries (figure 10). The favourable dynamics on the fiscal front were, however, interrupted in early 2020 by the adverse economic consequences of the ongoing COVID-19 pandemic.

Figure 9

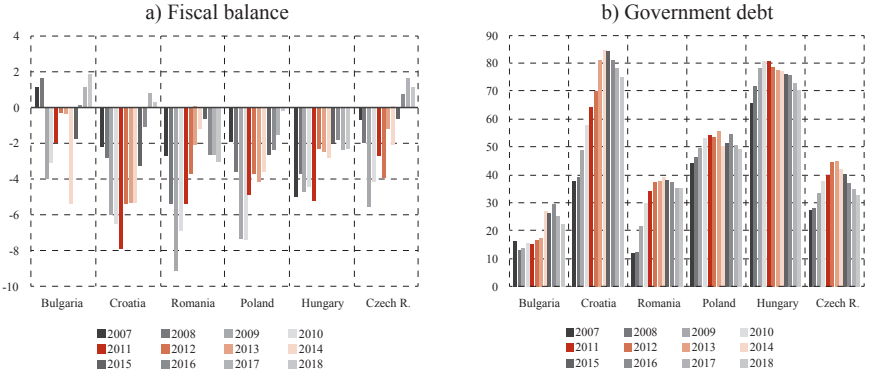
External fundamentals of CEE countries, 2007 and 2018, in percent of GDP



Source: IMF (2020d).

Figure 10

Fiscal indicators of CEE countries, 2007-2018, in percent of GDP



Source: Eurostat (2020a).

[21] The Czech Republic is a special case, as it experienced an increase in both international reserves and non-FDI liabilities from 2007 to 2018. This was partly driven by the Czech National Bank's decision of November 2013 to introduce an exchange rate floor with the aim of stimulating recovery and fending off deflationary pressures. This decision triggered large speculative non-FDI flows to the Czech Republic, as investors expected the koruna to strengthen against the euro once the floor has been removed. In 2017 alone, the central bank bought as much as EUR 42.5 billion (22% of GDP) in the foreign exchange market to defend the floor (Czech National Bank, 2018).

There have been other factors, apart from stronger external and fiscal positions, that have also contributed to reducing the exposure of non-euro area EU member states to currency risk. One of these factors is the moderate decline in loan and deposit euroization since 2008 (Dumičić, Ljubaj and Martinis, 2018). In particular, the prolonged period of very loose monetary policies worldwide has enabled central banks in CEE to create substantial local currency liquidity without jeopardizing exchange rate stability. Banks in turn have made use of the excess liquidity by issuing local currency loans, whose share in total bank loans consequently increased. In some countries, deposit euroization decreased too, as many depositors decided to transfer funds from foreign currency time deposits – which in recent years have been carrying interest rates close to zero – to demand deposits in local currency (Ljubaj and Petrović, 2016). Moreover, the high surplus liquidity in CEE banking systems has allowed their governments to replace to some extent external borrowing with borrowing from domestic banks in local currencies. This has led to a modest decline in the foreign currency component of the debt. In Croatia, for example, the share of non-residents in the ownership composition of government debt fell by close to 9 percentage points (from 41.6% to 32.7%) in the period 2015-2018. This was associated with an 8 pp drop (from 79.5% to 71.6%) in the share of foreign currency debt in total debt over the same period.

Finally, when discussing the sensitivity of CEE countries to currency risk, one should also take into account the high degree of integration of their economies with the euro area. The level of integration matters because the euro is the currency in which the largest part of CEE countries' foreign currency debt is denominated. The unpleasant historical experience of some emerging market countries, as documented in chapter 2, is a reminder that it can be very risky for a country to borrow heavily in a major foreign currency, if there are only loose connections with the country issuing the major currency. In particular, in the 1970s, Latin American countries accumulated large stocks of US dollar liabilities, while their economic ties with the US were relatively weak. In such an environment, there was a risk that monetary policy of the Federal Reserve would not always suit their needs.[22] This risk materialized in the early 1980s when the Fed decided to raise policy rates considerably to combat high inflation. The sharp increase in interest rates made it difficult for heavily indebted Latin American countries to service their dollar debts: not only did interest rates on their debts increase, but also their local currencies depreciated against the dollar, raising the real value of the dollar debt.

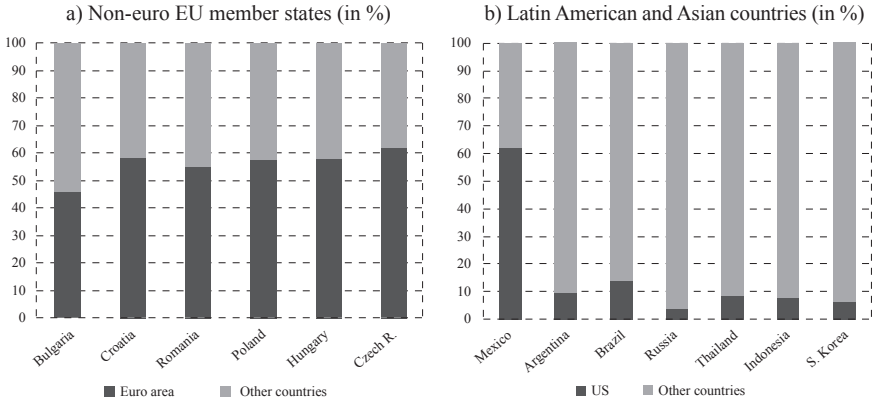
Such a scenario is less likely in Europe, given that the degree of integration is much higher than in Latin America and elsewhere (figure 11). Specifically, as non-euro area EU member states are in trade and financial terms tightly integrated with the euro area, economic shocks that hit these countries are highly synchronized with

[22] If economic ties between two countries are weak, the correlation of their business cycles is likely to be low, so monetary policy tailored to the needs of one of them will not necessarily be appropriate for the other. For example, if the anchor country is in a more mature phase of the economic expansion than the follower country, it may choose to raise interest rates to prevent its economy from overheating, and this in turn could depress growth in the follower country, which would prefer monetary policy to remain unchanged.

those affecting euro area members (Deskar-Škrbić, Kotarac and Kunovac, 2019). For this reason, monetary policy decisions of the ECB, tailored to the needs of euro area countries, are unlikely to have a dramatic negative impact on the currencies and economies of non-euro area countries. This leads to the tentative conclusion that borrowing in euros for well-integrated non-euro EU member states is probably less risky than borrowing in US dollars for Latin American and Asian countries.

Figure 11

Geographical composition of merchandise trade of selected countries, 2018



Source: IMF (2020c).

In view of the findings of the simple analysis given in this chapter, it appears that government borrowing in foreign currency is not an important source of risk in the EU. The total size of government debt denominated in or indexed to a foreign currency is low – just over 2% of EU GDP. In only two countries – Bulgaria and Croatia – does the foreign currency component (most of which are euro-denominated liabilities) account for a large majority of total government debt. Even these countries seem unlikely to experience a currency or sovereign debt crisis, as their fiscal and external fundamentals are sound and international reserves sizeable. Their resilience became apparent during the crisis triggered by the outbreak of the COVID-19 pandemic, when both countries were able to adopt sizeable fiscal stimulus programs to support the economy without compromising the stability of their currencies and public finances (European Commission, 2020).

Not surprisingly, the countries whose exposure to currency risk is the highest are the first of the remaining non-euro area EU member states to take concrete steps towards the introduction of the euro. Specifically, following the implementation of a number of pre-entry policy commitments, in July 2020, Bulgaria and Croatia joined the Exchange Rate Mechanism (ERM II), which is the final stage of the euro adoption process. The Romanian authorities have announced that they will initiate the same process in the coming years. Meanwhile, other EU member states outside the euro area have not yet expressed interest in adopting the euro. This can be partly explained by their relatively low exposure to currency risk. In particular,

given that currency mismatches are contained, the benefits of adopting the euro and eliminating currency risk do not seem very large from their perspective, making the euro adoption less attractive as a policy anchor.

5 CONCLUSION

There are at least three reasons why borrowing in foreign currency is more risky for a country than borrowing in its domestic currency. First, when a large percentage of government debt is denominated in foreign currency, public finances are highly sensitive to exchange rate fluctuations. In the case of depreciation, the debt-to-GDP ratio would increase immediately, while the fiscal balance would be negatively affected by higher interest expenses. Second, heavy indebtedness in foreign currency leaves the country vulnerable to sudden shifts in investor sentiment, as investors are aware that the country might experience a shortage of foreign currency if many investors decided not to roll over their investments. Third, if investors really start withdrawing funds from the sovereign debt market, thus exerting pressure on the currency, the central bank's capacity to cope with the debt and currency crisis will be constrained, as this capacity depends entirely on the size of its foreign exchange reserves.

The ability of the central bank to intervene is much greater in countries whose government debt is mostly denominated in local currency. Even if investors choose not to finance such a country any longer, its central bank can print more money – by lending to commercial banks or by purchasing bonds in the secondary market – in order to help the government refinance its liabilities. This is exactly what the European Central Bank did during the 2010-2012 European sovereign debt crisis and what it has been doing following the outbreak of the COVID-19 pandemic in early 2020. There is little doubt that these two crises would have been much worse had the ECB not intervened in such a way. In this regard, dependence on foreign currency borrowing could definitely be considered a "curse", as it makes the country both more likely to experience a negative shift in investor sentiment and less capable of managing the sovereign debt crisis if a negative shift does occur.

While the government's indebtedness in foreign currency is certainly a source of vulnerability, it does not necessarily lead to a debt crisis. The historical episodes documented in this paper clearly show that debt and currency crises are likely when the government is borrowing too much on short maturities, when reserves are insufficient, the real exchange rate is overvalued and credit growth is excessive. In contrast, the probability of a crisis is likely to be low if the authorities implement a prudent policy mix; if the government maintains a balanced budget, the debt-to-GDP ratio is relatively low and the average maturity of debt is long, it is unlikely that the country will have difficulty refinancing the debt, regardless of its unfavourable currency composition. The maintenance of ample foreign currency reserves is also important, for it signals to investors that the government will be able to meet its obligations even if it temporary loses access to international financial markets. It is also vital to carry out vigorous supervision and regulation

of the financial sector, as failures of large banks can impose a heavy burden on public finances and thus undermine debt sustainability.

Public finances of non-euro area EU member states do not appear to be heavily exposed to currency risk. In the event of a sharp depreciation of their currencies, the resulting increase in the debt-to-GDP ratio would be mild in most cases. Even countries with a relatively high share of foreign currency debt in total government debt, such as Bulgaria and Croatia, are unlikely to have trouble with debt refinancing in the near future owing to their generally robust fiscal and overall macroeconomic performance. Their resilience was demonstrated after the outbreak of the COVID-19 pandemic when both countries were able to implement significant fiscal stimulus programs to support the economy while keeping their currencies and public finances stable. However, from a long-term perspective, these two countries have every reason to adopt the euro. Apart from the fact that their government debt consists mainly of euro-denominated liabilities, the two countries stand out with persistently high levels of loan and deposit euroization, which is an additional major source of vulnerability. The introduction of the euro would bring substantial benefits to Bulgaria and Croatia in terms of lower risk exposure and higher resilience to financial crises. It is therefore not surprising that Bulgaria and Croatia are the first among the remaining non-euro area EU member states to express interest in joining the ERM II and introducing the euro. For all other member states, except Romania, the net economic benefit of adopting the euro appears to be smaller, which partly explains why their authorities do not have the ambition to launch the euro adoption process any time soon.

Disclosure statement
No potential conflict of interest was reported by the author.

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Decentralization and welfare: theory and an empirical analysis using Philippine data

TRISTAN CANARE, Ph.D.*

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Tristan CANARE
Department of Economics, School of Social Sciences, Ateneo de Manila University, Katipunan Ave., Loyola Heights, Quezon City, Metro Manila, Philippines 1108
e-mail: tristan.canare@gmail.com
ORCiD: 0000-0001-7737-3217

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Abstract

This study theoretically and empirically analyzes the relationship between decentralization and welfare. The model identifies conditions in which a decentralized government is utility-maximizing compared to a centralized one. The empirical analysis utilized data from Philippine provinces to study the relationship between several decentralization indicators and welfare, as measured by per capita income, human development index, and poverty. Results suggest that fiscal independence, or the ability of local governments to generate their own revenues to finance their own expenditures rather than relying on central government transfers, is positively associated with per capita income and HDI. Moreover, this relationship is stronger when governance is better and weaker among lower-income provinces. In contrast, a higher number of local government units per population is linked to adverse development outcomes, and this association is stronger among lower-income provinces and weaker among those with good governance.

Keywords: decentralization, welfare, fiscal independence, Philippines

1 INTRODUCTION AND OBJECTIVES

Decentralization is one of the most common fiscal reforms among low and middle-income economies (Smoke, 2005; Rodriguez-Pose and Gill, 2003; Bahl, 1999). The economic rationale behind decentralization is that in view of the proximity involved, local governments have an information advantage over the central government with respect to the preferences and needs of the consumers (Shah, 1998; Wallis and Oates, 1988; Wetzel, 2001). It has also been suggested that decentralization can help improve accountability and governance. By bringing the user and the provider of public goods nearer to each other, consumers can better check the performance of the government in the provision of public services (Faguet, 2009; Von Braun and Grote, 2002; Usui, 2007). Governance and efficiency can also improve when decentralized local governments compete with each other (Rodriguez-Pose, Tijmstra and Bwire, 2009).

The primary disadvantage of decentralization is that the central government has economies of scale. Usually, it also has better access to resources and technology (Bahl, 1999; Faguet, 2004; Prud'homme, 1995). This means that the central government can provide public services at a lower per unit cost. Aside from the production-side efficiency of the central government, decentralization can also affect fiscal stability. If funds and revenues are decentralized, the central government has less access to funds and spending instruments. This can affect its fiscal position and ability to implement fiscal policy (Prud'homme, 1995). Decentralization can also exacerbate inequality (Bahl, 1999; Prud'homme, 1995) and further empower local officials (Faguet, 2009; Boone, 2003), who are likely to be more corrupt than those in the central government (Prud'homme, 1995).

These contrasting effects make decentralization a highly debated policy. The primary objective of this paper is to study the relationship between decentralization

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and welfare. It has a two-fold approach. The first is the employment of a set of models that attempt to identify conditions that make decentralization preferable over a centralized government setup from a utility-maximizing perspective. The second is an empirical analysis using the case of the Philippines. It tests for the relationship between several indicators of decentralization and some welfare measures. It also tests if the decentralization-welfare relationship varies across governance quality and income.

This paper makes several contributions to the literature. For one, the model has improved on some of the often-cited theoretical models on decentralization. It has tried to address some of the limitations of these existing models; and incorporated the role of governance. Some studies argue that governance is important in making decentralization effective for development (Bardhan, 2002; World Bank, 2009). Next, while empirical decentralization literature is common, most of it has studied the relationship of decentralization with economic growth or quality of governance. There are limited empirical studies on how decentralization is associated with actual welfare indicators, such as income, poverty, and the human development index. In addition, the case of the Philippines is important because it is one of the largest developing countries to have implemented a decentralization program in the past few decades. Although the empirical section did not look at the effects of this specific decentralization law, a quantitative empirical study of the effects of decentralization using Philippine data is warranted and new (Llanto, 2009).

This paper is organized as follows. These introduction and objectives are followed by the presentation of the models, and then by the empirical analysis. The paper ends with a summary and conclusion.

2 THE MODEL

2.1 THEORETICAL AND CONCEPTUAL BACKGROUND

Before the model is presented, some of the conceptual and theoretical links between decentralization and welfare will be discussed. These arguments suggest that decentralization and welfare can have either a positive or a negative relationship; which of these effects dominates should be determined empirically. Some studies argue that the relationship is positive under certain conditions.

There are two primary channels through which decentralization enhances welfare: (a) better delivery of public goods and services due to the information advantage of local governments, and (b) better provision of public goods and services from improvements in governance and accountability. The information advantage arises from the relative proximity of the people to the local government, allowing the latter to tailor public services to a group of people that is more homogenous and has similar preferences (Boadway and Shah, 2009; Kubal, 2006; Tanzi, 1996; Wallis and Oates, 1988).

For the second channel, decentralization can promote good governance and improve government responsiveness by enhancing accountability and by increasing citizen participation (Faguet, 2009; Kubal, 2006; Von Braun and Grote, 2002; Persson and Tabellini, 2000). Accountability is enhanced because the users of public services are closer to the government agency responsible and accountable for their provision (Usui, 2007). Accountability and governance can also improve under decentralization because of inter-jurisdictional competition, according to the seminal work of Tiebout (1956).

On the other hand, decentralization can also affect welfare adversely. First, the central government usually has superior ability to produce public services because they have better access to resources. They can also produce these services at a lower per unit cost because of economies of scale and economies of scope (Bahl, 1999; Faguet, 2004; Prud'homme, 1995).

Another disadvantage of decentralization is it has the potential to increase inequality (Bahl, 1999; Prud'homme, 1995; Qiao, Martinez-Vasquez and Xu, 2008). When localities have different levels of development and local governments have different capacities to raise revenues and to provide services, transferring more responsibilities to the sub-national governments can exacerbate inequality. Decentralization can also risk macroeconomic stability. If government is decentralized, the central government has access to fewer revenues, and this limits its power to implement fiscal policy and other stabilizing policies (Prud'homme, 1995).

Decentralization also increases the likelihood of local elite capture and risks further empowerment of already powerful local officials (Faguet, 2009; Asante and Ayee, 2007; Boone, 2003). Prud'homme (1995) argues that corruption is generally more widespread in local than in central government.

Some studies argue that decentralization can be effective in promoting welfare, but only under certain conditions, with good governance, accountability, and quality of institutions as the most often cited intervening factors (Bardhan, 2002; Agrawal and Ribot, 1999; Jutting et al., 2005; Kim 2018). Good governance and institutions are important because they limit the leakages from corruption and bureaucracy; they also provide checks and balances among local government officials. Accountability is equally important because it provides incentives to deliver public services effectively and imposes disincentives for inefficiency.

Economic conditions can also affect the effectiveness of decentralization. Bahl (1999) argues that developing countries possess conditions that limit the effectiveness of decentralization as a development tool. In addition, implementing a decentralization program entails costs – and for low-income countries, the opportunity cost may be too high if other poverty-alleviation programs are affected (Jutting et al., 2005).

Some of these arguments are often the starting point of formal decentralization theories. One of the earliest seminal theories was Oates' (1972) "Decentralization Theorem". Oates argued that decentralization allows local governments to tailor public goods to suit local preferences, making it welfare-enhancing. This theory was built from early public finance literature, notably from the works of Arrow (1970), Musgrave (1959), Samuelson (1954; 1955), and Oates (2005). Another often-cited early theory that explained the benefits of decentralization was Tiebout's (1956) "voting with the feet" concept. If there is perfect mobility, consumers can choose the jurisdiction that offers their most preferred public goods.

The central ideas of these early theories are embodied even in more recent decentralization models. Xie, Zou and Davoodi (1999), and Davoodi and Zou (1998) modelled an optimal decentralization level from a growth and utility maximizing perspective. Relatedly, Faguet's (2004) model attempted to determine conditions wherein a decentralized government will provide consumers with higher utility compared to a centralized setup. One primary difference between these models is that Xie et al. and Davoodi and Zou's optimization is at the production side, i.e. they derived a decentralization level that maximizes growth (although the original objective function is to maximize utility from a single good). On the other hand, Faguet considered primarily the demand side – it maximized the net benefit from public goods. It then calculated the utility with and without decentralization and identified the condition in which decentralization produces the greater utility.

The Davoodi and Zou and Faguet models have some limitations. The former considered only the production side and not the demand side allocation of goods; and it assumed only one consumption good. The latter considered two consumption goods – private and public – but it did not incorporate the trade-off in producing these two types of goods. Moreover, it did not consider the allocative efficiency of the private and public good based on the consumer's preference; that is, it only maximized the net benefit of the public good, but it did not consider the private good in utility maximization.

Following Faguet (2004), the model presented here uses a quasi-linear utility function where the numeraire is the private good. The difference is that the function for the utility from the public good was parameterized to reflect the usual assumption of the utility increasing at a decreasing rate. The utility of the representative consumer, i, is

$$U_i = X_i + \theta_i g^{\beta}, \text{ where } 0 < \beta < 1 \tag{1}$$

Faguet called θ_i the preference of i for the public good g. The variable β determines the contribution of the public good to utility and the marginal utility of the public good. As will be discussed later, there are two cases – a decentralized and a centralized government setup. This model will likewise incorporate the benefit of decentralization, which is better information on the preferences and needs of

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the consumers; and its disadvantage, which is the higher cost of producing public goods and services.

The model has three versions. The first is static, wherein the economy has a fixed output. Resources are allocated between the production of private and public goods while maximizing the representative consumer's utility function, subject to the cost of producing each good and to the fixed income. The second follows Davoodi and Zou (1998) in that it is dynamic. Here, resources are allocated between producing the consumption goods and accumulating capital. Moreover, the income is not fixed – it is a function of private and public capital. The third version incorporates quality of governance in the model.

