Cladea's XII Doctoral Consortium

PhD Thesis Proposal

Essays on fiscal policy

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Contents

Doctoral dissertation title

Doctoral dissertation title in English: *Essays on Fiscal Policy*

Doctoral dissertation title in Spanish: *Ensayos de Politica Fiscal*

1 Introduction

Since the onset of the financial and economic crisis fiscal policy has received a lot of attention as a tool for achieving macroeconomic stabilisation. In that time many countries around the world have adopted sizeable fiscal stimulus packages in order to boost the economy. On the other hand, substantial deficits, growing debts and lack of the fiscal space in many developed economies emphasis the limits of discretionary fiscal policy and the need to design better automatic stabilizers in terms of fiscal rules.

Doctoral dissertation topic area will be the macroeconomic effects of fiscal policy. First, we will develop a dynamic stochastic general equilibrium (DSGE) model with a detailed description of the fiscal policy block which will be used to study the welfare and macroeconomic stability properties of different fiscal rules. Second, we will use firm-level data on government purchases and other firm-specific variables to examine the firm's response to a shift in government spending. And third, we will provide estimates of fiscal multipliers (which is commonly used measure to assess the effects of fiscal policy) in a DSGE model with heterogeneous firms.

The rest of the PhD thesis proposal is organized as follows. Section 2 presents focus of the research and research questions. Section 3 provides the expected contribution to the field. Section 4 takes a look at the methods we will use to design our research and describes data. Section 5 sketches the table of contents of the dissertation. We conclude with Section 6 where we present a bibliography of the relevant literature that will be used for the dissertation.

2 Research topic, focus of the research and research questions

The doctoral dissertation will be comprised of three essays (papers) on fiscal policy. The first essay will consider an estimated DSGE model for a small open economy in a monetary union to assess the performance of simple fiscal rules to stabilise cyclical fluctuations in the economy. The model will be estimated using Bayesian statistical method in Dynare. The estimates will be based on quarterly Slovenian data (standard and fiscal variables will be used). To our knowledge this will be the first DSGE model with a detailed role for fiscal policy using parameter estimates from the macroeconomic variables for the Slovenian economy. The second essay will be interested in exploring empirically the firm effects of

government spending. To perform this research we will use a unique Slovenian firm panel data set on government purchases and other firm-specific variables. To the best of our knowledge no existing empirical research addresses this issue using a firm-level data, so we can expect that our research will constitute an original contribution to the field. The third essay will use the empirical findings from the second essay to construct a simple DSGE model to examine the transmission mechanisms of fiscal policy shocks and size of fiscal multipliers with a special attention given to assessing the impact of a change in the composition of government spending on the size of fiscal multipliers. Hereafter we present a title and a brief overview of each of three papers.

The Performance of Simple Fiscal Rules for a Small Open Economy in a Monetary Union: The Case of Slovenia

In the first paper we will develop a small open economy DSGE model based on the work of Smets, & Wouters (2003, 2007), Christiano, Eichenbaum, & Evans (2005) and Adolfson, Laseén, Lindé, & Villani (2007) and we will enrich it with several fiscal features. The model with be estimated with Bayesian estimation techniques on Slovenian data. The main objective of the paper will be to use this model to investigate the effectiveness of simple fiscal policy rules to stabilize cyclical fluctuations as a consequence of different shocks hitting the economy. We will also look for the optimal fiscal policy in the class of simple fiscal rules in response to different types of shocks. There is no existing literature regarding the performance of fiscal rules and optimal fiscal policy in terms of simple fiscal rules for Slovenia, which is of most interest to our paper since these are all issues our paper attempts to deal with. The theoretical and analytical framework in our paper is inspired by Galí,, & Monacelli (2008, henceforth GM), Vogel, Roeger, & Hertz (2006, 2013, henceforth VRH) and Notarpietro, & Siviero (2013, henceforth NS). The paper of GM (2008) studies optimal monetary and fiscal policy in a monetary union of small economies with government purchases as fiscal instrument, price stickiness as friction, and technology shocks as exogenous disturbances. VRH (2013) broaden the analysis by (i) considering simple fiscal instrument rules over a range of policy parameters instead of focusing only to optimal policy, (ii) including a broader set of policy instruments and (iii) by including additional features to the model while the works of VRH (2006) and NS (2013) restrict attention mainly to the optimal fiscal/monetary policy in terms of simple fiscal/monetary rules, respectively.