2.2 THE BASIC (STATIC) MODEL

The utility function of the representative consumer differs between the decentralized and the centralized government setups. The utility function for the decentralized setup follows that in (1). In a centralized government, the benefit of decentralization is reflected by altering the utility function (1) into

$$U_i = X_i + (1 - \omega)\theta_i g^{\beta}, \text{ where } 0 < \beta, \omega < 1 \quad (2)$$

Following the argument that local governments have an information advantage over the central government with respect to the preferences and needs of consumers, the variable ω was included to moderate θ, or the preference for the public good. The variable ω reflects the utility effect of the local government's information advantage over the central government in providing public goods. The higher ω is, the larger the utility effect of the local government's information advantage.

The utility of the representative consumer is maximized subject to the constraint

$$M = X + Pg \quad (3)$$

where M is the fixed output of the economy and P is the price of producing the public good g, expressed in terms of the foregone production of the private good X. The price of the private good is thus normalized to one.

Like the utility function, the constraint differs between the centralized and the decentralized government setups. Following the argument that the disadvantage of decentralization is that the central government can produce public services more efficiently due to economies of scale and availability of better technologies and inputs, the constraint equation (3) is modified for the centralized setup into

$$M = X + (1 - \sigma)Pg, \text{ where } 0 < \sigma < 1 \quad (4)$$

The variable σ represents this cost advantage of the central government over the local governments. It measures how much lower the central government can

produce public goods compared to local governments. A higher value of σ means a larger difference in cost efficiency between the central and the local government.

The objective function and the constraint for the decentralized and the centralized setups are summarized in table 1. Under the decentralized government setup, the utility function (1) is maximized subject to the constraint (3). Under the centralized setup, the utility function (2) is maximized subject to the constraint (4).

TABLE 1

Summary of utility functions and constraints; decentralized and centralized

Government setup	Utility function		Constraint	
Decentralized	$U_i = X_i + \theta_i g^{\beta}$	(1)	$M = X + P * \mathrm{g}$	(3)
Centralized	$U_i = X_i + (1-\omega)\theta_i g^{\beta}$	(2)	$M = X + (1-\sigma)P * \mathrm{g}$	(4)

The solution to this optimization problem is a set of values of X and g, denoted as X_C* and g_C* for the centralized case and X_D* and g_D* for the decentralized case, expressed as a function of the parameters. For the centralized government setup, these are

$$\mathrm{g}_C^{\,*} = \left[\frac{(1-\omega)\theta\beta}{(1-\sigma)P}\right]^{\frac{1}{1-\beta}} \quad (5) \quad \text{and} \quad \mathrm{X}_C^{\,*} = M - [(1-\sigma)P]^{\frac{\beta}{\beta-1}}[(1-\omega)\theta\beta]^{\frac{1}{1-\beta}} \quad (6)$$

The optimized utility function under the centralized setup (U_C*) is then

$$\begin{aligned} U_c^{\,*} = M &- (1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}} (1-\omega)^{\frac{1}{1-\beta}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{1}{1-\beta}} \\ &+ (1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}} (1-\omega)^{\frac{1}{1-\beta}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{\beta}{1-\beta}} \end{aligned} \quad (7)$$

For the decentralized setup, the solutions are

$$\mathrm{g}_D^{\,*} = \left[\frac{\theta\beta}{P}\right]^{\frac{1}{1-\beta}} \quad (8) \quad \text{and} \quad \mathrm{X}_D^{\,*} = M - p^{\frac{\beta}{\beta-1}}[\theta\beta]^{\frac{1}{1-\beta}} \quad (9)$$

The optimized utility function under the decentralized setup (U_D*) is then

$$U_D^{\,*} = M - p^{\frac{\beta}{\beta-1}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{1}{1-\beta}} + p^{\frac{\beta}{\beta-1}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{\beta}{1-\beta}} \quad (10)$$

From a utility-maximizing perspective, decentralization is preferred over a centralized setup if $U_D^* > U_C^*$. This condition is met if

$$\omega > 1 - (1-\sigma)^{\beta} \quad (11)$$

This is more formally stated through Proposition 1.

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Proposition 1: *If the utility function of the representative consumer under a centralized and a decentralized government setup follows (2) and (1), respectively; and the constraint equation under a centralized and a decentralized government setup follows (4) and (3), respectively, then* $U_D^* > U_C^*$ *if* $\omega > 1 - (1 - \sigma)^{\beta}$.

Proof: *The proof of proposition 1 follows the derivation above. Compute first for the optimal values of X and g for both the decentralized and centralized cases; then substitute them to equations (1) and (2) to compute for* U_D^* *and* U_C^*. *Then simplify the inequality* $U_D^* > U_C^*$. Q.E.D.

This result is similar to that of Faguet's (2004) model, but with one important difference. In the Faguet model, the only condition for decentralization to be preferred over a centralized setup is for the information advantage of the local government to outweigh the cost advantage of the central government. In this model, it also must adjust for how much utility the consumer gains from the public good. The variable β is a measure of how much public goods contribute to the consumer's utility or welfare. The higher the value of β, the higher the marginal utility of the public good.

In equation (11), there are two factors that determine the cut-off level of ω, above which a decentralized setup is preferred. One factor is σ, or the cost advantage of the central government. The higher the cost advantage of the central government (σ) is, the higher the information advantage of the local government (ω) must be. The other factor is β. When the public good has a relatively large contribution to the consumer's utility (β), the information advantage of the local government (ω) should be larger for decentralization to be preferable.

For example, suppose that the only public good that the government provides is hospital services. Since the local government has an information advantage on consumer needs and preferences, it knows what diseases are prevalent in the locality and what medical services are needed most. Thus, it can tailor the hospitals to provide these services. However, the central government has economies of scale in hospital management, has better access to advanced medical technologies, and can hire better doctors. Thus, we can expect that σ is relatively high. The central government can provide the same service at a lower per unit cost. Moreover, because health services are crucial and is a basic human need, we expect β to be high. Therefore, for decentralization to be preferable over a centralized setup, the information advantage of the local government (ω) should be much higher (than in the case where σ and β are lower).

Compare this to the case when the only public good provided by the government is, say, public parks. Surely, the central government cannot have that much of a cost advantage over the local government in producing parks. In addition, additional units of parks are not likely to increase consumer utility by much. Thus, it is expected that σ and β are relatively low. Therefore, the utility effect of the local government's information advantage need not be that large for decentralization to be preferable over a centralized government.

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Note that the hospital and park examples were only given to intuitively illustrate the role of ω, σ, and β in determining whether a decentralized government is utility-maximizing compared to a centralized one. Public goods, in reality, are composed of a basket of goods and services; and ω, σ, and β are aggregated for the entire basket. The interpretation of equation (11) should be applied to the entire basket of public goods.

Equation (11) can also be interpreted in another way. A higher value of ω makes it more likely that equation (11) will be satisfied, while a higher value of σ makes it less likely. This implies that the higher the utility effect of the local government's information advantage, the more likely it is that decentralization is utility-maximizing. On the other hand, the higher the cost advantage of the central government in producing public goods, the more likely it is that a centralized government setup will be utility-maximizing.

2.3 THE DYNAMIC MODEL

This version has two fundamental differences from the static model. First, the output of the economy is no longer constant, but is a function of private capital, k, and public capital, f; and it takes a Cobb-Douglas form. Next, it is dynamic in that there is capital accumulation of both private and public capital and the utility being maximized is intertemporal, as in Davoodi and Zou (1998).

Thus, the utility functions for the centralized and decentralized government setup, respectively, are

$$U_i = \int_0^{\infty} e^{-\rho t}[X_i + (1-\omega)\theta_i \mathrm{g}^{\beta}]dt \quad (12) \quad \text{and} \quad U_i = \int_0^{\infty} e^{-\rho t}[X_i + \theta_i \mathrm{g}^{\beta}]dt \quad (13)$$

The constraints under centralized and decentralized government setups, respectively, are

$$k^{\gamma} f^{\varepsilon} = X + (1-\sigma)P\mathrm{g} + \frac{dk}{dt} + \frac{df}{dt} \quad (14) \quad \text{and} \quad k^{\gamma} f^{\varepsilon} = X + P\mathrm{g} + \frac{dk}{dt} + \frac{df}{dt} \quad (15)$$

$$\text{where } 0 < \gamma, \varepsilon, \sigma < 1 \; ; \; \gamma + \varepsilon < 1$$

The left-hand side of the constraint equations is the economy's production function. Under a centralized setup, the utility function in equation (12) is maximized subject to the constraint in equation (14). Under decentralization, (13) is maximized subject to (15).

For both the centralized and decentralized government setups, the solution to the optimization problem is a set of values of X and g expressed as a function of parameters, denoted as X_C*, g_C*, X_D*, and g_D*. At steady state, for the centralized setup, these are

$$\mathrm{g}_C^{\,*} = \left[\frac{(1-\omega)\theta\beta}{(1-\sigma)P}\right]^{\frac{1}{1-\beta}} \quad (16) \quad \text{and} \quad \mathrm{X}_C^{\,*} = \Omega - (1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}} (1-\omega)^{\frac{1}{1-\beta}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{1}{1-\beta}} \quad (17)$$

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$$\text{where } \Omega = [\gamma]^{\frac{\gamma}{1-\gamma-\varepsilon}} [\varepsilon]^{\frac{\varepsilon}{1-\gamma-\varepsilon}} \left[\frac{1}{\rho}\right]^{\frac{\gamma+\varepsilon}{1-\gamma-\varepsilon}}$$

And for the decentralized setup, the solutions are

$$g_D{}^* = \left[\frac{\theta\beta}{P}\right]^{\frac{1}{1-\beta}} \quad (18) \quad \text{and} \quad X_D{}^* = \Omega - p^{\frac{\beta}{\beta-1}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{1}{1-\beta}} \quad (19)$$

The optimized utility function can then be computed from the optimized values of the private and public goods. The maximized utility functions for the centralized and decentralized setups, denoted as U_C* and U_D* respectively, are

$$U_c{}^* = \int_0^\infty e^{-\rho t} \left[\begin{array}{l} \Omega - (1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}} (1-\omega)^{\frac{1}{1-\beta}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{1}{1-\beta}} \\ + (1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}} (1-\omega)^{\frac{1}{1-\beta}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{\beta}{1-\beta}} \end{array} \right] dt \quad (20)$$

$$U_D{}^* = \int_0^\infty e^{-\rho t} \left[\Omega - p^{\frac{\beta}{\beta-1}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{1}{1-\beta}} + p^{\frac{\beta}{\beta-1}} \theta^{\frac{1}{1-\beta}} \beta^{\frac{\beta}{1-\beta}} \right] dt \quad (21)$$

From a welfare point of view, a decentralized government setup is preferred to a centralized one if U_D* > U_C*. Like the static case, this condition is met when

$$\omega > 1 - (1-\sigma)^\beta \quad (22)$$

This is more formally stated through Proposition 2.

Proposition 2: *If the utility function of the representative consumer under a centralized and a decentralized government setup follows (12) and (13), respectively; and the constraint equation under a centralized and a decentralized government setup follows (14) and (15), respectively, then, at steady state,* U_D* > U_C* *if* $\omega > 1 - (1-\sigma)^\beta$.

Proof: *The proof of proposition 2 follows the derivation above. Compute first for the optimal values of X and g under steady state for both the centralized and decentralized cases; then substitute them to equations (12) and (13) to compute for* U_C* *and* U_D*. Then simplify the inequality* U_D* > U_C*.* Q.E.D.

Note that the optimal values of private and public capital in both the decentralized and centralized case (k_D*, f_D*, k_C*, f_C*) can also be computed, although they are not needed in determining U_D* and U_C* because utility is a function of consumption goods. These are:

$$k_C{}^* = k_D{}^* = \left[\frac{\gamma}{\rho}\right]^{\frac{1-\varepsilon}{(1-\gamma-\varepsilon)}} \left[\frac{\varepsilon}{\rho}\right]^{\frac{\varepsilon}{(1-\gamma-\varepsilon)}} \qquad f_C{}^* = f_D{}^* = [\gamma]^{\frac{\gamma}{1-\gamma-\varepsilon}} [\varepsilon]^{\frac{1-\gamma}{1-\gamma-\varepsilon}} \left[\frac{1}{\rho}\right]^{\frac{1}{1-\gamma-\varepsilon}}$$

In addition, the welfare loss of adopting the wrong (de)centralization policy can also be computed. When $U_D^* > U_C^*$, the welfare maximizing policy is to decentralize the government; and welfare loss from centralization is $U_D^* - U_C^* = \left[\beta^{\frac{\beta}{1-\beta}} - \beta^{\frac{1}{1-\beta}}\right]\left[p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\right]\left[1-(1-\sigma)^{\frac{\beta}{\beta-1}}(1-\omega)^{\frac{1}{1-\beta}}\right]$. On the other hand, when $U_C^* > U_D^*$, the welfare maximizing policy is to centralize the government; and welfare loss from decentralization is $U_C^* - U_D^* = \left[\beta^{\frac{1}{1-\beta}} - \beta^{\frac{\beta}{1-\beta}}\right]\left[-p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\right]\left[(1-\sigma)^{\frac{\beta}{\beta-1}}(1-\omega)^{\frac{1}{1-\beta}} - 1\right]$. The same computation can also be applied to the static model.

2.4 THE DYNAMIC MODEL WITH GOVERNANCE QUALITY

This version of the model incorporates the role of governance in the decentralization-welfare relationship. It considers the difference in quality of governance between the central and the local governments. Here, governance quality is measured by how much of the available public capital, *f*, is actually used in production. The utility functions remain the same as in the dynamic model. However, the constraints under centralized and decentralized government setups, respectively, become

$$k^{\gamma}[\varphi_c f]^{\varepsilon} = X + (1-\sigma)P^*\mathrm{g} + \frac{dk}{dt} + \frac{df}{dt} \tag{23}$$

$$k^{\gamma}[\varphi_d f]^{\varepsilon} = X + P^*\mathrm{g} + \frac{dk}{dt} + \frac{df}{dt} \tag{24}$$

$$\text{where } 0 < \gamma,\varepsilon,\sigma < 1 \; ; \; \gamma + \varepsilon < 1$$

The variables φ_c and φ_d measure the governance quality of the central and local governments, respectively. They measure how much of the available public capital is actually used in production, as some of it is wasted because of poor governance, corruption, and other inefficiencies. The higher the value of φ, the higher the amount of public capital that goes to production and the better the governance quality. The lower the value of φ, the higher the inefficiency and the poorer the quality of governance.

Following the same optimization process, the optimized values of *g* and *X* at steady state under a centralized government setup are

$$\mathrm{g}_C^* = \left[\frac{(1-\omega)\theta\beta}{(1-\sigma)P}\right]^{\frac{1}{1-\beta}} \quad (25) \text{ and } \mathrm{X}_C^* = \Omega\varphi_c^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - (1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}}(1-\omega)^{\frac{1}{1-\beta}}\theta^{\frac{1}{1-\beta}}\beta^{\frac{1}{1-\beta}} \quad (26)$$

Under a decentralized setup, the optimized values[1] of g and X are

$$g_D^* = \left[\frac{\theta\beta}{P}\right]^{\frac{1}{1-\beta}} (27) \text{ and } X_D^* = \Omega\varphi_d^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\beta^{\frac{1}{1-\beta}} \tag{28}$$

The maximized utility under a centralized and a decentralized government setup, respectively, are

$$U_c^* = \int_0^\infty e^{-\rho t}\left[\begin{array}{l}\Omega\varphi_c^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - (1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}}(1-\omega)^{\frac{1}{1-\beta}}\theta^{\frac{1}{1-\beta}}\beta^{\frac{1}{1-\beta}} \\ +(1-\sigma)^{\frac{\beta}{\beta-1}} p^{\frac{\beta}{\beta-1}}(1-\omega)^{\frac{1}{1-\beta}}\theta^{\frac{1}{1-\beta}}\beta^{\frac{\beta}{1-\beta}}\end{array}\right]dt \tag{29}$$

$$U_D^* = \int_0^\infty e^{-\rho t}\left[\Omega\varphi_d^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\beta^{\frac{1}{1-\beta}} + p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\beta^{\frac{\beta}{1-\beta}}\right]dt \tag{30}$$

As before, a decentralized government setup is preferred from a welfare point of view if $U_D^* > U_C^*$, and the condition for meeting this is

$$\omega > 1-(1-\sigma)^{\beta}\left[1+\frac{\Omega\left[\varphi_d^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - \varphi_c^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}}\right]}{\left[\beta^{\frac{\beta}{1-\beta}} - \beta^{\frac{1}{1-\beta}}\right]\left[p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\right]}\right]^{1-\beta} \tag{31}$$

This is more formally stated through Proposition 3.

Proposition 3: *If the utility function of the representative consumer under a centralized and a decentralized government setup follows (12) and (13), respectively; and the constraint equation under a centralized and a decentralized government setup follows (23) and (24), respectively, then, at steady state, $U_D^* > U_C^*$ if (31) holds.*

The proof of Proposition 3 is similar to that of Proposition 2. Equation (31) is similar to (11) and (22), except that the last term of the right-hand side is multiplied by a set of constants, which include the measures of governance quality for local and central governments (φ_d and φ_c). For ease of interpretation, let

[1] Like in the model without governance, the optimal values k_D^*, f_D^*, k_C^* and f_C^* can also be computed, although they are not needed in determining U_D^* and U_C^*. These are: $k_C^* = \left[\frac{\gamma}{\rho}\right]^{\frac{1-\varepsilon}{(1-\gamma-\varepsilon)}}\left[\frac{\varepsilon}{\rho}\right]^{\frac{\varepsilon}{(1-\gamma-\varepsilon)}}\varphi_c^{\frac{\varepsilon}{1-\gamma-\varepsilon}}$; $f_C^* = [\gamma]^{\frac{\gamma}{1-\gamma-\varepsilon}}[\varepsilon]^{\frac{1-\gamma}{1-\gamma-\varepsilon}}\left[\frac{1}{\rho}\right]^{\frac{1}{1-\gamma-\varepsilon}}\varphi_c^{\frac{\varepsilon}{1-\gamma-\varepsilon}}$; $k_D^* = \left[\frac{\gamma}{\rho}\right]^{\frac{1-\varepsilon}{(1-\gamma-\varepsilon)}}\left[\frac{\varepsilon}{\rho}\right]^{\frac{\varepsilon}{(1-\gamma-\varepsilon)}}\varphi_D^{\frac{\varepsilon}{1-\gamma-\varepsilon}}$; and $f_D^* = [\gamma]^{\frac{\gamma}{1-\gamma-\varepsilon}}[\varepsilon]^{\frac{1-\gamma}{1-\gamma-\varepsilon}}\left[\frac{1}{\rho}\right]^{\frac{1}{1-\gamma-\varepsilon}}\varphi_D^{\frac{\varepsilon}{1-\gamma-\varepsilon}}$.

$$J = \left[1 + \frac{\Omega\left[\varphi_d^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - \varphi_c^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}}\right]}{\left[\beta^{\frac{\beta}{1-\beta}} - \beta^{\frac{1}{1-\beta}}\right]\left[p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\right]}\right]^{1-\beta} \quad (32) \quad K = \left[\beta^{\frac{\beta}{1-\beta}} - \beta^{\frac{1}{1-\beta}}\right]\left[p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\right] \quad (33)$$

$$L = \Omega\left[\varphi_d^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - \varphi_c^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}}\right] \quad (34)$$

Thus,

$$J = \left[1 + \frac{L}{K}\right]^{1-\beta} \quad (35)$$

and equation (31) can be modified into

$$\omega > 1 - (1 - \sigma)^{\beta} J \quad (36)$$

Equations (31) and (36) show the effect of governance quality on the condition in which decentralization is utility-maximizing. Note that K and Ω are always greater than zero (as long as β is assumed to be < 1), while the sign of L depends on whether $\varphi_d > \varphi_c$ or $\varphi_c > \varphi_d$. If , $\varphi_c > \varphi_d$ the central government has better governance quality than the local governments. If , $\varphi_d > \varphi_c$ the opposite is true.

Take the case wherein $\varphi_d > \varphi_c$. Here, L is positive, and thus, $J > 1$. The second term in the right-hand side of (36) will therefore increase (compared to the model where there is no governance); and the required ω for (36) to hold will decrease. Alternatively, in the same case where $\varphi_d > \varphi_c$, and ω remains constant, σ would have to be higher (compared to the case where there is no governance) for (36) to hold. Intuitively, if the local government has better governance than the central government, then for decentralization to be welfare-maximizing, (1) the utility effect of the local government's information advantage need not be that high, or (2) the central government's cost advantage must be much higher. That is, if the local governments have better governance than the central government, it makes sense to decentralize even if the former's information advantage is not that much. Alternatively, it makes sense to decentralize even if the latter's cost advantage is much higher.

Now, for the case in which $\varphi_c > \varphi_d$. Here, L is negative. If it will be assumed that $/L/ < /K/$,[2] then $0 < J < 1$. The second term in the right-hand side of (36) will therefore decrease (compared to the model where there is no governance and compared to the case where $\varphi_d > \varphi_c$); and the required ω for equation (36) to hold will increase. Alternatively, if ω remains constant, σ would have to be lower for equation (36) to hold. Intuitively, if the central government has better governance than the local

[2] In the case where $/L/ > /K/$, the terms inside the bracket in equation (35) will be negative. Since it will be raised to a fraction $(1-\beta)$, J could either be positive, negative, or imaginary.

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government, then for decentralization to be welfare-maximizing, the utility effect of the local government's information advantage should be much higher or the central government's cost advantage need not be that high. That is, if the central government has better governance than the local governments, it would only make sense to decentralize if the latter's information advantage is much higher. Alternatively, it would make sense to centralize even if the former's cost advantage is not that much.

The effect of σ remains the same. The higher the cost advantage of the central government in providing public goods (σ), the higher the information advantage of the local government should be for decentralization to be preferred.[3]

2.5 SUMMARY OF RESULTS FROM THE MODELS

The results imply that decentralization is utility-maximizing compared to a centralized government under certain conditions. The key variables are: the additional utility from local public goods brought about by the information advantage of the local government, the cost advantage of the central government, the contribution of the public good to the consumer's utility, and the difference in governance quality between the local and the central government.

The higher the additional utility from local public goods brought about by the local government's information advantage and the lower the cost advantage of the central government, the greater the case for decentralization. In addition, better governance for the central government is a case for centralization while better governance for the local governments is a case for decentralization. Whether decentralization is preferred from a utility-maximizing perspective depends on the relative values of these variables.

3 EMPIRICAL ANALYSIS

The empirical analysis utilized data from Philippine provinces. Accordingly, a background on the local government structure of the Philippines will be briefly discussed first. The highest level of sub-national government in the Philippines is the province, with the country being composed of 81 such local government units (80 during the time period covered by this study). Provinces are composed of cities and municipalities – with the former being more populous, larger in area, earning higher incomes, and having greater autonomy. There are almost 1,500 municipalities and almost 150 cities in the Philippines. All municipalities and a great majority of cities are politically and administratively under the supervision of a province. A small number of cities are politically independent from a province,

[3] Like in the model without governance, the welfare loss from adopting the wrong (de)centralization policy can be computed. If the welfare maximizing policy is to decentralize, welfare loss from centralization is $U_D^* - U_C^* = \Omega\left[\varphi_d^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - \varphi_c^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}}\right] + \left[\beta^{\frac{\beta}{1-\beta}} - \beta^{\frac{1}{1-\beta}}\right]\left[p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\right]\left[1-(1-\sigma)^{\frac{\beta}{\beta-1}}(1-\omega)^{\frac{1}{1-\beta}}\right]$. If centralization is welfare maximizing, the welfare loss from decentralization is $U_C^* - U_D^* = \Omega\left[\varphi_c^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}} - \varphi_d^{\frac{\varepsilon(\varepsilon+\gamma)}{1-\gamma-\varepsilon}}\right] - \left[\beta^{\frac{\beta}{1-\beta}} - \beta^{\frac{1}{1-\beta}}\right]\left[p^{\frac{\beta}{\beta-1}}\theta^{\frac{1}{1-\beta}}\right]\left[1-(1-\sigma)^{\frac{\beta}{\beta-1}}(1-\omega)^{\frac{1}{1-\beta}}\right]$.

most of them in the Metro Manila area – an agglomeration of cities surrounding the national capital.

The smallest political unit with a local government is the *barangay*, and there are more than 42,000 of these in the country. Cities and municipalities are divided into these *barangays*. The *barangay* government, however, has very little power, limited to such matters as settling minor disputes and conducting community programs.

3.1 LINKAGES BETWEEN THE MODEL AND THE EMPIRICS

Before proceeding, it must be made clear that this section is not a direct empirical test of the model. A direct empirical test would be difficult given the available data and given that the primary model results are conditions that make decentralization preferable to a centralized government. However, the theoretical model is linked to the empirical section in several ways. In particular, the model results regarding governance can be supported empirically.

The first link between the model and the empirical section is the governance variable. The model says that the difference in the governance quality between the local and the central government affects the likelihood of decentralization being welfare-enhancing or not. If local governments have better governance, decentralization is more likely to be welfare-enhancing; if governance in the central government is better, then decentralization may lead to adverse welfare effects. In the empirical section, governance quality is interacted with the decentralization variables to see if it enhances any positive effect of decentralization or if it moderates any adverse impact of decentralization. This is an important contribution to the literature because some research argues that good governance is an important factor in making decentralization effective (Bardhan, 2002; World Bank, 2009).

Another link is the control variables used in the regressions. Private capital can be argued to be proxied by the control variable bank deposits and public capital by provincial government revenue per capita. The dependent variables used in the regression analyses also link the models with the empirics. The model looks at conditions that make decentralization welfare- or utility-enhancing; and the regression analysis looks at the relationship between three indicators of welfare and decentralization.

3.2 MEASURING DECENTRALIZATION AND WELFARE

Using an appropriate decentralization measure is a challenge in any empirical decentralization study, and this is more pronounced in country-specific papers. Comparing decentralization across countries is more direct and straightforward, using such indicators as proportion of local government to total government spending (Gemmell, Kneller and Sanz, 2013; Rodriguez-Pose and Ezcurra, 2011), proportion of local government to total government revenue (Bodman, 2010; Woller and Phillips, 1998), number of local government units (Bodman, 2010;

Arikan, 2004), and even the extent to which the government uses the internet to deliver public services (called virtual decentralization (Goel and Saunoris, 2016)). In contrast, comparing decentralization across territories from the same country (e.g. states, provinces, regions, cities, etc.) is more difficult. The reason is that states, provinces, and cities are subjected to the same national or federal laws. The difficulty is more pronounced in countries where there is not much variation in local laws and sub-national governments have little power.

Nonetheless, country-specific decentralization studies have used various indicators. Three indicators of decentralization at the provincial level were used for this analysis. The first is an indicator of fiscal independence, similar to that used by Akai and Sakata (2002). The other two measure how fragmented the province is in terms of local governance, akin to Hammond and Tosun (2011), Stansel (2005), and Tosun and Yilmaz (2008). The fiscal independence indicator is own-sourced revenues of the provincial government expressed as share of total expenditure of the provincial government (*fiscal_indep*)[4]. This variable measures the independence of the provincial government from the central government in funding its expenditures. It measures the local government's ability to generate its own revenue to fund its functions[5].

Fiscal independence is an important component of fiscal decentralization. Akai and Sakata (2002) argue that even if expenditure shares of the sub-national governments are small relative to total government spending, the local government is still independent if its spending needs can be financed from within. There are several reasons for using this indicator as a measure of decentralization. First, it measures revenue independence of the provincial government from the national government. When locally sourced revenues account for a larger share of total revenues and expenditures, provincial governments do not need to depend as much on the national government for funds. Second, there are local government units – usually the low-income municipalities or even provinces – that are heavily dependent on revenue share transfers from the national government, formally known in the Philippines as the Internal Revenue Allotment (IRA). This means that although there are functions assigned to these local governments, they still rely heavily on national government transfers to fund these functions.

Third, having more locally sourced revenue means provincial governments can implement more of their own programs, reducing their dependence on national government programs for their constituents. Manasan (1997) and Capuno (2017) argue that after the 1991 decentralization law, some local governments had a hard time performing the devolved functions because the additional fiscal revenues did not match the additional responsibilities. If a local government can generate its

[4] A second indicator – own-sourced revenues of the provincial government expressed as share of total revenue of the provincial government – was considered. However, it was no longer used because it is highly correlated with *fiscal_indep* (correlation coefficient of 0.92).

[5] It must be noted that the variable *fiscal_indep* was computed using own revenues and expenditures of the provincial government – and not the consolidated budget of provincial plus sub-provincial governments.

own revenue source, not only does it not have to rely as much on the national government for revenues, it can also finance its functions better and even implement additional programs.

The final two decentralization indicators are the number of local government units (cities and municipalities) in the province per 100 thousand population (*decent_popn*) and the number of local government units in the province per one thousand square kilometers of land area (*decent_area*). A province is more decentralized if each local government unit governs fewer people. The fewer constituents and the more homogenous preferences that come with it can complement the local government's information advantage with respect to the needs and preferences of the consumers. This can allow local governments to provide locally suited public goods and services. On the other hand, too much decentralization can lead to fragmented and incomplete public service provision (Wetzel, 2001; Capuno, 2017) and high per unit cost due to the absence of economies of scale.

This study used three indicators of welfare – poverty incidence, per capita income, and the human development index (HDI). The poverty indicator is the percentage of population below the poverty line (*poverty*), based on the provincial-level poverty estimates of the Philippine Statistical Authority made available every three years. The provincial per capita income is expressed in constant 2012 Philippine pesos (PhP) with purchasing power parity based in Metro Manila prices (*income*). This variable and the provincial HDI (*hdi*) are from the triannual (once every three years) Philippine Human Development Report, available in the same years as the poverty incidence report.

These indicators represent various kinds or levels of welfare. Using different outcome variables not only act as robustness check, it can also provide insights on how decentralization affects welfare. For instance, if this study finds a positive relationship between decentralization and per capita income, and a similar positive association between decentralization and poverty, it could suggest that decentralization positively affects average welfare but negatively influences those at the bottom of the income range.

3.3 ESTIMATION STRATEGY

Equation (37) shows the general empirical model that tests for the relationship between decentralization and welfare. It is roughly based on the empirical specification of studies on determinants of poverty and living standards in the Philippines (e.g. Balisacan and Pernia, 2002; Balisacan and Fuwa, 2004).

$$w_{it} = a + \boldsymbol{\beta_1}^{*}\boldsymbol{d_{it}} + \boldsymbol{\beta_2}^{*}\boldsymbol{X_{it}} + \mu_{it} \tag{37}$$

In (37), the dependent variable w_{it} is a welfare measure of province i at year t, d_{it} is a vector of decentralization indicators of province i at year t, X_{it} is a vector of control variables, and μ_{it} is the error term. The vector X_{it} contains variables that control for

other factors that may affect per capita income, poverty incidence, and HDI. The included control variables are mean years of schooling (*educ*), the province's good governance index (*governance*), per capita total bank deposits in Philippine pesos (*bankdep*), urbanization rate (*urban*), and provincial government revenue per capita (*provrevpc*[6]). The regressions also included year fixed effects and island group fixed effects. The Philippines is divided into three so-called island groups: Luzon, Visayas, and Mindanao. Luzon, the northernmost and the most developed, consists of one large island and surrounding small ones. Visayas is in the middle part of the country and is composed of smaller islands. Mindanao, like Luzon, is composed of a mainland and some smaller islands, but is the poorest and least developed among the three. The good governance index (GGI) is an index published by the Philippine Statistical Authority (PSA) that measures governance in local governments. The rest of the control variables were from the PSA.

The control vector also contains several interaction terms. It includes an interaction between decentralization and the governance indicator, and between decentralization and a dummy for lower-income provinces[7]. The former tests if governance affects the decentralization-welfare relationship; while the latter tests if the effect of decentralization on welfare, if any, is stronger or weaker in lower-income provinces. The summary statistics and the correlation table of all the variables used are reported in appendix tables A1 and A2.

The data on poverty, per capita income, and HDI are available every three years. This study made use of the 2006, 2009, and 2012 statistics. While data for earlier years were available, this period has the most complete set of available control variables.

On the other hand, the decentralization indicators and most control variables are available annually. The fiscal independence variable was generated using data from the Bureau of Local Government Finance (BLGF), while the remaining two decentralization indicators were constructed using data from the Philippine Statistical Authority. To account for this timing difference in available data, the welfare indicators *poverty*, *income*, and *hdi* were matched with the annual average of the previous three years of the independent variables. For instance, the 2012 poverty, per capita income, and HDI data were matched with the 2010 to 2012 annual average of the independent variables; while the one for 2009 was matched with the 2007 to 2009 annual average. The GGI was available only for 2005 and 2008. Thus, GGI 2005 was matched with 2006 observations while GGI 2008 was matched with 2009 and 2012.

Equation (37) was estimated using ordinary least squares with heteroskedasticity-robust standard errors. To check for robustness, it was also estimated using

[6] The author thanks one anonymous reviewer for suggesting the inclusion of this independent variable.
[7] Dummy =1 if provincial per capita income is below the median; =0 otherwise.

cluster-robust standard errors, with clustering in regions.[8] It was estimated on a panel consisting of the 80 provinces of the Philippines and the three time periods discussed above. As a further robustness check, the control variables were varied to see if the results were affected. Eventually, only the significant controls were included in the regressions.

3.4 RESULTS AND DISCUSSIONS

The regression coefficients are presented in table 2. Columns 1 to 3 of table 2 show the results of regressing per capita income on the three decentralization variables. Columns 4 to 6 present the results for HDI, and columns 7 to 9 for poverty incidence. In each of these panels, the left-most column (columns 1, 4, and 7) shows the results without the interaction terms; the second column (columns 2, 5, and 8) includes the interaction terms between decentralization and governance; and the third column (columns 3, 6, and 9) includes the interaction terms between decentralization and dummy for lower-income provinces (*lowinc*).

Results suggest that the share of own-sourced revenue to expenditure (*fiscal_indep*), is positively associated with per capita income and with HDI. Using the coefficients in columns 1 to 3, a one percentage point increase in *fiscal_indep* is associated with PhP89.8 to PhP109.4 higher provincial per capita income. Similarly, using the coefficients in columns 4 to 6, a one percentage point increase in *fiscal_indep* is associated with 0.07 to 0.08 higher HDI.

The interaction terms involving fiscal independence also proved to be significant. The interaction between *fiscal_indep* and governance quality is positive and significant for both the per capita income and HDI runs. This suggests that the positive relationship between *fiscal_indep* and per capita income and between *fiscal_indep* and HDI is stronger in provinces with better governance and weaker in provinces with poorer governance. In addition, the interaction between *fiscal_indep* and the low-income province dummy was negative and significant in the per capita income regression. This suggests that the positive relationship between per capita income and fiscal independence is weaker among lower-income provinces.

In contrast to fiscal independence, the number of local governments per 100 thousand population (*sng_popn*) is negatively associated with both per capita income and HDI. An additional local government per 100 thousand people is associated with PhP292 to PhP855 lower per capita income and with 0.004 to 0.012 lower HDI. However, as in *fiscal_indep*, governance and the low-income dummy are intervening variables to the relationship between *sng_popn* and per capita income and HDI. For both the per capita income and HDI runs, the coefficient of the interaction term between *sng_popn* and governance is positive and significant, while the interaction between *sng_popn* and the low-income dummy is negative and

[8] The 80 Philippine provinces are grouped into 16 so-called regions. These regions are not local governments but are merely geographic groupings.

significant. These suggest that the adverse effect of *sng_popn* on per capita income and on HDI is weaker among provinces with good governance; and stronger among lower-income provinces.

Unlike *fiscal_indep* and *sng_popn*, the number of local governments per 1,000 square kilometer land area (*sng_area*) is insignificant for all regressions involving per capita income and HDI. As mentioned in the footnotes of table 2, the results for per capita income and HDI are mostly robust to using cluster-robust standard errors and in adding a few more control variables.

Turning the discussion to the poverty regressions, the results are mostly consistent with those of per capita income and HDI. However, they are not as robust. As mentioned in the footnotes of table 2, about half of the significant decentralization indicators and their interaction terms lost significance when using cluster-robust standard errors or when a few more control variables were added. One should therefore be more careful in forming interpretations based on the poverty runs.
Fiscal independence, which is positively associated with per capita income and HDI, has no relationship with poverty. Its coefficients were negative in the poverty regressions, but none were significant. The number of local governments per 100 thousand population (*sng_popn*) was positive and significant in columns 7 to 9 of table 2. This is consistent with its negative and significant coefficients in columns 1 to 6. Moreover, the interaction between *sng_popn* and governance is negative and significant. This suggests that the adverse effect of *sng_popn* on poverty is weaker among provinces with good governance. The interaction between *sng_popn* and the low-income dummy is positive and significant, suggesting that the adverse effect of *sng_popn* on poverty is stronger among lower-income provinces.

An interesting result for poverty is the negative and significant coefficients of *sng_area*. This means that the number of local governments per population is associated with higher poverty, but the number of local governments per land area is associated with lower poverty. The significance of *sng_area* in the poverty regressions, however, disappears with additional controls. It also loses its significance in some poverty runs when cluster-robust SEs are used.

Nonetheless, what could be the reason for these contrasting results? A possible explanation is that too many local governments per population lead to fragmented delivery of public services (Wetzel, 2001). On the other hand, the presence of more local governments per area ensures that no locality is so remote that they are neglected because no public service provider reaches them.

As for the control variables, they have their expected signs. More years of schooling, better quality of governance, higher rate of urbanity, and greater bank deposits per capita are associated with higher per capita income and higher HDI. Moreover, more years of schooling, better quality of governance, and higher rate of urbanity, are associated with lower poverty.

TABLE 2

Regression results

	Income per capita			HDI			Poverty		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
fiscal_indep	10.935***	14.638***	8.981*	0.0701**	0.0847***	0.0776**	-4.717	-7.551	-3.679
	(4.094)	(4.263)	(5.072)	(0.0302)	(0.0311)	(0.0326)	(7.011)	(6.583)	(9.013)
sng_popn	-291.8**	-855.2***	-504.4***	-0.00426***	-0.0116***	-0.00579***	0.486*	1.573***	1.086***
	(133.3)	(289.0)	(152.6)	(0.00121)	(0.00222)	(0.00129)	(0.292)	(0.467)	(0.270)
sng_area	97.04	91.45	-65.16	0.000610	0.00106	-0.000264	-0.518***	-0.382*	-0.497**
	(146.6)	(137.8)	(125.9)	(0.00111)	(0.00107)	(0.00104)	(0.187)	(0.227)	(0.214)
fiscal_indep *governance		812.5***			0.00446***			-0.540**	
		(165.1)			(0.00124)			(0.227)	
sng_popn *governance		17.86***			0.000203***			-0.0266**	
		(6.722)			(5.29e-05)			(0.0115)	
sng_area *governance		-4.601			-5.12e-05			-0.00107	
		(4.357)			(3.69e-05)			(0.00600)	
fiscal_indep *lowinc			-26.005***			-0.0596			18.37
			(7.574)			(0.0540)			(13.30)
sng_popn *lowinc			-813.6***			-0.00624***			2.008***
			(258.6)			(0.00227)			(0.467)
sng_area *lowinc			1.739			0.000923			-0.724*
			(227.9)			(0.00191)			(0.408)
governance	84.94***	119.7***	78.36***	0.000535***	0.000802***	0.000481***	-0.0935***	-0.129***	-0.103***
	(22.12)	(21.10)	(21.09)	(0.000170)	(0.000165)	(0.000157)	(0.0282)	(0.0290)	(0.0278)

	Income per capita			HDI			Poverty		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lowinc			-6.140***			-0.0517***			7.770***
			(1.001)			(0.00738)			(1.424)
Observations	237	237	237	237	237	237	237	237	237
R-squared	0.749	0.777	0.798	0.814	0.826	0.851	0.666	0.680	0.736
Notes	1. Heteroskedasticity-robust SEs in parentheses 2. *** p<0.01, ** p<0.05, * p<0.1 3. Results are robust to the use of cluster-robust SEs 4. Control variables included: *year fixed effects, island group fixed effects*, *governance*, *educ*, and *urban* 5. Results are robust to adding *bankdep* and *provrevpc* among the controls			1. Heteroskedasticity-robust SEs in parentheses 2. *** p<0.01, ** p<0.05, * p<0.1 3. Results are robust to the use of cluster-robust SEs 4. Control variables included: *year fixed effects, island group fixed effects*, *governance*, *educ*, and *urban* 5. Results are robust to adding *bankdep* and *provrevpc* among the controls			1. Heteroskedasticity-robust SEs in parentheses 2. *** p<0.01, ** p<0.05, * p<0.1 3. When cluster-robust SEs are used: a) *sng_area* and most of the significant interaction terms became insignificant; b) *fiscal_indep* remains insignificant 4. Control variables included: *year fixed effects, island group fixed effects*, *governance*, *educ*, and *urban* 5. When *bankdep* and *provrevpc* were included among the controls: a) about half of the significant decentralization variables and their interaction terms became insignificant; b) *fiscal_indep* remains insignificant		

Note: Table shows the decentralization independent variables only. Complete results available upon request.

3.5 DISCUSSIONS AND IMPLICATIONS

These empirical results suggest several implications on the relationship between decentralization and welfare. First, the relationship is mixed, depending on the form of decentralization and indicator of welfare. Fiscal independence – the ability of the local government to generate own-sourced revenues – appears to have a positive relationship with per capita income and with HDI. That is, provinces where the provincial government has greater ability to generate its own resources rather than relying on transfers from the central government have greater per capita income and higher HDI. Fiscal independence, however, has no significant relationship with poverty.

The importance of the local government's ability to generate its own revenue for decentralization to be effective has been emphasized in the literature (Manasan, 1997; Capuno, 2017; Shen, Jin and Zou, 2012). With more revenue-generating capability, local governments need not rely too much on the national government to fund their spending requirements. Therefore, more funds are available readily, without having to go through the politics of inter-governmental fiscal transfers from the central to the local governments. In the Philippines, Hutchcroft (2012) argues, these transfers have become a tool for patronage politics among local politicians.