In the recent crisis many governments faced a trade-off in deciding between fiscal consolidation and fiscal stimulus. Due to the excessive government spending during good times and fast growing debts in the time of crisis, governments in many developed economies had no available fiscal space to fighting against the current recession. Adopting fiscal rule is one of the way that can help to prevent such situations in the future. Fiscal rule is a quantitative rule that determines allowable deficit or required surplus depending on the economic situation. In plain words, fiscal rule means that a

fiscal policy instrument ensures debt sustainability, but also stabilizes the business cycle by reacting to a real economic activity measure. There exist many different types of fiscal rules. One of them is the government spending fiscal rule, where government saves part of the revenues during good times and spends excess revenues during bad times in order to mitigate negative effects of the shocks and to reduce cyclical fluctuations in the economy. In the paper we will study how the Slovenian economy would benefit in terms of welfare and less macroeconomic volatility under different specifications of fiscal rules, taking into account all the stochastic shocks that will be identified over the estimation period. We will consider simple fiscal policy rules for a broader set of policy instruments (government purchases, transfers, consumption, labour and capital taxes) in analogy to the Taylor rule for interest rate setting first proposed by Taylor (1993). Concerning the computation of the optimal fiscal policy in response to different shocks we will first derive the welfare loss function using a second order approximation to the utility function of the representative consumer. After doing so we will employ the optimal simple rule procedure for computation of the optimal policy which is available in Dynare. With optimal simple rule procedure, Dynare searches numerically the best value for the coefficients of some specified policy rule (in our case fiscal rule). Formally, this procedure minimizes a quadratic loss function of the form (Juillard, 2011, p. 2)

$$\min_{\gamma} \mathbb{E}_t \left(y_t' W y_t \right) \tag{1}$$

subject to

$$A_1 \mathbb{E}_t y_{t+1} + A_2 y_t + A_3 y_{t-1} + C e_t = 0 \tag{2}$$

where γ is a subset of parameters appearing in A_1, A_2, A_3 and pertaining to the policy rule; W is a semi-positive definite matrix; y_t is the vector of endogenous variables; e_t is a vector of shocks; A_1, A_2, A_3 and C are coefficient matrices. Then we will compare welfare looses under these optimal fiscal rules. In addition, we will also calculate the welfare gains and costs for a broader set of policy parameters instead of focusing only on optimal values of parameters to assess the robustness of the fiscal rules and the costs of non-optimal policy.

Firm Effects of Government Spending: Micro-evidence from Slovenia

The aim of the second paper will be to provide new evidence on the effects of fiscal policy by studying, using firm-level data, how firms respond to a shift in government spending. Our paper will be based on the recent theoretical and empirical work of Nekarda, & Ramey (2011) who investigate the effects of industry-specific government spending on output, hours, wages, prices and other inputs (employment, averages hours per worker, capital, material, and energy usage) in a panel of industries for the U. S. economy in order to shed light on the transmission mechanism for government spending on the aggregate economy. A central question of their research is a disagreement among

the approaches over the effects of government spending on key economic variables. While most approaches agree that increases of government spending lead to rises in output and hours, they differ in their predictions concerning other key variables. For example, both the neoclassical and the standard New Keynesian models predict that an increase in government spending raises labour supply through a negative wealth effect. Under the neoclassical models which are characterized by the perfect competition and diminishing returns to labour, the rise in hours worked should be accompanied by a short-run fall in real wages and labour productivity. One the other hand New Keynesian models that feature imperfect competition, sticky prices and increasing returns to scale predicts lower markups over marginal costs and thus a rise in both real wages and hours associated with an increase in government spending. Their research finds that an increase in government spending raises output and hours, lowers real product wages and labour productivity, and has no effect on the markup. Their estimates also suggest approximately constant returns to scale. Contrary to their paper which use the industry-specific data, the key novelty of our paper will be that we will use a unique panel data set at the firm level for Slovenian firms over the period 2005-2012. The data set contains information on government purchases at the firm level provided by the Commission for Prevention of Corruption and on a wide range of other firm-specific variables which are obtained from the Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES) (see Chapter 4 of the proposal for a more detailed description of the data). In this paper we will answer a number of questions such as: In the first place we will provide some summary statistics on firm characteristics and government purchases over the estimated period; Are more productive firms more likely to win a government contract i.e. is there a selection effect?; What are the effects of government purchases on firm's output, working hours, employment and other key variables?; Do different types of firms react differently to a government spending shift?; How does the magnitude of the firm's response to a change in government spending vary over the business cycle?