Second, in contrast to fiscal independence, a greater number of local governments per population is associated with lower welfare. A possible explanation for this is that too many local governments per population lead to fragmented delivery of public services (Wetzel, 2001). Too many local governments providing public services to too few people can cause a loss of efficiency and economies of scale. Capuno (2017) further argues that public service delivery is already fragmented with the current decentralization setup of the Philippine government. Adding more local governments per unit population can worsen this.

Third, the results suggest that governance plays an important intervening role in the relationship between decentralization and welfare. Good governance enhances the positive relationship between fiscal independence and per capita income and HDI. That is, the positive relationship of fiscal independence with per capita income and with HDI is stronger among provinces with better governance (and weaker among those that are poorly governed). Conversely, good governance moderates the negative relationship between *sng_popn* and welfare. That is, the negative relationship of *sng_popn* with per capita income and with HDI is weaker among provinces with good governance. This coheres with the literature saying that good governance is needed for decentralization to be effective (World Bank, 2009).

These results also provide empirical support to the model developed in this paper. One implication of the model is better governance in the local government increases the likelihood that decentralization will be welfare-maximizing; and better governance in the central government increases the likelihood that a centralized government setup is welfare-enhancing. This empirical result also

supports the model's finding that when decentralization is utility-maximizing, the difference between the utility under a decentralized government and the utility under a centralized setup is positively related to the quality of local governance (see footnote 3).

Fourth, income level also has an intervening role in the decentralization-welfare relationship. When the relationship between decentralization and welfare is positive – as in fiscal independence with per capita income and HDI – the relationship is weaker among lower income provinces. When the relationship between relationship and welfare is negative – as in *sng_popn* with per capita income and HDI – the relationship is even stronger among lower-income provinces. These results suggest that lower income provinces get the shorter end of the stick of decentralization, while richer provinces get most of the benefits.

Fifth, these empirical results could have some policy implications on decentralization as a development strategy. Fiscal independence could have a positive effect on average welfare (per capita income and HDI), but it cannot influence poverty reduction. Consequently, if fiscal independence positively affects per capita income but not poverty, and this effect is stronger on those with higher income to begin with, a possible unintended consequence of fiscal independence is worsening inequality.

Moreover, the positive relationship of welfare with fiscal independence and its negative relationship with fragmentation (number of local governments) suggest that decentralization can have varying effects depending on its form. In other words, decentralization can involve tradeoffs and its design is crucial in making it effective. Finally, another policy implication is that improving governance quality is an important factor in linking decentralization to welfare.

4 SUMMARY AND CONCLUSION

This paper studies the relationship between decentralization and welfare using a theoretical and an empirical approach. Building on existing literature, this paper proposes three related models that analyze under what conditions decentralization is utility-maximizing compared to a centralized government setup. The main results show that decentralization being preferred over a centralized setup depends on several key variables – the utility effect of the local government's information advantage, the cost advantage of the central government in producing public goods, the contribution of public goods to the consumer's utility, and the difference in governance quality between the local and the central government.

The higher the additional utility from public goods brought about by the local government's information advantage and the lower the cost advantage of the central government, the greater the case for decentralization. In addition, better governance for the central government is a case for centralization while better governance for the local governments is a case for decentralization. Whether decentralization is

preferred from a welfare-maximizing perspective depends on the relative values of these variables.

The empirical analysis used data from Philippine provinces and studied the relationship between decentralization and welfare as measured by per capita income, HDI, and poverty incidence. Three decentralization measures at the provincial level were used – share of own-sourced revenues to total expenditures of the provincial government, number of local government units per population, and number of local government units per land area.

Results suggest that fiscal independence is positively associated with per capita income and with HDI. However, there are intervening variables in this relationship, particularly governance quality and income level. The positive relationship is stronger when governance is better and weaker among lower-income provinces. Fiscal independence has no relationship with poverty. In contrast, a greater number of local government units per population is associated with lower per capita income and lower HDI. This adverse relationship is weaker among provinces with good governance and stronger among lower-income provinces.

These results could have some policy implications on decentralization as a development strategy. If the positive relationship between fiscal independence and per capita income is observed more strongly among higher income provinces, and fiscal independence has no effect on poverty, then a possible unintended consequence is worsening inequality. Another policy implication is the importance of quality of governance in making decentralization effective. All these points suggest that decentralization could indeed have mixed effects, and its effectiveness depends on a proper policy mix along with proper institutional and economic environments.

Disclosure statement

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APPENDIX

TABLE A1

Summary statistics

Variable	Description		Mean	Std. dev.	Observations
per capita income	Per capita income (PPP) in 2012 Metro Manila Philippine Peso (PhP)	overall	40,772	12,173	N = 240
		between		11,652	n = 80
		within		3,678	T = 3
hdi	Human development index	overall	0.53	0.11	N = 240
		between		0.11	n = 80
		within		0.03	T = 3
poverty	Population poverty incidence (in %)	overall	36.00	14.99	N = 240
		between		14.28	n = 80
		within		4.76	T = 3
fiscal_indep	Ratio of provincial government own-sourced revenue to provincial government expenditures	overall	0.18	0.16	N = 240
		between		0.15	n = 80
		within		0.06	T = 3
sng_popn	Number of local government units (cities and municipalities) per 100 thousand population	overall	3.38	4.18	N = 240
		between		4.19	n = 0
		within		0.23	T = 3
sng_area	Number of local government units (cities and municipalities) per 1,000 square kilometers	overall	6.83	5.20	N = 240
		between		5.22	n = 80
		within		0.00	T = 3
governance	Good governance index	overall	123.81	23.36	N = 237
		between		23.46	n = 79
		within		0.00	T = 3
educ	Mean years of schooling	overall	8.24	1.11	N = 240
		between		1.03	n = 80
		within		0.44	T = 3
urban	Percent of population living in urban areas	overall	25.49	22.96	N = 240
		between		22.97	n = 80
		within		1.95	T = 3
bankdep	Total bank deposits in millions PhP	overall	15,861.98	29,186.78	N = 239
		between		28,184.31	n = 80
		within		7,847.41	T = 2.99
provrevpc	Provincial government total revenue per capita	overall	1,293.80	1,357.46	N = 240
		between		1,305.74	n = 80
		within		389.86	T = 3

N = number of observations; n = number of cross-sections (provinces); T / T-bar = number of / average number of time periods.

TABLE A2
Correlation table

	fiscal_indep	sng_popn	sng_area	governance	educ	urban	bankdep	provrevpc
fiscal_indep	1.000							
sng_popn	-0.266	1.000						
sng_area	0.183	0.521	1.000					
governance	0.092	0.344	0.406	1.000				
educ	0.563	0.165	0.509	0.298	1.000			
urban	0.518	-0.371	-0.049	0.000	0.283	1.000		
bankdep	0.476	0.000	0.288	0.202	0.627	0.458	1.000	
provrevpc	-0.160	0.911	0.462	0.423	0.236	-0.299	0.028	1.000

Effects of fiscal credibility on inflation expectations: evidence from an emerging economy

JUAN CAMILO ANZOÁTEGUI-ZAPATA, MSc*
JUAN CAMILO GALVIS-CIRO, Ph.D.*

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Juan Camilo ANZOÁTEGUI-ZAPATA
Universidad Autónoma Latinoamericana, Department of Economics, Carrera 55A No. 49-51, Medellín, Colombia
e-mail: juan.anzoategui@unaula.edu.co
ORCiD: 0000-0003-0588-1364

Juan Camilo GALVIS-CIRO
Universidad Pontificia Bolivariana, Department of Economics, Circular 1 No. 70-01, Medellin, Colombia
e-mail: jcgalvisciro@gmail.com
ORCiD: 0000-0001-6680-275X

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Abstract

This paper analyses the impact of fiscal imbalances on expectations for an emerging economy with inflation targeting. In particular, based on the Colombian experience, we build a fiscal credibility index and evaluate its impact on inflation expectations for the 2004-2019 period. To analyse fiscal and monetary interactions, we propose an econometric model and use the OLS and GMM methods. The results show that the loss of fiscal credibility, associated with divergences between the fiscal deficit and agents' expectations, can increase inflation expectations by between 9% and 12%. Furthermore, inflation expectations in Colombia incorporate important macroeconomic information related to unemployment, GDP and exchange rates.

Keywords: inflation expectations, fiscal policy, credibility

1 INTRODUCTION

The anchoring factors for inflation expectations are essential for fine-tuning an economic policy framework (Mankiw, Reis and Wolfers, 2003). In inflation targeting, expectations are monitored by central banks because agents set prices according to their inflation forecasting. These expectations affect the long-term structure of the interest rate, the planned expenditure and, therefore, inflation control (Blinder et al., 2008). According to the seminal contributions of Sargent and Wallace (1981), a fiscal policy stance is relevant for controlling inflation expectations. In this regard, if the public expects that the fiscal position is unsustainable, inflation expectations will not be low. Based on this relative consensus in economic theory, there is a growing and dynamic literature on the interactions between fiscal and monetary policies in emerging economies.

Prompted by Sargent and Wallace (1981), some studies have sought to analyse the empirical and theoretical relationship between fiscal variables and inflation expectations in economies with inflation targets. First, Catao and Terrones (2003) find that deficit/GDP ratio downturns produce a significant reduction in inflation, with more effects in countries with high and persistent inflation. A similar result is reported by de Mendonça and Machado (2013). Celasun, Gelos and Prati (2004) as well as de Mendonça and Tostes (2015) note that fiscal balance recoveries reduce inflation expectations and observed inflation. Other studies, such as Cerisola and Gelos (2009), suggest that the inflation target, past inflation, and the primary fiscal balance can anchor inflation expectations in emerging economies. Nonetheless, Celasun, Gelos and Prati (2004) provide empirical evidence that inflation expectations have backward-looking components despite inflation target announcements. Similar results are reported by Araujo and Gaglianone (2010) and Gaglianone (2017), who highlight that inflation expectations show persistence. Other perspectives, for example, Berlemann and Elzemann (2006), find that inflation expectations are driven by presidential election results and the probability that leftist parties will come to power.

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With central bank independence, the use of the inflation tax to achieve fiscal balance decreases (Minea and Tapsoba, 2014). Inflation targeting adoption leads to a government commitment to fiscal sustainability, which allows inflation expectations to be anchored in the central bank's targets (see, for example, Cerisola and Gelos, 2009). With this perspective being borne in mind, the objective of this paper is empirical and consists of examining the effects of fiscal credibility on inflation expectations in the Colombian economy.

Colombia is a small emerging economy in Latin America that has made important efforts to achieve better economic stability through a coherent and prudent policy. In the Colombian case, the government adopted the inflation targeting at the end of 1999. Since 2000, the Central Bank of Colombia has improved its communication with markets by informing them about inflation targets and monetary policy management (Hamann, Hofstetter and Urrutia, 2014). Since 2003, the central bank has implemented sophisticated methodologies to monitor inflation expectations, fiscal deficit expectations and expected economic growth. In the fiscal management strand, the government established a decreasing goal for the fiscal deficit to convince markets about fiscal balance sustainability. As a result, after more than 10 years, the Colombian economy recovered its investment grade (Moody's, 2014). In sum, Colombia is an interesting economic laboratory in which to analyse the interactions between monetary and fiscal policy (Ciro and de Mendonça, 2017).

This paper offers a new perspective on the problem of fiscal effects on inflation expectations. First, we use central bank expectations surveys and build a fiscal credibility index based on overall fiscal deficit expectations. Second, we analyse the long-term relationships that may exist between fiscal credibility and inflation expectations based on a cointegration model. Third, we verify whether, for the formation of inflation expectations, agents consider the available public information about macroeconomic variables. Finally, this study presents a contribution to the understanding of the effects of fiscal credibility on inflation expectations in the Colombian case. The results show that the loss of fiscal credibility, which is associated with divergences between the fiscal deficit and agents' expectations, can increase inflation expectations by between 9% and 12%. Furthermore, this study shows that inflation expectations present inertia and react to GDP and the exchange rate. The evidence also indicates that the 2008 subprime crisis increased inflation expectations in Colombia.

The remainder of this paper is organized as follows: section 2 presents a literature review; section 3 presents the methodology for measuring fiscal credibility; section 4 provides empirical evidence, by means of econometric analysis, on the fiscal credibility effect on inflation expectations; and section 5 concludes the paper.

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2 FISCAL CREDIBILITY AND INFLATION TARGETING

The inflation targeting framework requires a high degree of coordination between the central bank and fiscal policy. In fact, for the policy framework to be credible, there cannot be permanent fiscal deficits that lead to fiscal dominance and public debt monetization (Mishkin and Savastano, 2001; Allsopp and Vines, 2005; De Mendonça, 2007). The absence of fiscal dominance is a requirement for inflation targeting (Mishkin and Savastano, 2001). For this, institutions are necessary to ensure the bank's independence and the government's commitments to fiscal balance (Wyplosz, 2005).

According to Gürkaynak, Levin and Swanson (2010), and Strohsal, Melnick and Nautz (2016), long-term inflation expectations should not respond to macroeconomic information when there is economic policy credibility. In Latin America, fiscal imbalances are a problem and cast doubt on monetary policy credibility. Fiscal balance is thus an indicator that must be carefully monitored to ensure the credibility of the inflation targets (Minea and Tapsoba, 2014). One strategy to resolve this problem resorts to the imposition of fiscal responsibility laws (Debrun, Hauner and Kumar, 2009; Lin and Ye, 2009; de Mendonça and da Silva, 2016). Following up on this idea, several studies have analysed the effect of fiscal targets or rules on inflation.

One strand of the literature has focused on measuring the effects of fiscal credibility in emerging economies under inflation targeting. This literature focuses on fiscal credibility indices to identify their effects on macroeconomic variables. In the case of Brazil, there are fiscal credibility indices on the deficit and public debt. The results of these studies show that fiscal credibility helps to anchor inflation expectations, reduces inflationary pressures and exchange rate pass-through on inflation, lowers disagreement in fiscal expectations and stabilizes market interest rates (de Mendonça and Tostes, 2015; de Mendonça and da Silva, 2016; Montes and Acar, 2018). According to de Mendonça and Machado (2013), an increase in fiscal credibility helps fixed rate bonds to be issued. Furthermore, credibility reduces the public debt indexed to market interest rates. Along this same line, the study by Montes and Souza (2020) suggests that greater fiscal credibility reduces sovereign risk.

Other studies have found similar results without using credibility indices. Thornton and Vasilakis (2019), using a sample of 61 low- and middle-income countries, find that countries that adopted transparent fiscal rules increased their fiscal credibility. Moreover, in the case of Indonesia, Kunkoro (2015) shows that rules for the fiscal deficit are a device to obtain fiscal credibility. Furthermore, credibility reduces deficit volatility and contributes to price stability. A similar result is reported for the case of Japan. According to Shirakawa (2012), when the government loses credibility regarding debt sustainability, inflation increases, boosting interest rates and increasing default probabilities. Similarly, for the case of the Czech Republic, Klyuev and Snudden (2011) demonstrate that public expectations about the government's commitments to fiscal consolidation can improve its

credibility. According to their results, fiscal credibility helps higher tax incomes and lower market interest rates to be achieved.

Other empirical studies measure credibility through financial markets' reactions. In particular, Kandil and Morsy (2014) propose that fiscal credibility can be measured by the confidence that markets show in fiscal stimuli. According to their results, fiscal stimuli backed by international reserves generate greater credibility and increase the impact of stimuli related to public spending. In addition, credible market announcements help reduce the costs associated with loans and debt service.

2.1 THE COLOMBIAN CASE

The Bank of the Republic, the central bank of Colombia, emerged in 1923 as an issue, transfer, deposit, and discount bank and is the highest monetary, exchange and credit authority in Colombia. The bank functioned as a development bank for the economic growth of Colombia between 1930 and 1980. In those years, coffee growers, industrialists, merchants, and other agents had representation on the board of directors. In this period, the Colombian economy exhibited average annual inflation rates of 20%.

The independence of the central bank was achieved in 1991 with the reform of the political constitution of Colombia. At that time, the reform created a board of directors for the bank, made up of seven members: the general manager, a representative of the government, who is the Minister of Finance and Public Credit, and five full-time members. As a positive sign of independence between monetary and fiscal policy, to date, the Board of Directors has never approved loans to the government to finance the fiscal deficit.

In 2000, the Central Bank of Colombia adopted an inflation targeting regime, and inflation rates have averaged 5% per year. Inflation targeting was adopted as a monetary policy response to anchor inflation expectations and increase fiscal restrictions (Gómez, 2006; López-Enciso, Vargas-Herrera and Rodríguez-Niño, 2016). To support the central bank, since 2004, the Colombian government has had debt controls and a medium-term fiscal framework that provides information about fiscal plans. In addition, in 2012 the Colombian government adopted a fiscal rule to progressively reduce the fiscal deficit. The objective of this rule is to achieve a primary fiscal deficit of less than 1% of GDP from 2022 (López-Enciso, Vargas-Herrera and Rodríguez-Niño, 2016). To achieve these targets, the government has carried out tax reforms to reduce the fiscal deficit. Despite all these fiscal commitments, reforms have been partial, with an average of one tax reform every two years. As a result, fiscal imbalances have not been resolved and fiscal credibility is low.

3 METHODOLOGY

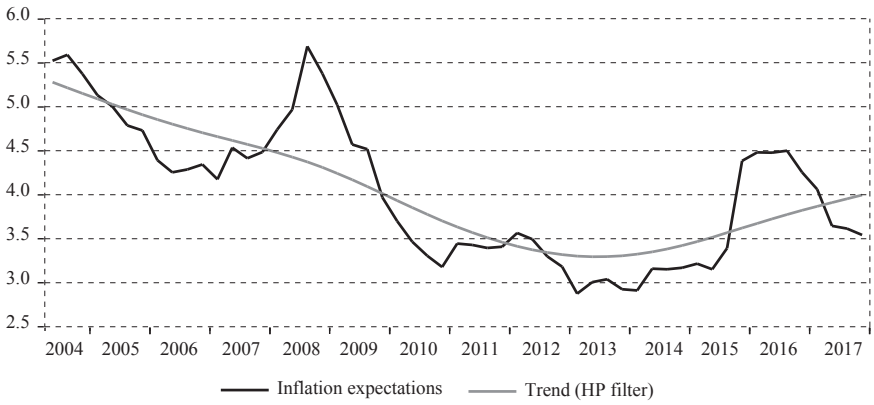
Fiscal policy has effects on macroeconomic stability and must be managed in a liable and coherent manner (Fatás and Mihov, 2003). Fiscal credibility is an asset for governments and indicates that agents believe that fiscal targets will be achieved and that a sustainable fiscal position will be maintained (Hauner, Jonáš

and Kumar, 2007). In particular, fiscal credibility is relevant to policymakers because it can help guide the market in a way that avoids rising inflation expectations (de Mendonça and Machado, 2013).

It is important to note that, in the case of emerging economies, fiscal deficits constantly put the fulfilment of the central bank's objectives at risk. As a result, inflation expectation control is affected by fiscal credibility (Cerisola and Geros, 2009). This paper evaluates the effects of fiscal credibility on inflation expectations for the case of the Colombian economy based on central bank expectations surveys. These surveys average 40 participants among private banks, stockbrokers, pension funds, academics and international organizations. In the present study, inflation expectations are calculated as 1-year-ahead inflation forecasts of the participants surveyed. This information is available to the public through its central bank time series statistics system. Drawing on the information available, we present the inflation expectations for the 2004-2019 period in figure 1.

Figure 1

Inflation expectations in the Colombian economy (in %)



Source: Author´s elaboration. Data from the Central Bank of Colombia. Trend calculated with the Hodrick-Prescott filter.

Inflation expectations declined between 2004 and 2013 towards the central bank's long-term inflation target, which was set at 3%. This process was partially interrupted by the subprime crisis of 2007-2008. Since 2014, there has been an increase in inflation expectations due to the great difficulty of controlling some unexpected events, such as a strong devaluation in the exchange rate and some internal crises caused by internal political problems related to monetary policy.

There are several challenges in measuring fiscal credibility because the government's budget constraint involves several variables. According to de Mendonça and Machado (2013), fiscal credibility can be evaluated by public confidence in relation to the government's ability to avoid the risk of default. Moreover, it is possible to affirm that there is fiscal credibility when there is a government

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commitment to the sustainability of public finances. As a result, there is credibility when the government does not use the inflation tax to fulfil its obligations (Hauner, Jonas and Kumar, 2007; Debrun and Kinda, 2017).

To make credibility measurable, there are several proposals. According to Drazen and Masson (1994), credibility can be measured by agents' expectations regarding the fiscal results. Another approach is offered by Naert (2011), who postulates that fiscal policy is credible if there is little difference between the current level and the projected level of some fiscal measure. The challenge is to define some measure of fiscal performance on which agents form expectations and make projections. Based on Debrun and Kinda (2017), fiscal performance can be measured by the overall fiscal deficit, that is, by the difference between expenditures, debt service and taxes. Hence,

$$DEF_t = G_t + rD_{t-1} - T_t \tag{1}$$

where DEF_t is the overall fiscal deficit, G_t is the public expenditure, rD_{t-1} is the public debt interest, and T_t is the tax revenues. All the variables are defined as a percentage of the gross domestic product (GDP).

An essential point regarding the credibility of economic policy is public expectation. According to Cukierman and Meltzer (1986), credibility can be measured as the absolute value of the difference between the policymaker's plans and the public's beliefs about those plans. Moreover, as highlighted by Faust and Svensson (2001), credibility is negatively related to the distance between agents' expectations and the achievements of the policy maker. Following Hauner, Jonas and Kumar (2007), fiscal credibility can be approximated by the difference between agents' expectations of the fiscal deficit ($E(DEF_t)$) and the fiscal deficit achieved by the government (DEF_t). In other words, the greater the difference between the observed fiscal deficit and agents' expectations, the less fiscal credibility there is because there is no convergence in agents' beliefs.

From that perspective, this paper uses a credibility loss indicator (*CRED_LOSS*) that considers the differences between the agents' expectations about the fiscal deficit and the overall fiscal deficit observed (as an absolute value):

$$CRED\_LOSS_t = |E(DEF_t) - DEF_t| \tag{2}$$

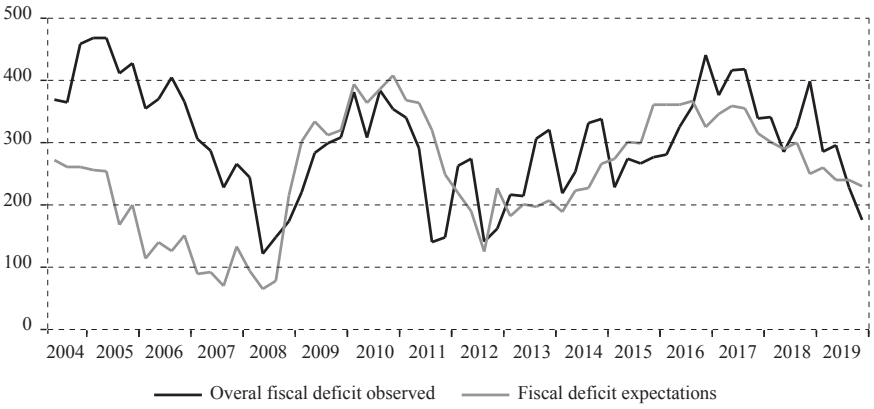
where *E(DEF)* is agents' expectations about the overall fiscal deficit and *DEF* is the overall fiscal deficit observed. The behaviour of both variables over time is presented in figure 2. The agents' expectations regarding the overall fiscal deficit are extracted from the survey of the Central Bank of Colombia called "Macroeconomic Projections of Local and Foreign Analysts". In this survey, the central bank asks brokers, commercial banks, pension funds, academic institutes, and rating agencies about the quarterly forecast of several macroeconomic variables,

including the overall fiscal deficit. The quarterly data are available from 2004 (see appendix, table A1).

The behaviour of both variables (*DEF* and *E(DEF)*) over time is presented in figure 2 below. It is observed that from 2004 to 2008, expectations underestimated the observed fiscal deficit. Then, since the end of 2008, expectations began to grow and were located close to the fiscal deficit, surpassing it in 2010. Between 2010 and 2011, the government adopted a fiscal rule on the primary fiscal deficit, and from then on, expectations began to fall. From 2012 to 2016, there has been an increase in the observed fiscal deficit and, consequently, in expectations. This increase in variables peaked in 2016. Since then, there has been a drop in both the observed deficit and the expectations.

Figure 2

Fiscal deficit expectations and overall fiscal deficit observed in Colombia (in % of GDP)



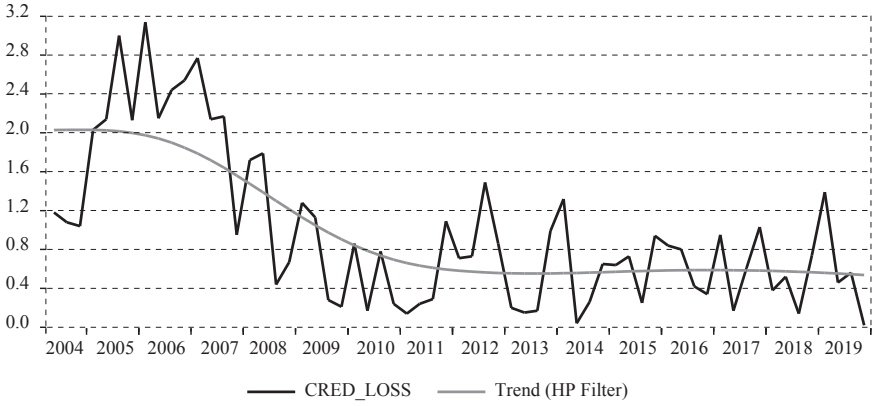
Source: Author´s elaboration. Data from the Central Bank of Colombia.

Figure 3 shows the performance of fiscal credibility loss (*CRED LOSS*) from 2004 to 2019 in Colombia. The *CRED LOSS* indicator shows that there was uncertainty about fiscal policy in the 2006-2008 period. As a result, fiscal credibility loss was high in that period. Once expectations began to approach the observed deficit, the loss of credibility eased and reached a low of 0.14% in 2011Q1. After this, we began to observe an unstable behaviour of credibility loss. Despite this, the trend of the series shows that the loss of credibility was stable between 2012 and 2019. For the full period (2004-2019), the credibility loss was 0.9% on average.

Since the seminal contribution of Kydland and Prescott (1977), economic theory has assumed that an agent's expectations depend on the government's credible commitment to an announced target. In other words, the expected path of the fiscal deficit matters for the formation of inflation expectations. In particular, when there is no commitment to fiscal equilibrium, government liabilities are ensured with seigniorage and the outcome is an increase in expected inflation (Sargent and Wallace, 1981).

Figure 3

Fiscal credibility loss in Colombia case (in %)



Source: Author's elaboration. Data from the Central Bank of Colombia.

Credibility is the ability of policymakers to inspire confidence, and it can help form expectations. According to Mishkin (2007), inflation targeting in an environment of low fiscal credibility causes difficulties in managing inflation expectations and impacts the effectiveness of monetary policy. Hence, the baseline model considered in our empirical analysis is as follows:

$$E(\pi_t) = \beta_1 + \beta_2 CRED\_LOSS_t + \alpha_3 X_t + \varepsilon_t \quad (3)$$

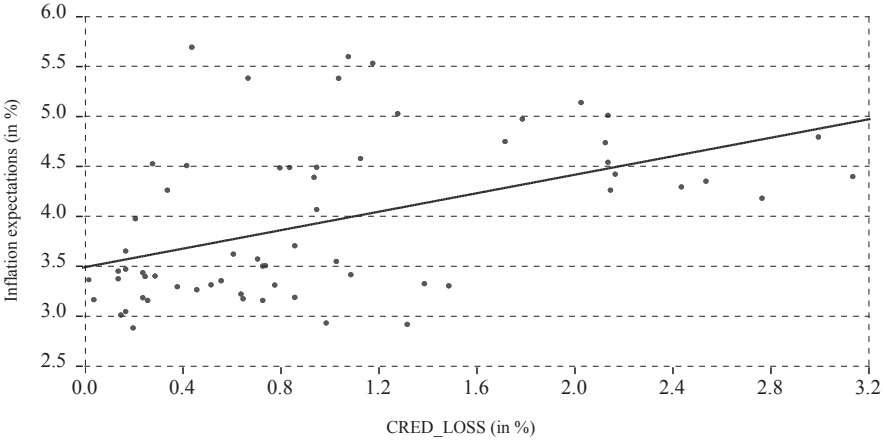
where $E(\pi_t)$ is the annualized inflation expectations, $CRED\_LOSS_t$ is the fiscal policy credibility loss, X_t is a vector of explanatory variables, and ε_t is the residual term.

To observe an initial empirical relationship between inflation expectations and fiscal credibility loss, a scatter plot for both variables is presented in figure 4. The theoretical intuition of a positive relationship between both variables is confirmed. Thus, a better projection of the fiscal deficit can lead to a reduction in inflation expectations.

It is important to verify whether the public information available on macroeconomic and financial variables is taken into consideration by the agents. For this, it is useful to use the most recent data for inflation forecasts (Mankiw, Reis and Wolfers, 2003). Financial market volatility affects the performance of emerging economies and, indirectly, the formation of expectations (Kennedy and Palerm, 2014). For the Colombian case, the international economy outlook causes volatility in capital flows and the balance of payments that can impact inflation expectations. Therefore, we use behaviour of the S&P 500 stock market index (VIX_{t-1}) as our first explanatory variable for inflation expectations.

Figure 4

Inflation expectations and fiscal credibility loss in Colombia



Source: Author's elaboration. Data from the Central Bank of Colombia.

Expectations depend on past information, and each agent interprets the available information in a different way (Roberts, 1997). In fact, the increase in inflation expectations can be attributed to *backward-looking* behaviour (Dornbusch and Fischer, 1993). Therefore, past inflation (π_{t-1}) is used as the second explanatory variable.

In emerging economies, movements in the exchange rate impact marginal costs and inflation forecasts (Celasun, Gelos and Prati, 2004). In particular, the Colombian economy has an important pass-through of the exchange rate to domestic inflation through its cost effects. Thus, as the third explanatory variable, the past exchange rate (e_{t-1}) is used.

According to the Neo-Keynesian Phillips Curve model, inflation expectations are related to the profit mark-up over costs. These mark-up changes are a function of the economic cycle (Woodford, 2003). Thus, we use *GDP* (y_{t-1}) as the fourth explanatory variable for inflation expectations.

On the basis of Okun's law, it is possible to establish a relationship between output and the labour market. Accordingly, as an alternative measure of the economy, the past unemployment rate, is used as the fifth explanatory variable for inflation expectations (U_{t-1}).

In short, to analyse the effect of fiscal credibility on inflation expectations we used an explanatory variable associated with external risk (VIX_{t-1}), two measures associated with past prices (π_{t-1}, e_{t-1}) and two measures associated with economic performance (y_{t-1}, U_{t-1}). The past inflation expectations are also incorporated as an explanatory variable ($E(\pi_{t-1})$) to capture some inertia in expectations. A dummy variable (D_t) is also added to capture the possible effect of the 2007-2008

subprime crisis. This dummy takes a value of 1 for the year 2008.[1] Thus, the possible combinations of these variables allow us to postulate the following models:

$$E(\pi_t) = \alpha_0 + \alpha_1 E(\pi_{t-1}) + \alpha_2 CRED\_LOSS_t + \alpha_3 VIX_{t-1} + \alpha_4 \pi_{t-1} + \alpha_5 y_{t-1} + \alpha_6 D_t + \varepsilon_t^0 \quad (4)$$

$$E(\pi_t) = \alpha_7 + \alpha_8 E(\pi_{t-1}) + \alpha_9 CRED\_LOSS_t + \alpha_{10} VIX_{t-1} + \alpha_{11} e_{t-1} + \alpha_{12} y_{t-1} + \alpha_{13} D_t + \varepsilon_t^1 \quad (5)$$

$$E(\pi_t) = \alpha_{14} + \alpha_{15} E(\pi_{t-1}) + \alpha_{16} CRED\_LOSS_t + \alpha_{17} VIX_{t-1} + \alpha_{18} \pi_{t-1} + \alpha_{19} U_{t-1} + \alpha_{20} D_t + \varepsilon_t^2 \quad (6)$$

$$E(\pi_t) = \alpha_{21} + \alpha_{22} E(\pi_{t-1}) + \alpha_{23} CRED\_LOSS_t + \alpha_{24} VIX_{t-1} + \alpha_{25} e_{t-1} + \alpha_{26} U_{t-1} + \alpha_{27} D_t + \varepsilon_t^3 \quad (7)$$

Additionally, we estimate the full model with all the variables:

$$E(\pi_t) = \alpha_{28} + \alpha_{29} E(\pi_{t-1}) + \alpha_{30} CRED\_LOSS_t + \alpha_{31} VIX_{t-1} + \alpha_{32} \pi_{t-1} + \alpha_{33} y_{t-1} + \alpha_{34} e_{t-1} + \alpha_{35} U_{t-1} + \alpha_{36} D_t + \varepsilon_t^4 \quad (8)$$

The period under consideration is from 2004-1 to 2019-4 (quarterly data). The choice of the period is due to data availability for the fiscal deficit expected, which are necessary to build the credibility index. See table A1 (appendix) for the sources of data and descriptions of all variables used in the study.

4 EMPIRICAL EVIDENCE

As in previous literature, the use of time series data in estimations entails verifying whether unit roots exist. Therefore, before carrying out the estimations of all models, the increased Dickey-Fuller unit root test (ADF), the Phillips-Perron test (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test were performed. The results are presented in table A3 (appendix). Based on the results of the tests, the variables to be used in equations (4)-(8) are *I(1)* and have the same order of integration.

According to Engle and Granger (1981), it is possible to estimate the models proposed if there is a stationary combination in the series. Cointegration tests were performed for the proposed model. The choice of VAR lag and the inclusion of the deterministic components of the cointegration vector was made on the basis of the Schwarz criterion (Harris, 1995). The cointegration test proposed by Johansen (1991) based on the significance of the estimated eigenvalues indicates the existence of a cointegration vector in the models (see table A3, appendix). Thus, the models were estimated with the series in levels without problems of spurious regressions.

[1] Beside the presented models, we also estimated models with output gap replacing GDP as well as by including more lags of inflation. The obtained results were not statistically significant and are available upon request.

Table 1
Inflation expectations determinants in Colombia

	OLS					GMM–HAC				
Dependent variable: E(π)	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**
Constant	0.8989*** (0.2031) [4.4248]	0.0362 (0.2488) [0.1455]	0.6253** (0.2608) [2.3970]	0.9408*** (0.2767) [3.3991]	0.6288** (0.3236) [1.9629]	0.9959*** (0.2499) [3.9840]	0.3482** (0.1554) [2.2405]	0.6309*** (0.1903) [3.3140]	0.9878*** (0.1745) [5.6591]	1.0719*** (0.3441) [3.1124]
$E(\pi_{t-1})$	0.6092*** (0.0851) [7.1545]	0.8396*** (0.0593) [14.1422]	0.3724*** (0.1189) [3.1319]	0.8238*** (0.0504) [16.3314]	0.4751*** (0.1174) [4.0448]	0.5825*** (0.1077) [5.4078]	0.7714*** (0.0450) [17.1204]	0.3668*** (0.0840) [4.3202]	0.7946*** (0.0366) [21.7099]	0.4685*** (0.0597) [7.8414]
$CRED\ LOSS_t$	0.1054** (0.0412) [2.5584]	0.1133** (0.0478) [2.4474]	0.0947** (0.0402) [2.3528]	0.1269*** (0.0436) [2.9071]	0.0915** (0.0411) [2.2243]	0.1052*** (0.0371) [2.8319]	0.0959*** (0.0317) [3.0221]	0.0972** (0.0458) [2.1210]	0.1213*** (0.0312) [3.8856]	0.0994*** (0.0249) [3.9793]
VIX_{t-1}	0.0001 (0.0038) [0.0315]	0.0033 (0.0044) [0.7421]	0.0040 (0.0036) [1.1140]	0.0047 (0.0038) [1.2400]	0.0017 (0.0037) [0.4600]	0.0003 (0.0021) [0.1541]	0.0044 (0.0042) [1.0539]	0.0022 (0.0029) [0.7648]	0.0057** (0.0026) [2.1536]	0.0004 (0.0024) [0.1691]
π_{t-1}	0.0979*** (0.0277) [3.5290]		0.1677*** (0.0397) [4.2245]		0.1334*** (0.0408) [3.2657]	0.1053*** (0.0312) [3.3666]		0.1600*** (0.0252) [6.3330]		0.1405*** (0.0178) [7.8799]
e_{t-1}		0.0001** (6.60E-05) [2.0913]		0.0003** (0.0001) [1.9674]	0.0002* (0.0001) [1.9534]		9.84E-05* (5.66E-05) [1.7388]		0.0005** (0.0002) [2.2540]	0.0001* (6.63E-05) [1.9117]
y_{t-1}	4.2515* (2.3130) [1.8380]	5.2183** (2.6785) [1.9681]			5.2481** (2.3384) [2.2442]	3.3457*** (0.9125) [3.6661]	5.6147*** (1.4500) [3.8720]			3.6543*** (0.9729) [3.7558]
U_{t-1}			0.0969** (0.0427) [2.2690]	0.0503* (0.0289) [1.7391]	0.1257** (0.0608) [2.1095]			0.0962** (0.0440) [2.3806]	0.0472*** (0.0185) [2.5415]	0.0989*** (0.0347) [2.8453]

	OLS					GMM−HAC				
Dependent variable: E(π)	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**
D_t	0.8585*** (0.1993) [4.3064]	-0.2435 (0.2559) [-0.9517]	0.8723*** (0.1858) [4.6937]	0.9731*** (0.2023) [4.8087]	0.9283*** (0.1967) [4.7174]	0.9354** (0.3533) [2.6475]	0.2069 (0.3345) [0.6163]	0.7943*** (0.2019) [3.5744]	1.0797*** (0.3648) [3.3984]	1.1167*** (0.3112) [3.5882]
R^2_{adj}	0.91	0.87	0.92	0.91	0.92	0.91	0.85	0.89	0.89	0.91
F-statistic	87.05	65.83	107.59	97.42	35.57					
Prob(F-Stat)	0.00	0.00	0.00	0.00	0.00					
LM test (1)	0.93	1.39	2.04	1.37	21.51					
p-value (LM Test)	0.40	0.25	0.14	0.26	0.00					
Breusch-Pagan-Godfrey test	0.60	0.96	0.67	1.39	1.79					
p-value (B-P-G test)	0.72	0.46	0.66	0.23	0.14					
J-statistic						4.87	5.21	2.39	8.50	3.79
Prob(J-stat)						0.56	0.39	0.66	0.20	0.70
Instruments						13	12	11	13	15
N. instr./N. obs.						0.20	0.19	0.17	0.20	0.23

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. Standard errors are in parentheses and t-statistics in brackets. P(F-statistic) report the respective p-value of the F-test. P(J-statistic) report the respective p-valued of the J-test. The list of GMM instruments are presented in table A6 (appendix).

The equations above were estimated using Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM). In the case of the models estimated with OLS, tests of autocorrelation (LM test) and heteroscedasticity (Breuch-Pagan-Godfrey test) were applied to validate the estimates. According to Hansen (1982), the main reason for using the GMM method is because endogeneity and autocorrelation problems may exist, which will invalidate the OLS estimates. Given this, in GMM estimates the instruments chosen were lagged for at least one period. According to Wooldridge (2001), to obtain efficient estimations with the GMM method, overidentification restrictions are necessary. In this sense, the J test was applied. The estimations of equations (4)-(8) are presented in table 1.

The results of the estimates show the expected sign. The parameter associated with past expectations ($E(\pi_{t-1})$) is positive and significant. Inflation expectations present some inertia with the expectations of the past period. That is, there is some evidence that expectations are adaptive, and agents learn slowly. A similar result is reported by Mankiw, Reis and Wolfers (2003).

The coefficient associated with fiscal credibility loss (*CRED LOSS*) is positive and statistically significant in all models. The theoretical intuition that the fiscal policy stance has been important in shaping inflation expectations is confirmed. Thus, when confidence grows about the government's commitment to fiscal sustainability, the expected inflation decreases. The evidence supports the theoretical perspective of Sargent and Wallace (1981) and the findings confirm that the lower uncertainty about the expected fiscal deficit and, therefore, greater fiscal credibility matter for inflation expectations. Similar results are reported by Kuncoro (2015), Cerisola and Geros (2009), and Celasun, Gelos and Prati (2004).

With the results in table 1, we calculated that an increase of one unit in *CRED LOSS* can boost inflation expectations in a range that varies between 9.15% and 12%. For example, if inflation expectations are at 3%, an increase of one unit in *CRED LOSS* can increase expectations to a range between 3.27% and 3.36%.[2] Therefore, according to Celasun, Gelos and Prati (2004), the findings show that building fiscal credibility is relevant to anchoring inflation expectations.

On the other hand, in relation to the coefficient associated with past external risk (VIX_{t-1}), the estimations show that the parameter is not significant. This finding suggests that increases in global financial uncertainty do not increase inflation expectations in Colombia. The importance of past inflation (π_{t-1}) for the formation of expectations is also significant. Using the results of Bomfim and Rudebusch (2000), it is possible to affirm that since inflation expectations respond to past inflation, monetary policy in Colombia is not fully credible. According to the results, the coefficient associated with past inflation varies between 9.79% and

[2] *CRED LOSS* is calculated in the units in which the fiscal deficit is measured as percentage of GDP. Therefore, an increase of one unit in *CRED LOSS* means that deficit expectations are 1% (% of GDP) above the observed deficit.

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16.77%. Therefore, if past inflation increases one unit and expectations are at 3%, the result is that expectations can move to between 3.29% and 3.50%. However, this result suggests that inflationary inertia has fallen in Colombia and expectations are better anchored. Some empirical studies highlight similar results for emerging economies that have adopted inflation targeting (see, Celasun, Gelos and Prati, 2004; Bevilaqua, Mesquita and Minella, 2008; Cerisola and Geros, 2009; Gaglianone, 2017).