Fiscal Multipliers in a DSGE Model with Heterogeneous Firms

In the last paper we will focus our attention on the estimation of the effects of different fiscal policy shocks and their transmission mechanisms on Slovenian macroeconomic variables. We will look at the effects of government spending shock and consumption, labour and capital tax rates shocks. To summarize the quantitative effects of these shocks we will report fiscal multipliers (which are defined as the ratio between the change in a macroeconomic variable and an exogenous change in a given fiscal variable) for the main macroeconomic variables. Our analysis will be based on the work of Forni, Monteforte, & Sessa (2009) who estimate the effects of fiscal policy in the Euro Area. The main contribution of our paper will be that we will evaluate the possible implication of a change in the composition of government spending i.e. if the government allocates its consumption

expenditures among different types of firms (for instance, among less and more productive firms) on the size of fiscal multipliers. To explore these issues we will develop a simple DSGE model with firm heterogeneity which will capture key features of the data that we will document in our empirical work in the second paper. We will assume that aggregate government consumption G_t will be given by a constant elasticity of substitution (CES) index of high-tech (G_{HT}) and low-tech (G_{LT}) goods according to

$$G_t = \left[(1-\alpha)^{\frac{1}{\eta}} G_{HT,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} G_{LT,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{3}$$

where the parameter $0 < \alpha < 1$ is the share of low-tech goods in the government consumption basket and the parameter $\eta > 0$ is the elasticity of substitution between high-tech and low-tech goods. Consumption baskets G_{HT} and G_{LT} are composite of a continuum of, respectively, differentiated high-tech (HT) and low-tech (LT) goods (brands), each supplied by a different firm. They corresponds to Dixit-Stiglitz aggregators (Dixit, & Stiglitz, 1977)

$$G_{HT,t} = \left[\int_0^1 G_{HT,t}(i)^{\frac{\theta^{HT}-1}{\theta^{HT}}} \, \mathrm{d}i \right]^{\frac{\theta^{HT}}{\theta^{HT}-1}} \tag{4}$$

$$G_{LT,t} = \left[\int_1^2 G_{LT,t}(i)^{\frac{\theta^{LT}-1}{\theta^{LT}}} \, \mathrm{d}i \right]^{\frac{\theta^{LT}}{\theta^{LT}-1}} \tag{5}$$

where the elasticities of substitution among high-tech goods and among low-tech goods are denoted by $\theta^{HT} > 1$ and $\theta^{LT} > 1$, respectively.

This will be the first research done by using a calibrated DSGE model with heterogeneous firms to estimate general equilibrium effects of fiscal shocks in Slovenia. The literature on the effects of fiscal shocks and size of fiscal multipliers is extensive and has evolved rapidly in recent years but it is mainly concerned with the estimates of fiscal multipliers under differing assumption concerning the macroeconomic environment (the monetary policy stance, the financing of the fiscal expansion, the state of the economy, the role of sovereign risk and others) - see Blanchard, & Perotti (2002); Christiano, Eichenbaum, & Rebelo (2011); Auerbach, & Gorodnichenko (2012); Belhocine, & Dell'Erba (2013) among others. On the other hand there is not so much literature regarding fiscal multipliers for the Slovenian economy. Jemec, Strojan Kastelec, & Delakorda (2013) quantify the effects of fiscal policy shocks on the Slovenian economy using the Blanchard and Perotti (2002) structural vector autoregression (SVAR) approach. They find that positive government spending shocks in Slovenia have an immediate positive effect on output, private consumption and investment. The effect becomes insignificant in the period following the shock. On the other hand, positive tax shocks indicate a negative effect on GDP, private consumption and investment in the period of a shock. The effect again becomes statistically insignificant afterwards. Authors conclude that one-off changes in government spending and taxes in Slovenia appear to be short-lived and can not be used to support economic activity.

The main research questions

The doctoral dissertation will address the following main research questions:

- How much stabilization is provided by different fiscal rules, taking into account all the stochastic shocks that will be identified over the estimation period?

- What are the optimal coefficients of the fiscal rules?

- What are the potential gain from optimal stabilisation and the welfare costs of non-optimal policy?

- What type of fiscal rule is better from the social welfare point of view?

- Are more productive firms more likely to win a government contract i.e. is there a selection effect?

- What are the effect of government purchases on firm's output, working hours, employment and other key variables?

- Do different types of firms react differently to a government spending shift?

- How does the magnitude of the firm's response to a change in government spending vary over the business cycle?

- What are the effects of fiscal shocks and what is the size of fiscal multipliers for the Slovenian economy using a DSGE model with heterogeneous firms?

3 Expected contribution to the field

The doctoral dissertation will contribute to existing literature for several reasons. Here we present expected contribution to the field from both theoretical and practical point of view.