In the case of the parameter associated with the exchange rate (e_{t-1}), the coefficient is positive and significant. Accordingly, depreciation tends to increase inflation expectations in the Colombian economy. This result indirectly confirms the hypothesis that firm costs are tied to the behaviour of the exchange rate due to its effects on imported inputs. However, in the estimated models, the estimated parameter tends toward zero, which indicates that very high devaluations (above 1,000 Colombian pesos) are necessary for expectations to increase by more than one percentage point. Similar evidence has been reported by Bevilaqua, Mesquita and Minella (2008), Araujo and Gaglianone (2010), and Gaglianone (2017).

The coefficient associated with the past behaviour of the economy (y_{t-1}) is positive and statistically significant. That is, inflation expectations fall in recessions and rise in economic booms. In the case of the coefficient associated with the past unemployment rate (U_{t-1}), the econometric result shows that it is also positive and significant. According to Mankiw, Reis and Wolfers (2003), inflation expectations are high during periods of high unemployment, suggesting a belated overreaction of expectations to the labour market situation. With the results of table 1, an increase in the past unemployment rate leads to increases in inflation expectations in a range between 0.04 and 0.12 percentage points. The results confirm the theoretical perspective of the Kydland and Prescott (1977) dynamic incoherence models. These models indicate that increases in unemployment can be the result of attempts to surprise agents with unexpected inflation. Expansive policy can lead to short-term gains in terms of product increases, as the Phillips curve points out. However, according to the findings of Ireland (1999), in the long term, the result is a balance in which the inertia of inflation expectations is positively cointegrated with the unemployment rate. Thus, the evidence suggests that during the period of analysis, there was no trade-off between inflation expectations, inflation and unemployment. Finally, the coefficient associated with the dummy variable (D_t) is positive and significant in almost all models. In other words, the subprime crisis raised inflation expectations in Colombia.

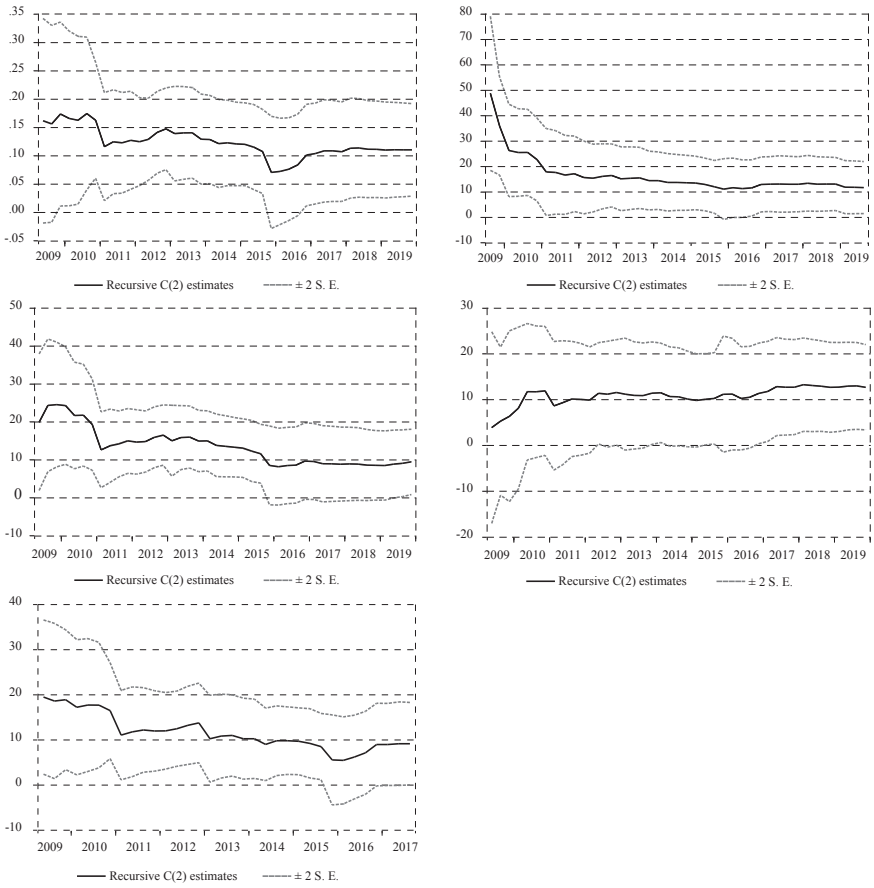
4.1 OLS RECURSIVE ESTIMATES

It is important to verify the way in which the effect of fiscal credibility on inflation expectations has varied over time. For this, OLS recursive estimates were performed on the coefficient of fiscal credibility loss (*CRED LOSS*) estimated in the five models presented in table 1. The stability over time of the parameters associated with fiscal credibility is presented in figure 5.

In general, the estimates show that for the period analysed, the signs and effects of fiscal credibility on inflation expectations were stable, but in 4 of the 5 models, the parameters decreased. According to the graphs, the parameters associated with the *CRED LOSS* variable dropped from 20% to 10%. Thus, the impact of credibility was reduced by a half. In the 2016-2019 period, the effect of credibility stabilized, and the results confirm the importance of fiscal policy in the shaping of inflation expectations in Colombia.

Figure 5

Fiscal credibility coefficient: recursive estimates, model 1, 2, 3, 4, 5 (in %)



Source: Author´s elaboration. Data from the Central Bank of Colombia.

5 CONCLUSIONS

This study analysed the influence of fiscal credibility on inflation expectations in the Colombian economy. The results allow us to make three observations. First, econometric estimate results indicate that an anchoring of expectations in the observed fiscal deficit (lower *CRED LOSS*) can reduce inflation expectations. In particular, the findings show that fiscal credibility should be monitored by the central bank in

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its efforts to stabilize expectations. Second, past inflation behaviour continues to be important in determining inflation expectations. Thus, the results suggest that there is still a gap in strengthening the management of expectations in long-term central bank targets and incorporating forward-looking behaviour. Third, inflation expectations in Colombia incorporate important macroeconomic information related to unemployment, GDP and exchange rates. In brief, the empirical evidence developed in this study indicates that to stabilize inflation expectations in Colombia, it is necessary to have a stable economic environment and credible fiscal policy.

Disclosure statement

No potential conflict of interest was reported by the authors.

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APPENDIX

Table A1

Sources of data and description of the variables

Variable	Variable description	Data source
$E(\pi)$	Inflation expectations computed by the Central Bank of Colombia. Inflation expectations are 1 year forward. The survey is called "Macroeconomic Projections of Local and Foreign Analysts". Data in %.	Central Bank of Colombia
CRED LOSS	Credibility. The indicator was constructed with the difference between the observed deficit and the expected deficit.	Devised by authors
DEF	Fiscal deficit observed by the Central National Government (% GDP) - Accumulated in the last 4 quarters. Data in %.	Central Bank of Colombia
E(DEF)	Fiscal deficit expectations (% GDP). Expectations come from central bank surveys. The forecasting deficit is the overall fiscal deficit. The survey is called "Macroeconomic Projections of Local and Foreign Analysts". Data in %	Central Bank of Colombia
π	Inflation accumulated in 12 months measured by the variation of the consumer price index. Data in %.	Central Bank of Colombia
e	Exchange rate (month average) of the Colombian peso/United States dollar.	Central Bank of Colombia
y	Gross domestic product. Series was built on real Colombian currency with constant prices from 2005. The variable is seasonally adjusted by the central bank. In the models, the series was used in natural logarithm.	Central Bank of Colombia
U	Unemployment rate with seasonal adjustment X12. Data in %.	Central Bank of Colombia
VIX	Volatility of the stock market index S&P 500.	Federal Reserve of St. Louis
D	A dummy variable. The dummy takes a value of 1 for year 2008 and 0 for the rest.	Devised by authors

Table A2

Descriptive statistics

Variable	Mean	Min.	Max.	SD.
E(π)	3.9455	2.8766	5.6900	0.7804
DEF	3.0272	1.2166	4.6816	0.8691
E(DEF)	2.4996	0.6500	4.0800	0.9183
CRED LOSS	0.9798	0.0200	3.1400	0.7920
π	4.3057	1.8464	8.2436	1.6576
e	2,360.02	1,762.14	3,462.01	495.15
U	10.6105	8.4389	14.2076	1.3231
y	12.0552	11.7126	12.3205	0.1811
VIX	18.1577	9.5100	44.1400	7.7106

Note: E(π), DEF, E(DEF), CRED LOSS, π and U were used in %.

Table A3

Unit root tests (ADF, PP, and KPSS)

Series	ADF				PP				KPSS			
	Lags	Esp.	Test	C.V (1%)	Banda	Esp.	Test	C.V (1%)	Banda	Esp.	Test	C.V (5%)
E(π)	1	C	-2.44	-3.54	3	N	-1.28	-2.60	4	C, T	0.16	0.14
CRED LOSS	2	N	-1.16	-2.60	1	N	-1.61	-2.60	5	C, T	0.15	0.14
π	1	C	-3.15	-3.56	3	N	-1.06	-2.60	3	C, T	0.16	0.14
e	0	N	-0.65	-2.60	1	N	-0.53	-2.60	6	C, T	0.23	0.14
U	0	C	-2.86	-3.55	3	C	-2.86	-3.55	5	C	0.84	0.46
y	0	C, T	-1.75	-4.11	4	C, T	-1.59	-4.13	6	C	1.00	0.46
VIX	0	C	-3.61	-3.54	1	C	-3.49	-3.54	5	C, T	0.15	0.14

Note: C.V., critical value. Trend (T) and intercept (I) are included based on Schwarz criterion. ADF – the final choice of lag was made based on Schwarz criterion. PP and KPSS – spectral estimation method is Bartlett kernel and the Newey-West Bandwidth is used.

Table A4

VAR lag order selection criteria (with constant)

Lag	Schwarz	Lag	Schwarz
Equation (4)		Equation (5)	
0	8.81	0	14.31
1	1.50*	1	6.74*
2	2.08	2	7.56
Equation (6)		Equation (7)	
0	2.95	0	19.57
1	-3.75*	1	13.45*
2	-3.07	2	14.70

*Note: * denotes the lag order selection.*

TABLE A5

Number of cointegrating relations by model

Data trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test type	No intercept No trend	Intercept No Trend	Intercept No trend	Intercept trend	Intercept trend
Equation (4) trace	2	3	2	2	3
Equation (5) trace	2	2	2	2	3
Equation (6) trace	1	1	2	2	3
Equation (7) trace	1	1	1	1	2
Johansen's cointegration test					
Hyp. N. of CE (s)	Eigen value	Trace statistic	Critical value (0.05)		p-value
Equation (4)					
R=0	0.50	96.73	69.81		0.00
R≤1**	0.46	60.18	47.85		0.00
R=2	0.31	27.34	29.79		0.09
Equation (5)					
R=0	0.62	116.19	76.97		0.00
R≤1**	0.50	65.87	54.07		0.00
R=2	0.27	29.77	35.19		0.17
Equation (6)					
R=0**	0.56	95.52	76.97		0.00
R≤1	0.35	52.48	54.07		0.06
Equation (7)					
R=0**	0.62	109.60	88.80		0.00
R≤1	0.42	59.65	63.87		0.10

*Note: *Model selected by the Schwarz criterion. Values based on Mackinnon. **Denotes the null hypothesis rejection at 5%.*

TABLE A6

List of GMM instruments

Model 1	$E(\pi)_{t-2}$, $E(\pi)_{t-3}$, CRED $LOSS_{t-2}$, CRED $LOSS_{t-3}$, π_{t-2}, π_{t-3}, y_{t-4}, y_{t-5}, VIX_{t-2}, VIX_{t-3}, VIX_{t-4}, D_{t-1}
Model 2	$E(\pi)_{t-2}$, $E(\pi)_{t-3}$, CRED $LOSS_{t-2}$, e_{t-3}, e_{t-4}, y_{t-3}, y_{t-4}, VIX_{t-2}, VIX_{t-3}, VIX_{t-4}, D_{t-1}
Model 3	$E(\pi)_{t-2}$, $E(\pi)_{t-3}$, $E(\pi)_{t-4}$, CRED $LOSS_{t-2}$, CRED $LOSS_{t-3}$, π_{t-2}, π_{t-3}, U_{t-2}, VIX_{t-2}, D_{t-1}
Model 4	$E(\pi)_{t-2}$, $E(\pi)_{t-3}$, $E(\pi)_{t-4}$, CRED $LOSS_{t-2}$, CRED $LOSS_{t-3}$, e_{t-2}, e_{t-3}, U_{t-2}, U_{t-3}, U_{t-4}, VIX_{t-2}, D_{t-1}
Model 5	$E(\pi)_{t-2}$, $E(\pi)_{t-3}$, CRED $LOSS_{t-2}$, CRED $LOSS_{t-3}$, e_{t-2}, e_{t-3}, y_{t-4}, y_{t-5}, U_{t-2}, U_{t-3}, VIX_{t-2}, π_{t-2}, π_{t-3}, D_{t-1}

The evolution of the Polish government bond market

PIOTR BARTKIEWICZ, MA*

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Piotr BARTKIEWICZ
SGH Warsaw School of Economics, Collegium of Economic Analysis, ul. Madalińskiego 6/8 02-513 Warszawa, Poland
e-mail: bartkiewicz.p@gmail.com
ORCiD: 0000-0003-0838-2536

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Abstract

Poland's marketable government debt has grown from essentially zero in the early 1990s to USD 180 bn by 2019, with a wide range of maturities and security types. The aim of the article is to describe the long-term trends in the Polish sovereign local currency debt. Changes in its composition, maturity profile and ownership structure are analysed. The Ministry of Finance's databases on bond transactions and secondary market activity are used. Since early 2000s the market has become less fragmented and the ownership structure has shifted considerably in reaction to global and national factors. Debt management strategy has stabilized the market and reduced frictions. Countries developing their local currency bond markets should be encouraged to avoid market fragmentation and concentrate on selected benchmark issues. Creating a functioning local currency bond market is essential in avoiding the so called "original sin", but must be part of a broader institutional push.

Keywords: fixed income, bond market, market structure, foreign investors

1 INTRODUCTION

Government bonds are one of the most important financial asset classes and play an important role in government policy and economic decisions made by public and private agents. This is also the case in Poland, where public debt amounted to 46.1% of GDP in 2019. This debt consists in large part of government bonds of various types, maturities and currencies. Due to the relatively large size of the Polish economy and its high-income (but also emerging-market) status, it constitutes a large part of popular government bond indices and is a target of investing by institutional investors, both local and foreign (one notable example is the JP Morgan EM Local Currency Bond Index). Price discovery occurring in the market is also of interest to fiscal and monetary policy and researchers as it informs interest rate expectations, term and risk premia, as well as inflation expectations (mostly indirectly). The development of a local currency government bond market (and, by extension, corporate debt market as well) is an important step in achieving financial maturity and promotes economic growth (Wurgler, 2000; Fabozzi, 2005; Prasad, Rajan and Zingales, 2009). This is because of the need to avoid what is called "original sin", i.e. borrowing in foreign currency and the resulting mismatch between assets and liabilities as well as revenues and expenditures (for more details see Eichengreen, Hausmann and Panizza, 2003, 2007; McKinnon and Schnabl, 2004).

The development of the Polish bond market has been researched since its inception (the mid-1990s) and multiple studies regarding its organisation, ownership structure and information content have emerged. A succinct summary of its evolution until 2000 is presented by Klimek (1998), Wasilewska (1998) and Babczuk (2002). The role of the bond market for financing government deficit was discussed by Klimek (1998), Wasilewska and Korczak (1998), Zembura (2006), and Ciak and Górniewicz (2010). Ziarko-Siwek (2012) conducted an event study on

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the impact of primary market sales of government bonds on the prices on the secondary market. The ownership structure of the bond market has been studied in the post-crisis period, for example, by Banaszewska (2015). More typical is the research interest in the influence of external factors on the Polish bond market, typically considered as one of many EM bond markets (see: Rai and Suchanek, 2014; Bowman, Londono and Spinoza, 2015; Fratzscher, Lo Duca and Straub, 2018). A regular update on the basic features of the Polish bond market is provided by both the National Bank of Poland in its annual reports on financial market developments (NBP, 2001; 2004 through 2018) and by the Ministry of Finance in the annually updated debt management strategy (MoF, 2019).

The aim of this article is to analyse the developments on the Polish bond markets that have taken place over the last three decades. The case of Poland is particularly instructive for many developing countries, as since 1989 a well-functioning and liquid domestic bond market has been developed almost from scratch. For the purpose of analysis we make use of the Ministry of Finance's (MoF) online datasets: the treasury bond and bill transactions database, ownership structure of public debt and detailed information on foreign investors' holdings. Overall, the databases extend from 1991 to April 2020. To include full-year data only, we cut the sample off at end-2019. The paper is based on statistical analysis and also draws from fixed income tools (calculation of modified durations for individual securities). In the paper we hypothesize that: (1) the market has attained all liquidity- and information-enhancing features well before the present; (2) major institutional and macroeconomic events have had a limited impact on its key features.

This study contributes to the literature in several ways. First, it offers an up-to-date analysis of the trends and events shaping the Polish government bond market. Second, it makes use of a novel dataset – the MoF's bond transaction database transformed to depict a full history of each bond issue. Third, it analyses the ownership structure of Polish government bonds using detailed data, including the characteristics of different investors' portfolios.

The paper is organized as follows. In the second section we present the basic concepts and features of bond markets as well as providing the national context for the analysis of the Polish bond market. In the third section we describe the history of the Polish bond market and its evolution over time. In the fourth section the life cycle of a bond is presented, starting from primary bond auctions, through early repurchases at the switching auction and its maturity. The subsequent section describes the current characteristics of the Polish government bond market, i.e. size, depth and structure. The last section analyses the ownership structure of the Polish bond market and its recent changes. We end the paper with a brief discussion of the results.

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2 LITERATURE REVIEW

A bond is a financial instrument characterized by a fixed schedule of cashflows: periodic interest payments (known as coupons) and the repayment of the principal at maturity (Fabozzi, 2005). Bonds are traded on various exchanges during which the right to the entire series of future cashflows is transferred between the parties involved in trading.

While most bonds outstanding in the world today have periodic, fixed coupon payments, other types of bonds are also popular (BIS, 2017). For zero-coupon bonds, the repayment of the principal is the only future cashflow to which the bond holder is entitled. Coupon payments of floating-rate bonds (or floaters in financial market parlance) are linked to a benchmark short-term rate (plus a premium) and reset periodically at pre-determined dates. Cashflows of inflation-linked bonds (also known as linkers) are tied to inflation. Apart from the rare and unused case of perpetual bonds, the contract expires at maturity, when the principal payment is made, and the bond is redeemed or repurchased (Fabozzi, 2005). Bonds are usually divided into maturity brackets: up to 1 year, 1-3 years, 4-6 years, 7-10 years and more than 10 years. In contrast to the situation in developed markets, emerging and frontier market issuers often issue debt denominated in foreign currencies (typically, the US dollar or the euro) to make use of lower interest rates abroad and bypass a shallow or illiquid domestic market (Jeanne, 2003; Bordo, Meissner and Stuckler, 2010). Foreign exchange (FX) debt is an important part of public debt in Poland as well.

The bond market plays an important role in the economy (Wurgler, 2000; Fabozzi, 2005). First and foremost, it allows the state to finance its borrowing needs in a transparent, flexible, efficient and cost-effective fashion. Second, it provides high-quality, low-risk interest bearing assets to the private sector – i.e. to institutions and companies that either find holding such assets advantageous or are mandated by law and financial regulators to diversify portfolios (certain types of funds) or hedge interest rate risk using government bonds (banks). Third, the price discovery on the government bond market provides information to bond market participants and other economic agents. This information pertains to interest rate expectations, various risk and term premia, as well as – provided that a liquid market for inflation-linked bonds exists – inflation compensation and expectations (Gurkanyak, Sack and Wright, 2010).

For obvious reasons, bond markets are segregated geographically and inextricably tied to nation-states or currency areas. Thus, the number of government bond markets in the world is large, albeit the existence of a local bond market is typically predicated on reaching a certain level of economic development, private savings and financial depth that allows for sufficient demand for interest-bearing instruments (Burger and Warnock, 2006). Bond markets are usually characterized by size, liquidity, issuer and bondholder concentration, diversity and openness (McCauley and Remolona, 2000).

3 CURRENT SIZE AND STRUCTURE OF THE POLISH BOND MARKET

Poland's public debt is of moderate size, constituting 46.0% of GDP at the end of 2019 (PLN 1.05 trillion). The bulk of outstanding debt exists in the form of publicly traded bonds – as of December 31st, 2019 there were bonds worth PLN 867 bn in all types, currencies and denominations. PLN-denominated marketable debt constituted PLN 646 bn, while marketable FX-denominated debt stood at PLN 257 bn and savings bonds offered to retail investors stood at PLN 28 bn. The remaining part of Poland's public debt is divided into loans from foreign institutions, debt incurred by local governments (in some cases in the form of bonds) and debt of various agencies and special purpose vehicles (SPVs) consolidated into the general government sector. Local currency debt constitutes 31% of GDP. Since Poland is typically classified as an emerging market, Poland's marketable debt (both local currency and FX) is included in popular international bond market indices. Its weight typically stands at 5-10% (depending on the instrument), ranking it among the key constituents of this asset class. For instance: Poland's weight in the JP Morgan GBI-EM Global Diversified Index stood at 10.05%; FTSE RAFI Sovereign Emerging Markets Local Currency Bond Index weighted Polish debt at 5.36% (although it is explicitly underweighted, i.e. weight derived from market value of debt would have amounted to 10.05%, per the most recent prospectus); the iShares JP Morgan Local Currency Bond ETF weights Polish PLN debt at 5.03%. Current structure of Polish public debt is presented in table 1.

Table 1

Current structure of Polish public debt (billions of PLN, as of December 31st 2019)

Total	**1,063.9**
central government	**973.3**
domestic currency	716.5
wholesale bonds	646.1
retail bonds	27.6
other	42.8
foreign currency	256.9
bonds	193.7
loans	63.2
other	0.0
other central gov	**2.3**
local governments	**88.3**

Source: Own elaboration based on MoF data.

As of December 2019, MoF lists 33 separate PLN-denominated bonds and 42 bonds issued in four different foreign currencies (USD, EUR, JPY, CHF). The former group is dominated by fixed-coupon bonds (19), complemented by one inflation-linked bond, 3 zero-coupon papers and 10 floaters. By value, 65% of outstanding PLN debt is kept in fixed-rate bonds, 30% in floating-rate bonds and 4% in zero-coupon notes (the single inflation-linked bond consists of the remaining 1%). In international comparisons, Poland stands out from its EM peers due to

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relatively large role of floating-rate debt and the paucity of inflation-linked notes, as shown by Mehrotra, Miyajima and Villar (2012), and by Cantu, Goel and Schanz (2020). For instance, in Brazil, Colombia, Mexico and South Africa inflation-protected securities constitute up to 25% of total debt outstanding. Within the foreign currency debt universe, debt issued in euro remains the most popular type (26 different bonds, 74% of total value of FX bonds), exceeding the depth of Poland's JPY- (9 issues, 5%), USD- (6 issues, 21%) and CHF-denominated (1 issue, 1%) bond markets.

4 THE LIFE CYCLE OF A POLISH BOND

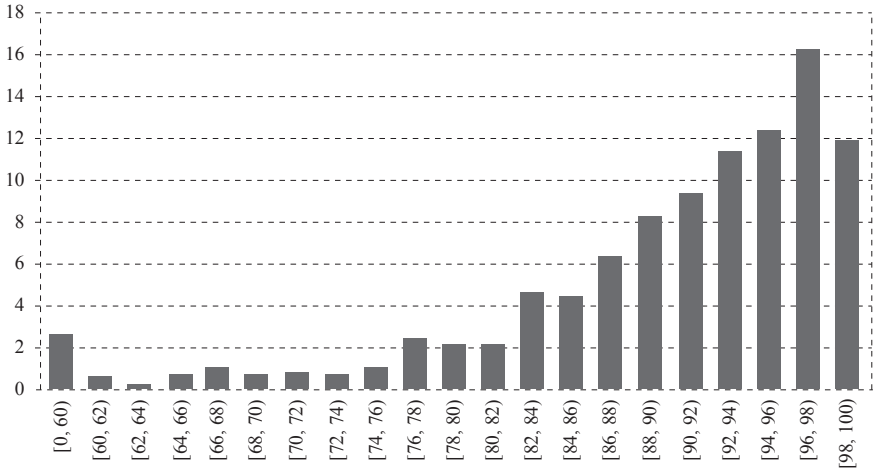
The Polish government bond market is organized into bundles known as bond issues differentiated by maturity and coupon. The overwhelming majority of bonds begin their market life at auctions organized by the MoF, in which only certified bond dealers (i.e. around fifteen major domestic and foreign banks – the list is updated annually) are allowed to take part. Bonds bought at auction are then distributed to other purchasers and traded freely on several exchanges. In limited cases (more common for FX bonds) private placements are organized and small amounts of government bonds are sold that way.

Since 2001, government bonds are subject to partial redemption before maturity – either at switch or repurchase auctions (the latter were organized only four times over the past fifteen years). This approach offers advantages and disadvantages. On one hand, it is advantageous from the government cash management perspective, since it allows it to spread out and smooth out government outlays and reduces cash requirements upon redemption. Even though nearly zero new debt (in face value) is issued at switch auctions (which essentially swap short-dated debt for longer-duration papers), they offer a convenient opportunity to supply the private sector with government bonds of desired maturities without increasing the overall government debt level. That way, the debt manager can increase secondary market liquidity in the desired segments of the yield curve. In some cases, if repurchase happens sufficiently early, swapping new debt for old issues reduces interest payments, provided that the yield curve has shifted downwards in the preceding period. On the other hand, switch and repurchase auctions force the MoF to redeem debt at market price. Therefore, if interest rates have risen since the bond's issuance, it will likely be repurchased at a small discount. Conversely, if interest rates have fallen, it will be repurchased at a premium. Given the prevalent downward trend in interest rates in Poland, it should not come as a surprise that the former has been more common. At maturity, outstanding debt is repurchased at par. The existence of switch and repurchase auctions might thus increase the debt manager's flexibility. This practice is pursued in other countries, but rarely is it done regularly (Marchesi, 2006). Among OECD countries where switch auctions are regularly conducted are: Canada, Hungary, Israel, Mexico, Norway and Sweden (Blommenstein, Elmadag and Ejsing, 2012). For the most part it is employed in foreign currency debt more often given additional risks, e.g. exchange rate (Medeiros, Poland and Ramlogan, 2007). However, it has been proposed as a

viable enhancement of US Treasury debt issuance and management strategy, with all the above-mentioned advantages (Garbade and Rutherford, 2007).

Figure 1

Timing of switching auctions – distribution as % of original maturity



Notes: The brackets in the horizontal axis denote the time when switching auctions are performed, i.e. [96-98) groups all instances when bonds were repurchased when at least 96%, but no more than 98% of their original maturity elapsed.

Source: Own elaboration based on MoF data.

MoF's database on bond transactions offers more details on how switch auctions impact the bond's life cycle. First, as of December 2019, not a single bond issue has ever been completely repurchased before maturity (figure 1). Conversely, for 36% of PLN-denominated bonds no switch or repurchase auctions have ever been organized – with one exception, all such bonds matured in 2009 at the latest (figure 2). Switch auctions have thus become the norm in public debt management in Poland. Second, switching auctions typically occur late in a bond's life – the median remaining time at repurchase of a bond is 7.5% of its original maturity (i.e. 16 weeks). Its distribution is negatively skewed, though, and repurchases often occur earlier, even more than a year prior to the bond's maturity. Third, among the remaining 64% of bond issues, the median amount repurchased prior to maturity is 43% of maximum stock. In several cases, more than two thirds of the supply were repurchased that way. Finally, repurchases are more common for larger bond issues – the larger the bond's supply, the more repurchases occurred and the larger the amount that was pulled from the market prior to maturity. In the extreme case of a 5-year bond maturing in April 2018 (the second-largest bond issue in the history of Polish bond market, calculated by notional value), PLN 23.4 bn (of PLN 34.9 bn outstanding) was repurchased at switch auctions, and PLN 11.5 bn redeemed at maturity.

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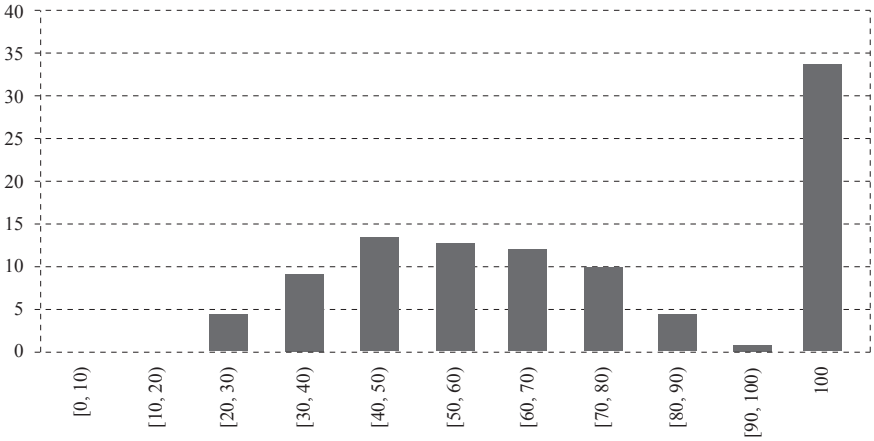
Figure 2

Distribution of the amount of bonds repurchased at maturity (in %)



Notes: The brackets in the horizontal axis denote the total share of bond issue's nominal value repurchased on all switching when the bond was subject to repurchases, e.g. [50, 60) groups all instances when at least 50% of total nominal value, but no more than 60% was repurchased – conversely, for this group 40-50% of the bond's nominal value was redeemed at maturity.

Source: Own elaboration based on MoF data.

5 THE HISTORY OF THE POLISH BOND MARKET

Poland is a high-income country, but usually considered to be an emerging market in the context of financial market indicators (EM; Morck, Yeung and Yu, 2000; Arora and Cerisola, 2001; IMF, 2017). However, its current status and the state of both fiscal policy and bond market is a far cry from Poland's recent past. Poland emerged from the communist era with considerable external debt (see: Olszański (2002) for a detailed description), but almost no domestic debt. At the beginning of transformation, the country essentially defaulted on its domestic obligations and bequeathed the remaining liabilities vis-à-vis local banks to its successor. The ongoing institutional and economic transformation saw the development of modern public finances, but the public sector ran chronic deficits (de Crombrugghe and Lipton, 1994). From the very beginning, fiscal deficits were financed domestically, but until 1994 bank lending constituted the bulk of newly created debt (Walczyk, 2001). Non-bank, marketable debt began to grow in 1992, chiefly in the form of treasury bills of various maturities. Only in the second half of 1990s did longer-dated securities start to be issued, which coincided with the establishment of domestic financial markets (e.g. the Warsaw Stock Exchange, interbank markets, etc.) as well as a secular decline in short-term interest rates, inflation and inflation variability. A secondary market for government bonds barely existed until 2002 and 2003 – between 1998 and 2002 turnover rose from 2.7x to 15x of total marketable debt outstanding (NBP, 2002; 2004). This allowed fixed income securities to become more attractive. The latter factors put Poland firmly in line with other countries where the development of local currency bond markets was successful (see: Burger and Warnock, 2006; Burger, Warnock and Warnock, 2012).

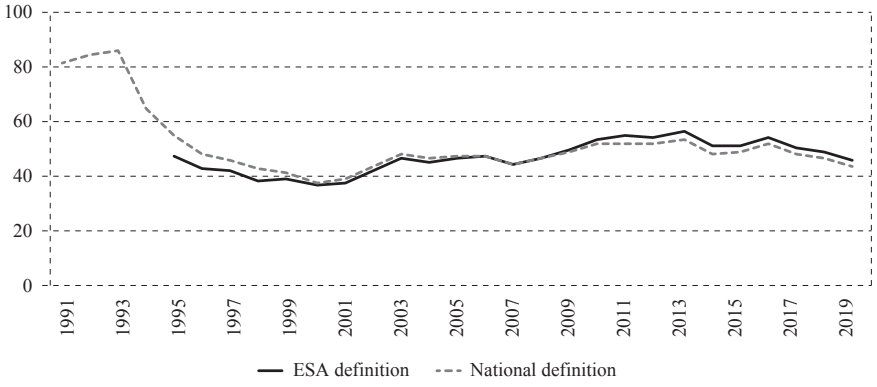
Further expansion of the PLN-denominated debt market can be associated with subsequent changes in monetary policy strategy and operations (inflation targeting was formally adopted in 2003, inflation itself was brought under control – see Rybiński (2000) and Brzoza-Brzezina (2006) for more details) and the establishment of private pension funds as an important source of demand for fixed income securities. Introduction of a larger variety of maturities and types of bonds also occurred at the turn of the century. The state's borrowing needs continued to grow in the first decade of the 2000s.

The Great Financial Crisis can be seen as another watershed moment for the Polish bond market. The impact of large-scale fiscal stimulation raised fiscal deficits and public debt considerably (IMF, 2010; Aizenmann and Pasricha, 2013), but at the same time brought several changes to the pension fund system. First, contributions to the pension funds were scaled down by 68% and replaced with a "subaccount" managed by the Social Security Institution (Łuszczyk, 2015). Second, participation in pension funds became strictly voluntary. Third, mandatory transfer of an individual's assets accumulated in the pension fund to the Social Security Institution 10 years prior to retirement was introduced. Finally, almost PLN 140 bn of bonds held by pension funds was redeemed and pension funds were barred from investing in government securities (Jakubowski, 2017). The reforms greatly reduced the build-up in debt (increased the implicit pension debt, though) and pension funds' demand for fixed income securities (IMF, 2011; Fultz, 2012; Buchholtz, Chłoń-Domińczak and Góra, 2019).

In purely nominal terms, total public debt (general government sector) rose from PLN 164 bn in 1995 to PLN 272 bn in 2000, PLN 460 bn in 2005, PLN 768 bn in 2010 and PLN 923 bn in 2015 (47.6, 36.5, 46.4, 53.1 and 51.3% of GDP, respectively) (figure 3).

Figure 3

General government consolidated debt as percentage of GDP, historical data

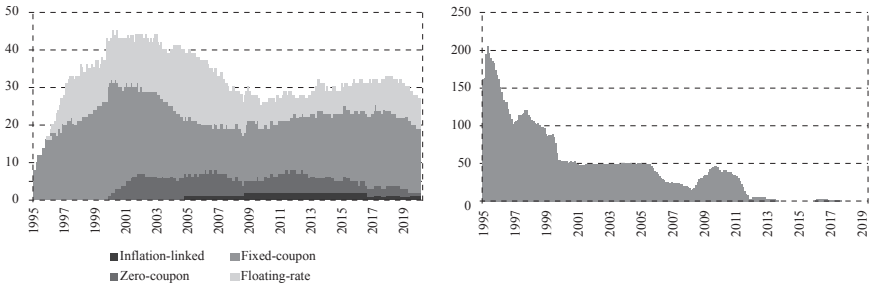


Source: Own elaboration based on Statistics Poland, Eurostat, MoF data and Walczyk (2001).

The current structure of the Polish bond market is the result of a long evolution constituted by several concurrent shifts. First, there has been a long-lasting move away from Treasury bills (up to 1-year maturity – see figure 4, right panel) and into Treasury bonds (see figure 4, left panel). While before 1994 marketable PLN-denominated debt consisted solely of Treasury bills and more than 100 separate T-bill issues existed in the 1990s, the role of these instruments has steadily declined. Apart from a short-lived episode in 2016, the Polish MoF ceased to issue T-bills in 2013. Second, in 2000 the MoF introduced zero-coupon bonds of OK series (2-year maturity) and several separate issues have existed in circulation ever since (as of November 2018, there are 3 separate zero-coupon bond issues). Polish PLN-denominated government bonds have two separate, but interchangeable ID systems. All Treasury notes and all Treasury bills issued after July 1999 have ISINs (International Securities Identification Numbers). There is also a local nomenclature based on a six-character code with two-character series identifier and the security's maturity time in MMYY format. In recent months, MoF has issued bonds of five series: 2-year zero-coupon OK series, 5-year fixed-coupon PS series, 10-year fixed-coupon DS series, 20- and 30-year fixed-coupon WS series and floating-rate WZ series of various maturities. PLN debt outstanding as of today includes an inflation-linked IZ bond and a small privately-placed floating-rate PP issue. For instance, OK0722 is a zero-coupon bond maturing in July 2022, while DS0725 is a fixed-coupon issue with original maturity of 10 years, maturing in July 2025. Previously, MoF also issued 3-year DZ floaters and various fixed-coupon and zero-coupon bonds. A similar system applies to bonds issued for retail investors and to bonds issued by the state-owned BGK bank on behalf of the government's SPVs (IDS and FPC series). Third, the introduction of fixed-coupon bonds predates the issuance of the first floating-rate bonds only by several quarters. Over the past twenty years, the number of separate fixed-coupon bond issues has fluctuated between 12 and 31. The number of floating-rate bond issues rose to 17 by mid-2000s and has declined to 4-9 issues in the post-crisis period. Finally, there is a relatively small amount of debt issued in the form of inflation-linked bonds (since August 2004) – there have been two such bonds in circulation.

Figure 4

Number of Treasury bond (left panel) and Treasury bill (right panel) issues outstanding



Source: Own elaboration based on MoF data.

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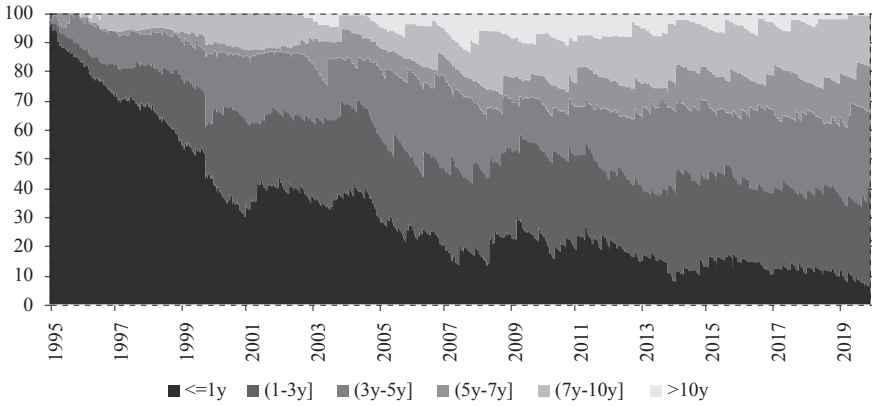
For the past 25 years, the Polish bond market has seen a widening of the range of available maturities and a decrease in the share of the shortest debt (up to 1 year) – of note is the introduction of 15-, 20- and 30-year bonds at various points in the past. However, this shift was largely over by 2007 – since then, the average maturity of PLN-denominated bonds (be they floating – or fixed-rate) has little changed and oscillated between 4 and 4.5 years (see figures 5-6). Very similar was the stability in average duration of PLN-denominated bonds (close to 3 years). There is a downward trend in the average maturity of FX debt, but this can be attributed to the legacy nature of this segment (FX bond issuance dropped 4-fold in 2015-2018 vis-à-vis the 2004-14 average), and does not represent a conscious policy choice to shorten its maturity. These findings are consistent with the Ministry of Finance's debt management strategy (MoF, 2019), which clearly aims at stabilizing the average maturity and duration of local currency debt and reducing the share of FX debt.

Figure 5

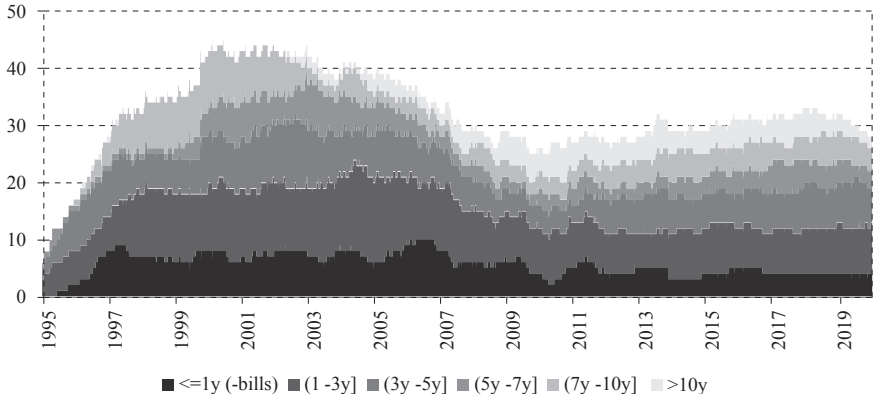
Distribution of outstanding PLN-denominated debt by maturity (in %)



Source: Own elaboration based on MoF data.

Figure 6

Number of outstanding PLN-denominated bond issues by maturity



Source: Own elaboration based on MoF data.

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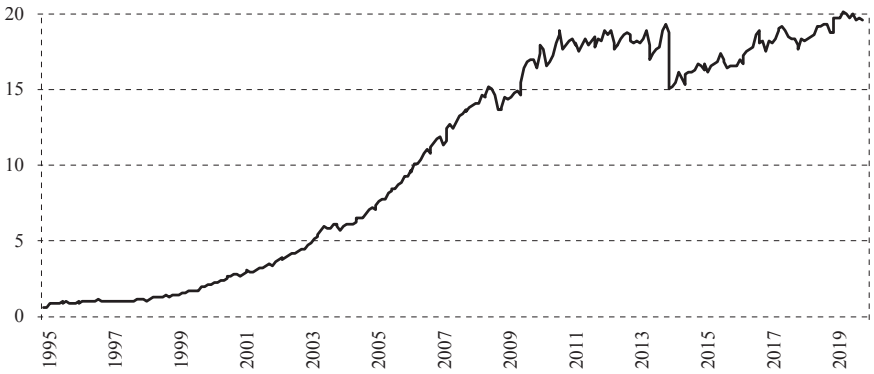
Taking a broader look – the steady increase in the size of local currency bond market was accompanied by the overall decrease in the number of available bond issues. As a result, the average outstanding size of a bond issue rose from PLN 822m in 1995 to PLN 8128m in 2005 and to PLN 18679m in 2018 (all values expressed in constant prices, base year 2016 – see figure 7 for a complete series). The redemption of securities owned by pension funds temporarily reduced the average issue size, but the difference quickly disappeared as debt continued to rise in the subsequent period. The distribution of issue sizes has historically been shifting rightward, with a thinner left-hand tail and a smaller number of limited-size bond issues. In fact, in July 2009 the distribution became negatively skewed and has remained so ever since. By then, multiple closely-maturing issues had already matured and the resumption of Treasury bill issuance allowed the MoF to reduce the number of separate Treasury bond issues. In the first post-GFC years, issuance remained high, but the large-scale purchases from non-residents (see the following chapter) allowed the MoF to extend debt duration again and curtail bill issuance again.