Contribution to the field in theoretical terms will be:

- Development and enrichment of a DSGE model with several fiscal features;

- Firsthand estimation of a DSGE model with Bayesian estimation method for Slovenian economy;

- Estimation of the model on a newly computed quarterly data set for Slovenian fiscal variables, which will result (i) in a proper identification of parameters and shocks, (ii) in an improvement of the model fit to data and in addition, (iii) it will allow us to study different aspects of fiscal policy in detail;

- Simulation and evaluation of different fiscal rules for Slovenian economy;

- Firsthand evidence on firm effects of government spending; The key novelty will be that we will use micro data at the firm level;

- Examination of the transmission mechanism of a wide range of fiscal shocks and quantification of their effects on the Slovenian economy in a DSGE model which accounts for firm heterogeneity with a special attention given to assessing the impact of a change in the composition of government spending on the size of fiscal multipliers.

Expected contribution to the field in practical terms:

- Since this research will provide answers associated with conducting fiscal policy, it will have a meaningful message for policymakers.

4   Methodology and data

The analysis in the first and third paper will be done using dynamic stochastic general equilibrium (DSGE) model which has recently become widely used in terms of policy analysis. As it is evident from his name, these models are: **(D) dynamic**, which means that they take into account that economic conditions and agents decisions change over time; **(S) stochastic**, which means that they allow random fluctuations in the economy as a consequence of different shocks (productivity shock, preference shock, fiscal policy shock, ...); and they form **(GE) general equilibrium**, which means that they take into account optimal microeconomic decisions of different agents or in other words, they connect partial equilibriums into general equilibrium. As Tovar (2009, p. 1) wrote: DSGE models are powerful tools that provide a coherent framework for policy discussion and analysis. In principle, they can help to identify sources of fluctuations, answer questions about structural changes, forecast and predict the effect of policy changes, and perform counterfactual experiments. They also allow to establish a link between structural features of the economy and reduced-form parameters, something that was always possible with large-scale macroeconomic models.

The model will be estimated with Bayesian estimation method, following Adolfson et al. (2007). All estimates will be performed using Dynare and Matlab. The key idea of the Bayesian estimation method (which is based on the Bayes theorem) is that it combines prior belief of the parameters with empirical data to form the posterior distributions of the parameters.

To illustrate the intuition behind the Bayesian statistical method, let us start by writing the Bayes theorem - presentation below is based on the work of Almeida (2009), Adolfson et al. (2007) and Serbanoiu (2012)

$$p\left(\theta|Y_t^{obs}\right) = \frac{p\left(\theta, Y_t^{obs}\right)}{p\left(Y_t^{obs}\right)} \tag{6}$$

and

$$p\left(Y_t^{obs}|\theta\right) = \frac{p\left(\theta, Y_t^{obs}\right)}{p\left(\theta\right)}, \tag{7}$$

where $p\left(\theta|Y_t^{obs}\right)$ is the density of the parameters conditional on data (the posterior), $p\left(\theta, Y_t^{obs}\right)$ is the joint density of the parameters and the data, $p\left(Y_t^{obs}|\theta\right)$ is the density of the data conditional on the parameters (the likelihood), $p\left(\theta\right)$ is the unconditional density of the parameters (the prior) and $p\left(Y_t^{obs}\right)$ is the marginal density of the data which is defined as

$$p\left(Y_t^{obs}\right) = \int p\left(\theta, Y_t^{obs}\right) \mathrm{d}\theta = \int p\left(Y_t^{obs}|\theta\right) p\left(\theta\right) \mathrm{d}\theta. \tag{8}$$

By combining equations (6) and (7), we get

$$p\left(\theta|Y_t^{obs}\right) = \frac{p\left(Y_t^{obs}|\theta\right) p\left(\theta\right)}{p\left(Y_t^{obs}\right)}. \tag{9}$$

We can rewrite equation (9) as

$$p\left(\theta|Y_t^{obs}\right) \propto p\left(Y_t^{obs}|\theta\right) p\left(\theta\right) = K\left(\theta|Y_t^{obs}\right), \tag{10}$$

where $K\left(\theta|Y_t^{obs}\right)$ is the posterior kernel, which is proportional to the posterior by the factor $p\left(Y_t^{obs}\right)$. Taking logs of (10) we get

$$\ln K\left(\theta|Y_t^{obs}\right) = \ln p\left(Y_t^{obs}|\theta\right) + \ln p\left(\theta\right) = L\left(Y_t^{obs}|\theta\right) + \ln p\left(\theta\right). \tag{11}$$