Figure 7

Average size of a PLN-denominated bond issue (millions of PLN, 2015 prices)



Source: Own elaborations based on MoF data.

The changes to issue size distributions were, on balance, enhancing market liquidity. Multiple studies on bond market liquidity (see: Tanner and Kochin, 1971; McCauley and Remolona, 2000; Galliani, Petrella and Resti, 2014; Gao, Jin and Thompson, 2018) have shown that issue size is positively correlated with liquidity. Thus, the consolidation of the Polish local currency bond market had several consequences: improvement in liquidity, greater transparency and investability.

6 OWNERSHIP STRUCTURE

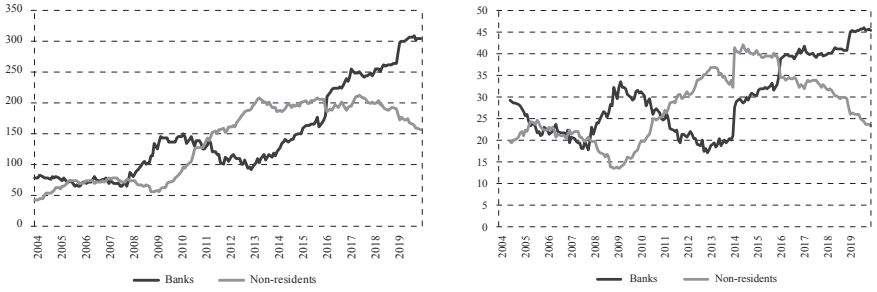
The modern structure of Polish public debt ownership emerged as a result of the introduction of the new (1997) constitution, which barred the government from borrowing funds directly from the central bank. Hitherto, existing loans to the MoF (14% of total domestic debt) were, converted into bonds and gradually sold to market participants – by 2003 the NBP's portfolio of Polish government bonds was wound down to zero (Panfil, 2014). In addition, the nature of the NBP's open

market operations has also changed – in the early 1990s Treasury bills were their primary instrument (Przybylska-Kapuścińska, 2003). Since then, the ownership structure of PLN-denominated bonds has been dominated by four key types of bondholders: foreign investors, commercial banks, local investment funds (including pension funds) and insurers – as of December 2019 those types of institutions held 88% of PLN-denominated marketable debt. The remaining 12% is distributed among households and non-financial companies as well as social security funds.

Since 2003, public debt ownership has undergone significant changes. In the pre-crisis period, the biggest accumulation in both nominal and relative terms occurred among pension funds, whose holdings rose from 13 to 25% of total marketable debt. Commercial banks' holdings, flat in nominal terms for several years, have only began to rise in 2007. Foreign ownership of PLN-denominated public debt remained essentially flat in nominal terms until early 2009. The era of quantitative easing and large-scale capital flows to emerging markets saw foreign holdings of PLN-denominated debt almost quadruple in absolute terms (from PLN 59 bn in March 2009 to PLN 207 bn in April 2013) and increase from 13 to 37% of total (see figure 8). Another era was brought about by two key events: the "taper tantrum" episode and the subsequent shift in the Federal Reserve's monetary policy (for a detailed discussion of US monetary policy easing and tightening see Chari, Stedman and Lundblad, 2017; Fratzscher, Lo Duca and Straub, 2018). Finally, an important milestone is the 2013-2014 reform of private pension funds (Jakubowski, 2016).

Figure 8

Value (left panel, bn PLN) and share (right panel, % of total) of banks and non-residents debt holdings



Source: Own elaborations based on MoF data.

From 2013 on, the amount of PLN-denominated debt held by non-residents has ebbed and flowed but remained essentially flat in nominal terms. The pension funds reform of 2013 (which came into force in February 2014) cancelled, among other changes, the private pension funds' entire portfolio of government bonds, thereby bringing its share in public debt to zero and mechanically raising the shares of other types of investors. The mantle of being the biggest net buyer of Polish government bonds over that period, both in absolute and relative terms

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must be awarded to commercial banks, whose holdings rose from PLN 91 bn in December 2012 (18% of total) to PLN 305 bn in December 2019 (45% of the total). The key factor behind this relentless rise in bank holdings of government debt has been the persistent decline in loan-to-deposit ratios and the rising capital of Polish banks, both resulting in greater demand for short-to-mid-term government bonds. This long-lasting trend was amplified in 2016 with the introduction of the bank asset tax, from which government bonds are exempt (UKNF, 2016; Wojciuk, 2017). In the end, the share of non-residents in Polish government debt is settling at levels close to EM or European averages: per BIS (2020), among EMs it varied between 5 and 54%; according to Eurostat data, foreign ownership of general government debt in Poland stood at 44.1% at end-2019, somewhat below the EU average of 49.3%.

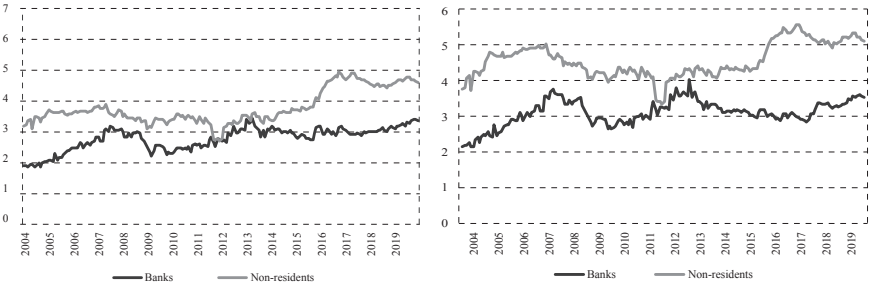
The changes in non-residents' share are inextricably linked to the overall external position of the Polish economy. The direction of causality is more debatable, though. Between 2006 and 2013 Poland has been running current account deficits of 4-6% of GDP. The financing of those deficits has changed drastically, though. In the run-up to the Global Financial Crisis and during the subsequent global recession the financial account was dominated by large FDI (3-4% of GDP) and other flows (4-8% of GDP, mostly through cross-border banking). The former source was curtailed after 2008 (to 1.5-2.5% of GDP) and the latter mostly dried up. The slack was taken by large-scale portfolio flows into Polish debt, which peaked at 5% of GDP in 2010 and stood at 3% of GDP until end-2012. Since 2014, the Polish current account balance has rarely shown deficits larger than 1% of GDP and portfolio flows into Polish debt remained negative throughout most of that period. On a net basis, portfolio debt flows reached -2% of GDP in 2019 (a record-high outflow).

Overall stability in the average duration and maturity of the overall PLN-denominated bond stock hides some shifts within portfolios held by different types of investors. Analysing detailed data on bond holdings, we find that several trends can be identified. First, banks' holdings are primarily concentrated in the shorter maturity bracket, with an average duration in the 2.3-3.5-year range since 2006 and an average maturity in the 2.8-4.0-year range since 2006. Interestingly, the accumulation of PLN bonds since 2013 did not lead to any meaningful change in the characteristics of banks' portfolio (figure 10). Presumably, it conforms to regulatory and legal limits banks' asset and risk exposures are subject to. Second, only between mid-2015 and mid-2017 was there any rapid change in duration risk borne by foreign investors – over that period, the average maturity and duration of their portfolios rose by more than a year – the biggest such shift observed in our sample (figure 9). Insurers operating portfolios of longer-dating bonds (with average maturity of 5.2 years in December 2019) have seen a multi-year decline in their maturities and durations. The investment fund sector, having reduced its portfolio maturity in 2013 and early 2014, now appears to replicate the maturity structure of the overall outstanding debt closely. Finally, purchases of

longer-dated bonds by households surged in 2011 and again in 2014, but their holdings remain small compared to other main types of PLN debt holders.

Figure 9

Average duration (left panel) and average maturity (right panel) of bond holdings (in years)



Notes: Average duration calculated only for fixed-rate and zero-coupon bonds of OK, PS, DS and WS series; average maturity was calculated for all PLN-denominated bond series.

Source: Own elaborations based on MoF data.

Finally, it is worth mentioning that the overall stability of non-residents' holdings of PLN-denominated debt has been accompanied with shifts in their geographical structure. Available data (MoF database on geographical origin of foreign investors on the local currency bond market starts in April 2014) indicate that over the period of 6 years the share of investors from the United States and several European locations has declined considerably. There was, however, a commensurate increase in the role of Asian investors (Japanese in particular) and central banks, whose identity is unfortunately unknown. By late 2018, the latter rose from 8.0 to 21.0% of the total non-residents' portfolio, only to fall back to 12% at the end of 2019. Herfindahl-Hirschmann-type indices show a slight decline in the geographical concentration of foreign holdings of PLN debt holdings over the aforementioned 6-year period.

7 CONCLUSIONS

The Polish bond market has evolved considerably over the past decades and continued to do so recently – this applies to both the structure of bond supply and changes in bond demand. In several ways, its structural characteristics, such as the size relative to the whole economy, available maturity range and types of bonds marketable, have changed little over the past ten years. While the Polish local currency bond market – in a way – matured in the past decade, there have been important shifts in the structure of debt holders that did not impact either the supply profile or liquidity. In particular, recent years saw the complete dissolution of one large debt holder (private pension funds) and sharp increase in the role of another (local banks and foreign investors – the latter heterogeneous themselves). Building a liquid and large local currency bond market is crucial for developing countries, as it allows them to escape the notorious "original sin" and therefore improve their financial and macroeconomic stability. The Polish experience,

however, points to the gradual nature of this process as all the major steps towards this goal were taken over several years. Additional prerequisites of a functioning bond market, such as a robust inflation targeting regime, successful disinflation and large enough pool of private savings are also present and they too unfolded over time. Moreover, even if a liquid and functioning local currency government bond market exists, some external vulnerabilities remain. Large swings in the amount and share of debt held by non-residents can, as Poland's example shows, still occur.

Our findings have implications for debt management strategies and their implementation. First, the reduction in the number of issues accompanied by raising issue sizes is net positive for liquidity and price discovery on the bond market. Therefore, governments should be encouraged to avoid market fragmentation and the cornerstone of an issuance strategy would be to limit the number of separate bond issues, while ensuring that a wide range of maturities is available to debt holders at all times. Second, compared to several peer markets, the Polish bond market lacks a sufficient number of inflation-linked securities, which limits their informational value. Third, rapid changes in the composition of debt holders are possible, especially if external factors are at play. However, this can occur within an unchanged issuance framework and purely through market forces. The Polish experience is one of falling interest rates and bond yields regardless of the composition of public debt holdings. Four, Polish experience shows that liquidity management can be improved by early repurchase of securities at auctions. This tends to increase debt service costs in an environment of falling interest rates, but by limiting the need to hold cash buffers, reduces the debt manager's operating costs in other areas. As an instrument of debt management, switch auctions tend to be less popular than regular auctions. However, Poland offers a case of consistent, uninterrupted use of switch auctions for almost twenty years. Finally, in open economies sovereign bond markets cannot be analyzed separately from broader macroeconomic trends, in particular, changes in the external balance of the country, foreign capital flows, and their determinants.

Several important questions can be raised. First, the exact impact of the changes in institutional environment, market structure and debt management practice on the liquidity of the Polish bond market, should be investigated and measured in a quantitative fashion. Second, the Ministry of Finance's long-standing issuance strategy might be investigated in greater detail as an avenue for further research. In particular, duration extension can be enhanced by utilizing favourable secondary market conditions (i.e. issuing more long-term debt when interest rates are low and the yield curve is flat). The extent to which actual issuance was operationalized this way is unknown at this stage and requires transaction and bond price databases to be cross-correlated. Finally, history is still being written and at the time of writing, additional factors have been influencing the functioning of the market (i.e. COVID-19 pandemic, significant issuance of government-guaranteed off-balance debt and unconventional monetary policies launched by the National Bank of Poland). A full accounting of their impact on Polish government debt

market will occur in the future as these processes continue to unfold. Finally, in addition to domestic monetary policy, the impact of other countries' monetary policies on the liquidity, ownership structure and price dynamics of bonds should be considered. Poland, as a small open economy could be a prime example for such investigation.

Disclosure statement

No potential conflict of interest was reported by the author.

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Modernizing VATs in Africa

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Antonija BULJAN, Ph.D.
Faculty of Economics and Business, Zagreb, Trg J. F. Kennedyja 6, 10000 Zagreb, Croatia
e-mail: abuljan2@net.efzg.hr
ORCiD: 0000-0002-0980-5206

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African countries continuously struggle with sharply increasing debts while their tax revenues are not sufficient to finance their development needs. The African Development Bank estimates that Africa's available finances per year are less than half of the needed amount to fund infrastructure alone (Commodore, 2020). In order to reach the UN Sustainable Development Goals in education, health, water and sanitation, roads and electricity by 2030, African countries need to mobilize domestic revenues (Gaspar and Selassie, 2017; UN, 2015). One of the tax forms with the largest revenue-generating potential is value added tax (VAT), a non-distortive tax, which is "growth friendly", important in the context of low potential growth in African countries.

That is why the book *Modernizing VATs in Africa* by Sijbren Cnossen puts VAT in Africa in the spotlight. The author is a professor of Economics at the University of Pretoria and academic partner of CPB Netherlands Bureau for Economic Policy Analysis. He has published numerous books and articles on the effects of taxation and on tax policy and advised many countries on the design of their tax systems.

The purpose of this book is to propose solutions for the reform of VAT design in Africa, to boost the revenue-generating capacity, while advocating a neutral, simple and revenue-productive VAT. At the moment, African VAT systems abound in exemptions and zero rates which hinder its collection efficiency, while nine countries in Africa do not have it yet. As stated in the title, the mission of this book is to make Africa's VAT systems more modern. While the traditional VAT system – implemented in the EU – contains numerous exemptions and reduced rates, a modern VAT – implemented in Japan (1984), New Zealand (1986), Canada (1991), South Africa (1991), Singapore (1994) and other countries that learned from the EU mistakes – will minimize the number of exemptions and apply just one rate to a broad tax base. Both kinds were introduced in Africa: based on the New Zealand goods and services tax (GST) in Southern Africa as well as on the EU's Common VAT Directive (2006) in franco, anglo- or lusophone countries. The proposed VAT modernization is primarily concerned with broadening the VAT base (through minimization of exemptions and zero rates), rather than with modification of the VAT rates. The author emphasizes that efficient regressive taxes combined with well targeted social transfers can result in a fiscal system that is equalizing, while zero rates and exemptions introduced for equity goals are proven not to be efficient and mostly benefit high-income groups.

The book examines the role of VAT in the context of economic and monetary union in Africa. With closer economic integration import duties are to be phased out and VAT is the main candidate for replacing lost revenue. The guiding principle for VAT design in this book is to broaden the VAT base while minimizing distortions of market competition and economic efficiency.

This book can be useful to tax professionals, policy makers and everyone interested in the specifics of VAT in Africa. It gives a valuable review of consumption

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taxes implemented in African countries in the context of regional economic communities, with a detailed overview of exemptions, zero and reduced rates. Due to its excellent critical approach to different taxing regimes, not just in Africa but worldwide, the book is recommended to anyone interested in modernizing VAT design in any country.

The book compares the current treatment of standard and non-standard exemptions and zero rates in Africa to that in other developed and developing countries. It lists the pros and cons for different taxing regimes, then it draws up the best practice examples and recommendations for African countries. The problems arising in each of the exemptions are discussed in detail in individual chapters, with interesting and sometimes innovative ideas to extending the coverage of VAT.

The author is well aware of administrative constraints in African countries, pointing out that "methods that are very complex should not be considered even if they can yield the correct result" (p. 218). Therefore, the proposal is not necessarily the best practice one, but the one that is the most appropriate given the stage of economic development and administrative capacities of African countries. Accordingly, the book suggests transitional measures intended to soften the impact of base-broadening changes.

The book is divided in 18 chapters and 4 appendices. Chapters 1-3 accentuate the need for reform of VAT in African countries, explain the basics of VAT, describe a best practice design and compare VAT with other consumption taxes.

Chapters 4-8 familiarize the reader with consumption taxation in Africa. This part gives an overview of VAT in African countries grouped by regional economic communities. It accentuates the need for VAT harmonization and the abolition of import duties. It also highlights the shortcomings of other existing sales tax regimes in African countries that did not implement VAT. In order to draw attention to the VAT base, the book then analyses VAT revenue generating performance, which is significantly lower in Africa than the world average, reviews the literature on the redistributive efficiency of zero rates and exemptions and discusses the current practice in Africa. It further discusses the application of higher than standard rates or excise taxes on luxury products and gives an overview of types of economic integration in Africa. It analyses VAT and excise taxes coordination and discusses the level of coordination needed to establish common markets.

Chapters 9-15 focus on the VAT base and treatment of standard and non-standard exemptions, exclusions and zero rates; repercussions of their application in the context of economic distortions and administrative complexities; comparisons of exclusions in EU with exclusions in New Zealand's GST and South Africa's VAT. While chapter 10 reviews non-standard exemptions and zero rates applied in Africa, chapters 11-15 analyse treatment of goods and services that are considered standard exemptions under EU VAT Directive 2006/112/EC: public utilities and cultural

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goods, immovable property, financial services, insurance, gambling and lotteries. These exemptions as applied in African countries are not in accordance with modern best practices in Australia, New Zealand, Canada, Singapore and South Africa. The author reviews the pros and cons of different taxing approaches, the best practice scenario and puts forward proposals for VAT modernization in Africa. He reviews possible solutions to the problem of taxing margin-based financial services and gives an overview of new and innovative methods that have not yet been implemented anywhere: cash flow method and modified reverse-charging.

Chapter 16 discusses the treatment of small businesses and farmers. Chapter 17 reviews the main tax administration processes: registration, filing, payment, collection, enforcement, audit and fraud, however, without going much into detail on the main administrative issues which are of major importance in African countries. The last chapter concludes with a review of the principal findings and recommendations for VAT modernization.

As compared with other academic discussions of VAT (Bird and Gendron, 2007; Ebrill et al., 2001, etc.), this book draws attention almost exclusively to its design. VAT administration, apart from one brief chapter, is not the focus of this book. Although better design should make VAT administration easier as administrative and compliance costs rise with multiple exemptions, zero rates and low threshold, the VAT administration itself should not be neglected. Especially not in Africa. The book does highlight the need for VAT administration reform as it states: "Changes in VAT design cannot achieve much if inefficient and wasteful, indeed sometimes counterproductive, administrative processes are left in place" (p. 6). Other issues such as the international aspects of VAT (treatment of cross border services supplies and so on) are not given much attention in the book, either.

Finally, we can summarize how the book envisions a more modern VAT in Africa. In order to broaden the VAT base, most non-standard exemptions should be abolished. Public transport and specific unprocessed items should temporarily remain exempt and gradually be replaced by the standard rate or a positive reduced rate. All services should be taxed unless they are exempt for social (healthcare, education, social services) or administrative reasons (margin-based financial services). As for standard exemptions, the book recommends taxing financial services, insurance, lotteries and gambling, supplies by public bodies (that can also be performed by private sector) and immovable property (except rental values, rents and sales of used dwellings). Transfer duties should be confined to transfers of immovable property between non-taxable persons. As for insurance, exemption should be confined to life and health insurance. A high registration threshold of US$50,000 or higher and a minimum threshold are recommended to exert less pressure on VAT administration while threshold differentiation for services is not recommended. The combination of high threshold and the zero-rating of agricultural inputs that have no use outside the agricultural sector should be sufficient for small farmers not to bear the burden of VAT.

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From the very beginning, it is clear that the author is aware of the difficulty of implementing the suggested modernization of VAT design in African countries. The book starts with a quotation that "one general lesson is the political difficulty of making sensible changes to a VAT once it has been introduced: Mistakes made at introduction are hard to undo" (Keen, 2009). Political support is indispensable for any of the suggested modernizations to achieve viability. The book concludes that modernizing VATs requires a "change in mindsets", referring to political elites in Africa. Political attention nowadays is predominantly focused on tax changes that are perceived as pro-poor and pro-growth such as zero rates, exemptions or tax holidays, rather than on the changes in expenditure that are really pro-poor and pro-growth such as healthcare, education, infrastructure and legal protection.

Sijbren Cnossen did an excellent job of describing the features of a modern VAT design and outlining the reform directions for African countries. Having said that, perhaps "modernizing VAT design in Africa" would have been a more suitable title for the book. Given its current title, more attention should have been paid to the administration. To develop a fully modern VAT it is necessary to reform both the design and the administration.