The prior distributions of the parameters will be chosen according to the common distributions used in the literature as for example in Adolfson et al. (2007), Smets, & Wouters (2003, 2007) or Fernández-Villaverde (2010). To calculate the likelihood function, which corresponds to the joint density of all variables in the data sample, conditional on the structure and parameters of the model, we will apply the Kalman filter under the assumption of all the structural shocks being normally distributed. The joint posterior distribution of all estimated parameters will be obtained in two steps: first, the posterior mode and an approximate covariance matrix Σ_m, based on the inverse Hessian matrix evaluated at the mode, will be obtained by numerical optimization (csminwel.m proposed by Chris Sims) on the log posterior density and second, the posterior distribution will be subsequently explored by generating draws using the Metropolis-Hastings (M-H) algorithm, which is a Markov chain Monte Carlo (MCMC) method to simulate posterior distribution. First M-H algorithm chooses a starting point (posterior mode), then it draws a candidate value θ^* from a jumping distribution $J\left(\theta^*|\theta^{t-1}\right) = N\left(\theta^{t-1}, c\Sigma_m\right)$, where c is the scale factor which is chosen to ensure an appropriate acceptance rate (usually about 30 percent). In the next step algorithm computes the acceptance ratio $\alpha = \frac{p\left(\theta^*|Y_t^{obs}\right)}{p\left(\theta^{t-1}|Y_t^{obs}\right)} = \frac{K\left(\theta^*|Y_t^{obs}\right)}{K\left(\theta^{t-1}|Y_t^{obs}\right)}$. After it accepts the parameter value or discards it. These algorithm's steps are repeated many times to simulate the posterior distribution. The parameters that will not be estimated will be calibrated using standard values in the literature or will be computed matching some relevant data moments for the Slovenian economy.

The estimates will be based on quarterly Slovenian data starting in the first quarter of 1995. The ending quarter and year will be determined when the doctoral dissertation will be prepared. We will use the following observable variables: gross domestic product, final consumption expenditure, general government final consumption expenditure, gross capital formation, exports of goods and services, imports of goods and services, real effective exchange rate, gross wages (income structure of GDP), total employment (domestic concept), GDP deflator, domestic lending rate, consumer price index, foreign gross domestic product (for the first 12 Euro Area (EA) countries), foreign GDP deflator (for the first 12 EA countries) and 12-month Euribor. The data sources are Statistical Office of the European Union (EUROSTAT), Statistical Office of the Republic of Slovenia (SORS) and Bank of Slovenia.

Along with standard macroeconomic variables, we will also use fiscal variables. In Slovenia we are constrained by the lack of quarterly data on government accounts. These data are only available from 2000 onwards while annual data exists from 1995. As we have computed these missing data for the period 1995-1999, we can contribute to the field by estimating a DSGE model on a rich dataset which will result in a proper identification of the parameters and shocks and in addition, it will allow us to study fiscal policy in detail. The fiscal data we will use are the following: government spending, suficit/deficit, public debt, employee and employer social security contributions, transfers to individuals and households and consumption tax, labour income tax and corporate profit tax revenue. The fiscal data have been obtained from the Institute of Macroeconomic Analysis and Development of the Republic of Slovenia (IMAD).

In the second paper we rely on the econometric methods for panel data. We will match panel data sets for Slovenian firms over the period 2005-2012 by using data from two distinct sources. The first source of data is the Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES), which provides data for firm identity, year of reporting, annual sales, costs of material and services, nominal physical capital, employment and other variables. The second source of data is the Commission for Prevention of Corruption and its online application Supervizor that provides information on business transactions of the public sector bodies (direct and indirect budget users). More specifically, this data set contains information on government purchases at the firm level, which means that we have information on purchases of goods and services, subsidies, etc. In addition, the data set also includes information on every transaction by date and on which firm (identified by firm identification number) received the payment. The data set also comprises information about the account from which the payment was made, which allows us to distinguish between the ministries, municipalities and other government entities. As we have matched these two distinct data sets we have obtained a unique data set for government purchases and other firm-specific variables at the firm level.

5   Structure of the dissertation

1 The Performance of Simple Fiscal Rules for a Small Open Economy in a Monetary Union: The Case of Slovenia

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3 Fiscal Multipliers in a DSGE Model with Heterogeneous Firms

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    3.4 Impulse responses to fiscal shocks

    3.5 Conclusion

        References

        Appendices

6 Literature

In this section we present a bibliography of the relevant literature that will be used for the dissertation. The list is not complete and will be extended during the preparation of the dissertation.

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